

E-ducAtion: Multidisciplinary Platform to Support the Teaching/Learning Process in Portuguese 1st cycle Schools

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Abstract— This work is focused on the development of a didactic platform to support the teaching/learning process in the 1st cycle of Portuguese education program. The platform has practical examples that should promote the competences taught in four areas: Mathematics, Portuguese, Science, and English. The specifications and the learning objectives were defined by the teachers and the research team. The final goal of this didactic tool is to motivate students to learn in a friendly way and to overcome the difficulties that some students have. In this paper are presented the requisites, the design and the implementation of the platform.

Keywords— 1st Cycle Education, Teaching/Learning Process, Didactic Platform.

I. INTRODUCTION

The development and introduction of new teaching/learning tools in the different cycles of education are considered of utmost importance. Several authors have been dedicating their attention on the Education area, in particular on how to implement new tools to motivate students in the learning process. In fact, the advances in technology allowed to change the traditional teaching inside and outside the classroom. Several works have been published in the literature registering this new friendly paradigm of teaching/learning. New tools applied to the different cycles of education and in different languages emerged [1]-[18]. From virtual and remote laboratories to serious games there are numerous applications of didactic tools from preschool to university.

Faria [2] refers the need for a change in teaching/learning strategies and methodologies developed by teachers in order to guarantee better 1st cycle school paths.

Focusing then our study on the 1st cycle of education, robots have been receiving special attention due to its engaging appearance and facility of use. Among those applications there is a platform based on the Lego Mindstorms robot for teaching mathematics to Portuguese students in the 1st cycle school [3]. It consists of a support tool for students and teachers with an intuitive and objective computational interface. Through this interface students can program the robot to perform movements that will give rise to a mathematical problem that the students will later have to solve. For example, the student inserts a time parameter in the robot, during which the robot moves in a

direction and at the end it asks the student to measure the distance travelled.

Under a Master thesis, Ribeiro [4] developed the *robôCarochinha*. The system recreates the Portuguese story of *Carochinha* in a setting dedicated and decorated specifically for children, to make a qualitative study of the effects of educational robotics in the first cycle of education. The robot used was the Lego Mindstorms RCX, which given the simplicity of its interface allows an adult or a child to program a robot without previous hard training. Each child had his/her robot and tried to recreate a scenario dedicated to *Carochinha* story.

Another robotic tool was proposed by Somyürek [5] where the students have to program and construct a robotic kit. Some basics of robotics are previously taught to students and suggestions are made on how to assemble LEGO Mindstorms NXT robots. After building the robot the students must create an imaginary and apply robot skills. For example, they must program the robot to make a certain trajectory and at the end of the trajectory there is a princess it must rescue and return to the place of departure. The main objective of this study is to encourage and increase students' attention in the works.

Apart from robotic applications, video games are receiving a special attention as innovative teaching tools fostering students' motivation and engagement. Gamification is a new concept intending to use elements from video games in non-game applications. In [6] the authors applied the social gamification approach in education, testing a framework in K-6 social learning environment.

According to another study, Gomes [7], the students' experimental interaction under certain subjects allows them to obtain a more solid and consistent conceptual perception of the subjects. Per this study, the experimental activities developed by the students contributed to a significant conceptual change confirming the importance of this method of teaching.

Given these examples, it is possible to conclude that the concern with the development of games for education has been increasing [8]. Although the number and kits has been increasing, the main focus still goes through digital solutions of little physical interaction with the students, which makes the assimilation of concepts more difficult [9].

As far as the authors know there are not so many didactic tools to the 1st cycle education. There are several robotic kits, as well as on-line or local serious games but there are few experimental rigs to promote the learning by “seeing and doing”. Also, of the mentioned platforms, practically all are focused on a certain area and the concept of multidisciplinary is lost somewhat.

So, the lack of students’ attention in class and the existence of an overly digital world with few physical solutions that capture students’ interest in all disciplinary areas led to the creation of the E-ducAtion Platform.

This platform works like a race competition that is commanded by the students’ performance in the didactic games. In this way, the focus of the platform is on the accomplishment of didactic games. The successful completion of one game frees the character/avatar from the first obstacle and so on until the student completes all the games. Each obstacle corresponds to a game scenario that the student must solve. The games can be held together or in a group, thus promoting cooperation between the students to successfully reach the end of the track. It will be possible to have two groups of students solving different games and they should cooperate with each other in such a way that the character/avatar of some students finishes the course in the first place.

This article is divided into five chapters. In section 2 an overall description of the platform, its specifications and design are detailed. In section 3 are described the games developed in the platform regarding the four academic areas, in particular the purpose of the game, how to play with it and how it will be implemented. In section 4, Platform Implementation, the software used and the structure of the program are presented. Finally, section 5 addresses the final comments on the development of this project and some future perspectives of the work.

II. PLATFORM SPECIFICATIONS AND DESIGN

This work was developed by a final year student under the dissertation of the Integrated Master of Industrial Electronics Engineering and Computers at University of Minho, Portugal.

A collaboration protocol was firmed between the board of the School of Engineering of University of Minho and the board of the School Group Rosa Ramalho, Barcelos, Portugal. In this protocol the School Group committed themselves to define the learning objectives the platform should promote as well as to perform the tests of the platform at the 1st cycle school of Macieira de Rates, Barcelos, Portugal; the University was responsible for accompanying and giving the student technical and scientific support as well as meeting the deadlines and the defined requirements.

The E-ducAtion (education + action) project is a platform to support education. The objective is to develop didactic games according to the curricular program of the 1st cycle program that may complement the traditional teaching/learning process. So, the main idea is that the platform may captivate the students to a friendly study.

The starting point of the project included the definition of the following:

- To define the learning difficulties students have;
- To define the algorithm students should employ to solve the problem;
- To define a friendly and engaging game environment;
- To define the test procedure and methodology.

The general characteristics defined for the platform are: modular, multidisciplinary, friendly and intuitive, portable, safe and adaptable. These characteristics are detailed below.

Modular

The platform is divided into 5 modules. The scenario (Fig. 1) where the adventure takes place, the master, and the four games (Fig.2), the slaves. In the scenario there is a character that walks a path with obstacles. To get on the road, the student must solve the games and to remove the obstacles along the path. Each game is linked to the master and it informs if the game has been correctly solved or not. The management of each game is local and the overall system management is performed in the scenario board. In the end, according to the score and time taken to solve the games there will be a race, between the main character (corresponds to the student performance) and a fixed character, defining the winner of the race.

In the future, it will be possible to exchange games between schools, or even change scenarios, without having to change the rest of the system.

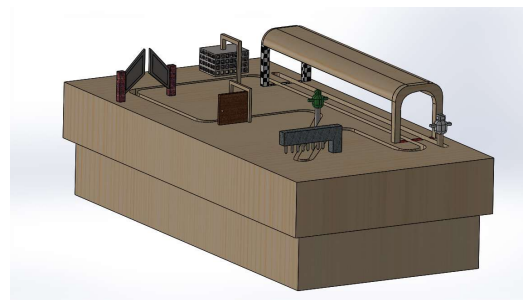


Fig. 1. Platform Scenario.

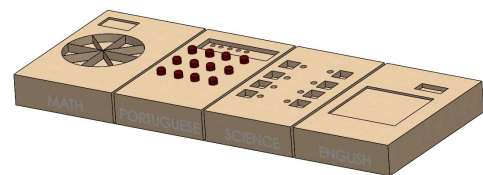


Fig. 2. Four Games: Mathematics, Portuguese, Science and English.

Multidisciplinary

The games are developed to address Mathematics, Portuguese, Science, and English that are the curricular disciplines in the 1st cycle.

The platform possibly will also include the discipline of arts since the scenarios may be constructed by the students.

Friendly and intuitive

The main action takes place in a friendly and colourful environment to captivate students' attention. The way games are thought of and the interaction mode is based on physical actions such as rotate, drag, carry, measure and weigh objects and press buttons.

Portable

The portability of the system resulted from a compromise between being large enough to spark the visual impact on students and at the same time making it easy to carry the platform. This is important for transporting the platform between classrooms or even between schools, thus making it accessible to a larger number of students.

Safe

The target group is children and therefore, some precautions have been taken to ensure their safety. Small pieces were not allowed to avoid pulling or swallowing. The entire mechanical transmission system is insulated and sealed so that no contact is possible. The most exposed electrical system only works with maximum voltages of 5 V which does not represent any type of danger to the students, in case of contact. The remaining electrical system is in the lower platform position and it is impossible to access it. The acrylic dome covers the entire scene of the main action and prevents children from sticking their fingers into obstacles or the character when it is in motion.

Adaptable

The system can easily be adaptable to other areas and modified to operate with other target audiences. It is possible to change the complexity of the games and the way they are designed and adapt the system for children with special needs.

Fig. 3 presents the E-ducAtion platform highlighting the scenario, where the main character/avatar go through the path overcoming the obstacles, and the game tablet for each thematic area.

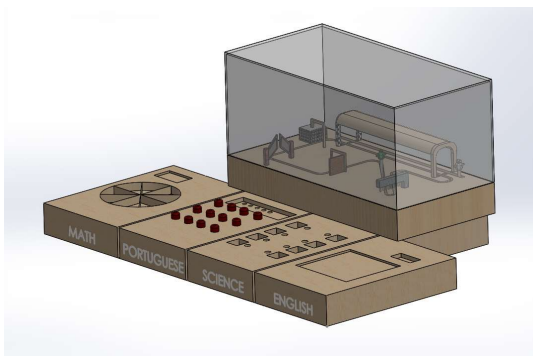


Fig. 3. E-ducAtion platform

III. PLATFORM DEVELOPMENT GAMES

This section presents the developed games for each of the four areas: Mathematics, Science, Portuguese and English.

A. Mathematics

For this area it was developed an environment where the students observe and interact with geometric figures [10].

The main objective of this game is to transmit to students the concept of fractions. It is an area where teachers identify some difficulties in learning and so it is expected that with the support of a visual activity an easier understating of the students can be obtained.

The game play starts with the presentation to the student of an interface that contains a list of ingredients that should be placed in a pizza in a form of fractions, Fig. 4. Then the student should build the pizza following the instructions given (correct quantities of each ingredient).

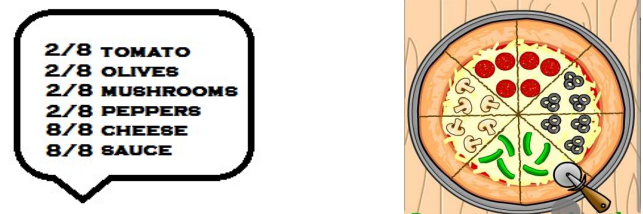


Fig. 4. Mathematics game

B. Science

In this area it was developed a game with the objective of developing students' memorization and visual perception in science concepts.

After the presentation of theoretical concepts, the game play includes the association between words and images, as presented in Fig. 5.

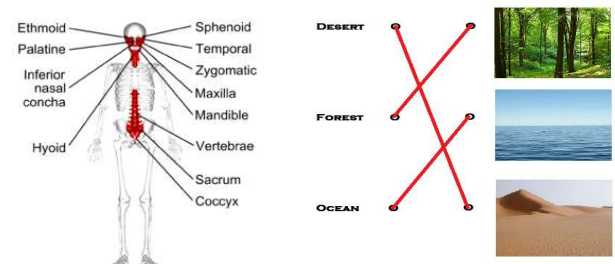


Fig. 5. Science games

C. Portuguese

In the Portuguese game the main objective is to develop the capacity of interpretation and logical reasoning.

The game play starts with the student taking a card from a box where it is a message that should be correctly interpreted (Fig. 6, left). Afterwards, from a list of buttons including figures, numbers, characters, among others, the student must choose the one that corresponds to the correct answer to the message (Fig. 6, right).



Fig. 6. Portuguese game.

D. English

In the English game there are proposed activities in order to enrich the English use vocabulary using several themes has sports, school, shopping, food, among others [11].

The game play will consider several scenarios associated to five areas (sports (Fig. 7 left), food (Fig. 7 right), weather, emotions and buildings). For each of these scenarios there will be presented questions to be answered, from a list of possible responses. The student must choose the correct one.



Fig. 7. English use game

IV. PLATFORM IMPLEMENTATION

In this section, it is described the developed platform, namely the interface and communication hardware, as well as a description of the platform main software function.

A. Interface and Communication

As presented in Fig. 8, the system is organized in 5 modules, each one controlled by an Arduino Mega 2560 platform. The system works as a network of microcontrollers that transmit data between the master and each one of the slaves, associated to a specific game. The communication master-slave is done using only 2 bits. A bit for indicating that a specific game was solved, and another bit for reinitialize the game.

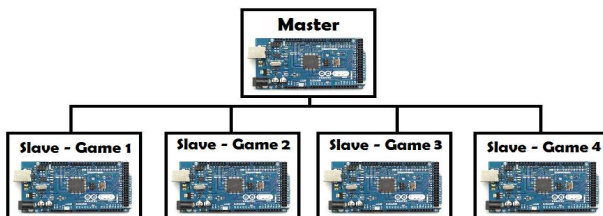


Fig. 8. System network of controllers

B. Software

The Arduino IDE will be used to develop the main software of control and operation.

The system will consider a track sequence with challenges/obstacles that are overcome when a specific game is completed. After the end of the 4 games, a race happens, where the performance depends on the time that the player required to finish the 4 games as well as the number of errors committed (Fig. 9).

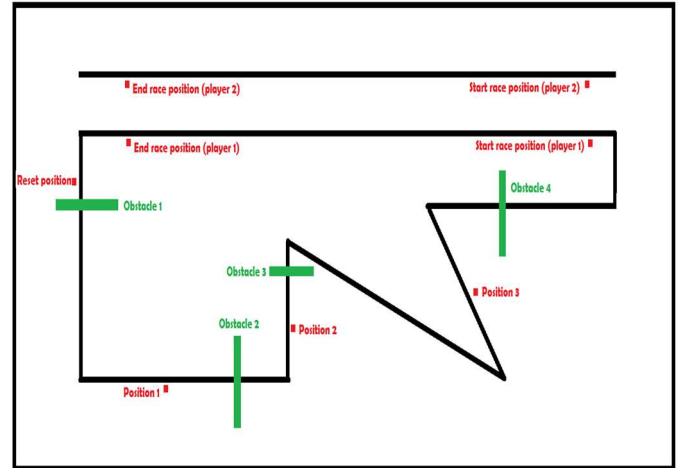


Fig. 9. System Track

Fig. 10 presents a flowchart describing all actions of the system track to complete a cycle.

Observing Fig. 10 it is verified that the cycle initiates with the verification of the reset position to remove or place the obstacles. Moreover, when each game is completed the corresponding obstacle is removed and the player position moves. At the end of the four games, the player opinion is collected and a final race between two characters/avatars occurs.

V. FINAL REMARKS

This article was focused on the design and implementation of the didactic platform E-ducAktion that promotes the learning of the four disciplines of the 1st cycle Portuguese program: Mathematics, Portuguese, Science, and English. The requisites and the pedagogical objectives were previously defined by the School Grouping Rosa Ramalho, project partner. The work was developed under a dissertation of the Master of Industrial Electronics Engineering and Computers of University of Minho.

The platform architecture and the game scenarios are defined. E-ducAktion is about to be concluded and able to be tested in the school environment. Through interviews and data collection from the platform it will be possible to conduct a study on the influence of the platform in the teaching/learning process. It is expected that students acquire knowledge in an easier and faster way than those who have not been in contact with the platform.

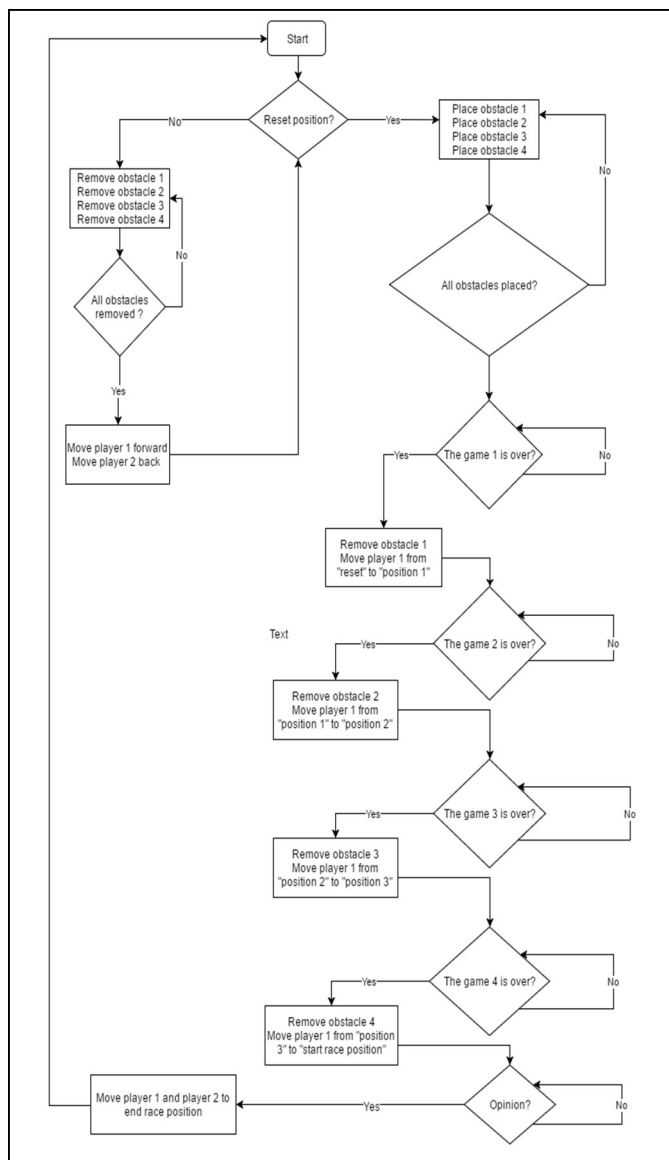


Fig. 10. System main software function

Regarding future applications of the platform, the games may be adapted and designed for children with special needs. Also, a larger platform may be considered to allow several students to play at the same time while competing.

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