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Adventure video game modeling for the teaching of mathematics in basic education

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Abstract. Basic mathematics can be complicated from primary education if the class is based on the presentation of the teacher and the explanation of basic topics instead of allowing students to investigate the topics and develop their own knowledge. In this sense, constructivism proposes that the necessary tools be granted to students with the aim of converting a boring and theoretical class into dynamic and fun. That is why taking advantage of the advantages offered by video games based on learning, the design and logic of an adventure videogame to teach mathematics to elementary school students is proposed, with the aim of providing a tool to educators that allows strengthening the student learning process in this area

Keywords: Learning, Basic education, Mathematics, Feedback, Videogame.

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1 Introduction

It is known that humans play for different reasons: by relaxation, by imitation, as an exercise to gain self-control, and by the desire to dominate or enter into competition with others [19]. In the American continent, evidence showing the practice of games have been found in different geographical locations (eg, the Mesoamerican ball game with a history of approximately 3500 years and 2000 courts found in territory that extends from the southwest of the United States to El Salvador, the importance of this game is that it was practiced by different cultures such as: the Olmecs, Zapotecs, Teotihuacans, Mayas, Toltecs, and Aztecs) with complex structures and rules that made them true competitions and beautiful demonstrations before spectators [1,7]. However, currently according to Connolly, Boyle, MacArthur, Hainey and Boyle declare that the way of playing has changed since 1980 video games appeared accompanied by the progress and progress of the computers, and with it, the definition of the game has changed, since with the evolution of the technology video games have been developed that adapt each time to the reality [5,10].

In this context, according to Connolly et al., and Boyle, Connolly, Hainey and Boyle [5,10] state that the introduction of video games in people's lives has had a transformative impact on the way they They spend time, since video games provide attractive and enjoyable recreational activities, becoming one of the favorite leisure activities worldwide, however much of the initial research on video games particularly those violent, focused on the negative impacts of these (eg, increased aggressive thoughts, aggressive affection and physiological arousal, social isolation, aggressive reaction, lack of control to regulate game time, and addiction to it) on the other hand, video games have been applied in different disciplines such as: education, health, public policy, strategic communication, mathematics, among others, where results have been obtained p Ossives among participants as videogames offer an interactive medium for learning through perceptual experiences [11, 34]. In this sense, according to Hainey, Connolly, Boyle, Wilson, and Razak [16], video games could improve the learning process because they provide an interactive platform where mistakes are allowed and replay without negative consequences for the player; this creates trust among users as it provides the possibility of retrying to play with feedback of the information, improving the skills of the players in the video game.

It has been observed that video games have been used in education as a support tool for teachers, taking advantage of the advantages they offer, that is, they are experiential, active (ie, every action generates a reaction), they provide immediate feedback, they provide a means interactive where there are no punishments for the mistakes made by users, the video game environment provides a better learning experience since it combines fun with education and also, its purpose is to support the assimilation of the concepts or topics that the teachers teach in the classrooms. In this way, learning based on games or Game-Based Learning (GBL) arises in the development of video games for educational purposes where video games are a support tool to reinforce the knowledge acquired in classes [18].

2 Development

In order to develop the videogame that is being proposed and which we call NovaMath, use is made of Game-Based Learning, this teaching approach will be approached in a general way with the structure shown in Figure 1.

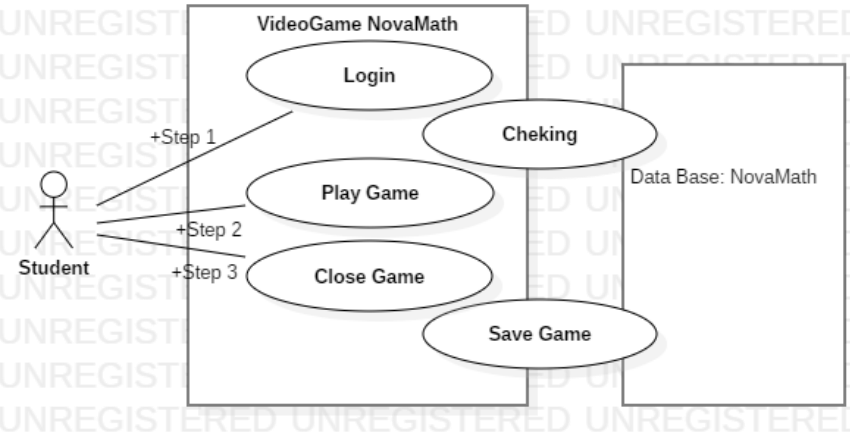

Figure 1. General structure of the NovaMath video game

The video game must keep a record of the players to have a rigorous control of the level of complexity in which each student is, and thus show the environment, obstacles, adventure and problems that correspond. The procedures and general logic of NovaMath are detailed in Figure 2; The student must log in, the data sent is evaluated, the corresponding data is shown on the screen and after the adventure the student must close the video game so that the program records the player's data and at the same time updates the level of game reached. Currently, video games aimed at teaching mathematics at different levels of education, omit calculating the complexity of each level of the game, make use of a strategy consisting of each player's correct response earning points or a heart, A star among other things. On the other hand, if the player responds incorrectly, one unit is deducted from the points reached [2, 14]. NovaMath considers complexity as explained below: The problems that NovaMath will present to players are Arithmetic (i.e., addition, subtraction, multiplication, and division) and will be generated by the videogame considering the following parameters.

- Game level, 5 levels.
- Number of problems already resolved at level a (i.e., a: is the level where the player is currently).
- The player's responses at level a (i.e., the correct answers will be counted against the incorrect answers).

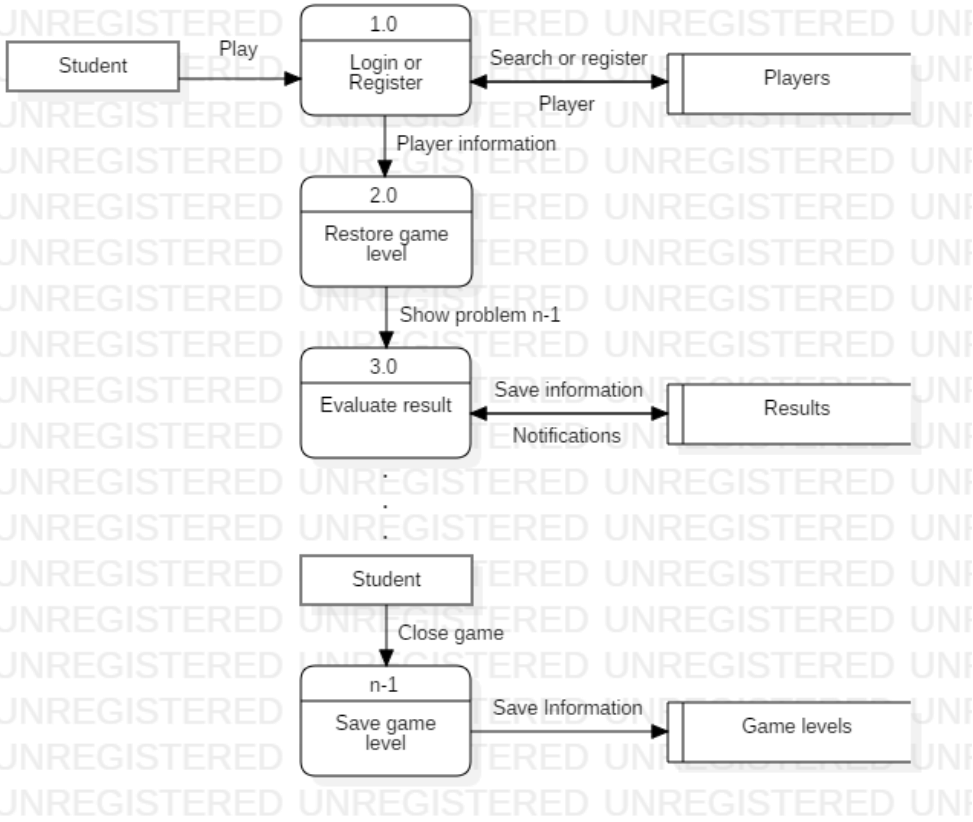

Figure 2. General logic of the NovaMath video game

NovaMath will generate the problems according to the level of play that corresponds to each registered player, that is, as long as the level of play is also greater the complexity of the obstacles and problems will increase. In this sense, the problems solved at the corresponding level (a) will also be considered, since the next problem to be solved, the video game will increase its complexity considering the success and number of attempts made in each problem, that is, as the number of attempts of the player (n), the complexity (p) of the video game should decrease. If the number of hits and the number of attempts are equal, the complexity must be maintained according to level a, and finally if the number of hits is greater than the number of attempts, the complexity must be increased. This process aims to adapt the complexity of NovaMath according to the registered performance of the player and thus prevent the student from finding the teaching-learning process tedious, boring, and complex.

Below is the formula for finding the complexity p of problem n + 1 of NovaMath level a:

$$\boldsymbol{p = [r - n] + a}$$

Where:
p = complexity of the problem n+1
r = number of problems resolved at level a
n = number of attempts made to solve problems r
a = complexity assigned to each level of the video game

3 Discussion and analysis of results

According to the modeling presented, NovaMath presents an adventure environment where the main player evades obstacles to follow the path established in each level of the game (ie, NovaMath has 5 levels of complexity) and at the same time when passing through a certain area of the land obstacles are activated, and arithmetic problems arise.

The Figure 3 shows the game environment with the player running through the established labyrinth.

Figure 3. Environment of the NovaMath.

As indicated, the video game also includes obstacles that the main player must avoid, including that the character must escape from dangerous animals in real life, as shown in Figure 4.

Figure 4. Animals that includes NovaMath.

The idea that the videogame includes this type of wild animals is with the aim of making students aware that there are animals that are better to escape from them. In the video game, if the wild animal catches the player, the player must solve an extra problem, which is why the player is forced to escape from these types of animals. Finally, in Figure 5, the videogame presents arithmetic problems.

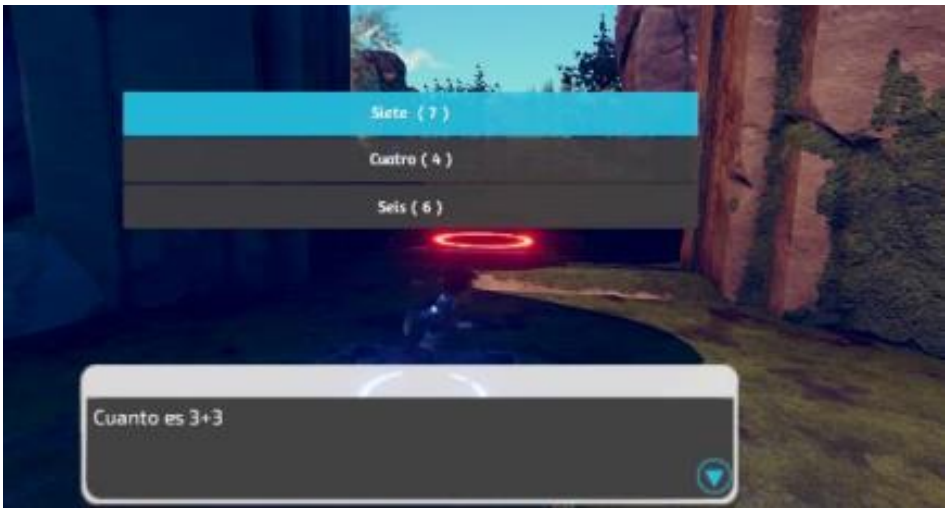

Figura 5. Presentando problemas de aritmética al estudiante.

Adventure, fun, and learning are the pillars of this video game to give the student an environment of fun, challenges and emotion.

4 Conclusions

Nowadays, it is very common for children to be familiar with mobile or cellular devices and computers because the vast majority of Mexican families have these electronic devices at home, which allows children to experience them. In this sense, for most students, playing with the cell phone or with the computer is no longer a problem or challenge since children are more curious, which provides an advantage or opportunity for parents to educate students. Children the good manners and good teachings that will be your guide for the rest of their lives, coupled with the above, it is convenient that from an early age they also be taught the use of digital tools to reinforce their knowledge in the different subjects to be taken In primary education and in this way good foundations are fostered in the different disciplines that they will learn in their academic life.

On the other hand, parents must observe their children's activities with cell phones and computers since they must fulfill their guiding role so that children are in a constant learning environment, since otherwise You run the risk of children consuming inappropriate content for their age. In this sense, learning-based video games are the best option as an entertainment activity since, in addition to offering fun, leisure time is used to improve students' knowledge in a subject that is critical in basic education that is Mathematics, video games can also be used by teachers, parents so that everyone helps children improve their academic performance in this discipline.

NovaMath presents a complete adventure environment, where the student faces challenges that make the fun attractive, and in addition to reinforcing his knowledge in mathematics, he learns to respect animals and the environment. In this sense, the video game adapts to the player as it presents problems consistent with the history of solved exercises and the mistakes made; in this way, NovaMath becomes a dynamic video game with feedback of information for the video game for the player. In this sense, the NovaMath video game is adaptable, and it was developed to be scalable, that is, add more levels and complexity to the exercises, without affecting the players' history.

The benefits of NovaMath are: improving the academic performance of elementary school students, providing a dynamic platform that conforms to student performance, and fun.

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