



PLATAGAM: a video game structured as a didactical material for divulgation of some of the benefits of the Gamma Radiation produced in the Cobalt 60 Multipurpose Irradiator at IPEN's facilities

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1. Introduction

In Brazil, during the last two decades, public policies have increased the process of digital inclusion for public schools and at distance education. Allegedly, a great portion of the XXI century new generation was born to a digital global context, where technology and widespread access to information are granted. Furthermore, the social distance demanded by COVID-19 pandemics implied the closing of most schools, thus emphasizing the importance of distance learning.

Brazilian official documents such as “Parâmetros Curriculares Nacionais” [1] endorse classroom technologies use. Available Information and Communication Digital Technologies (ICDT) merged with the pedagogical project of schools, pose a challenge and have been the object of ample debate nowadays. All of this may generate a much more stimulating learning environment for this generation.

The use of ICDT for scientific divulgation in schools of all levels is recommended. This work presents the conception and implementation of a video game designed to show playfully some nuclear technologies applications, as a didactical material for a meaningful learning. This work is a part of a major project, dealing with IPEN's technical visitation by means of Virtual Reality. As a member of the Comissão Nacional de Energia Nuclear (CNEN), IPEN conducts scientific and technological research, deals with teaching, executes services, and provides nuclear products for Brazilian communities.

IPEN's Radiation Technology Center (CETER) has developed and implemented the Compact Type Cobalt-60 Multi-Purpose Irradiator, featuring all-new Brazilian technology. This reactor uses gamma γ radiation to radiate various products and follows the same trend as commercially available compact irradiators, with the advantage of continuous product processing.

The research made at IPEN and similar institutions even at the Information Age are ample involved in some prejudices and misconceptions. Due to the very nature of the necessary activities, ample access to facilities is not granted, especially to children. Nuclear accidents also contribute to this picture, making the dissemination of the social advantages and benefits of nuclear technologies more difficult.

Given this context, this work aims to present the platform video game deployed to emphasize the Cobalt 60 Multipurpose Irradiator and its applications: the PLATAGAM. It addresses a modest contribution to the teaching and scientific divulgation of some of IPEN's activities in a playful way to students of various age groups and on an interdisciplinary view, once the theme involves several areas of knowledge.

2. Methodology

This paper presents a platform Digital Game Based Learning (DGBL) video game developed and implemented to disseminate the applications of Cobalt 60 Multipurpose Irradiator. To this end, students are briefly informed about the radiation involved to gain a qualitative understanding of what happens inside such an irradiator.

The name platform game is given to a genre of electronic games in which the player controls an avatar that runs and jumps between platforms and obstacles, dealing with damages and collecting objects. Digital games designed for a purpose other than just fun, but intended to instruct, educate, entertain the player with some serious theme or concept are called serious game or applied game [2].

Digital games aimed at learning can be considered DGBL, which represents a category of serious games. DGBL is a pedagogical methodology focused on the conception, development, use and application of games in education and training [3]. Games are contexts structured with the potential to provide student (player) motivation and involvement in order to provide personalized learning experiences, promoting long term memory, that is, favoring meaningful learning [4].

The video game proposed in this paper is an example of a curriculum material, a tool to help teachers respond to the concrete problems that the different phases of the planning, execution and evaluation processes present to them. Curriculum materials or curriculum development materials are all those instruments that provide the educator with references and criteria for decision-making, both in planning (as in direct intervention in the teaching / learning process) and in its evaluation [5]. This work also provides the educators some curriculum material so that they can create within their own space-time context their own didactic sequence.

For the development of this work, some of the techniques and documentation available for building virtual games were deployed. To achieve this goal, the chosen methodology demanded mastering the skills provided by some free software packages available on the Internet, such as Autodesk AutoCAD, image editors like Irfanview, Paint e Pixlr, and Unity Games Engine.

AutoCAD is a computer aided design (CAD) software that architects, engineers and construction professionals rely on to create precise 2D and 3D drawings. It was used to draw and edit the scene. This work deploys the free student version. Popular image editors such as Irfanview, Paint and Pixlr were used for manipulating and editing scene images, formatting, and background removal.

A Game Engine is a library of packaged features and tools, conceived to ease the development of a game, in such a way that not everything should be crafted from scratch. Many commercial game engines developed for original game titles released their programming structures for the construction of other games. Among them, one of the most regarded in this market and freely available for small developers, the Unity 3D game engine was the chosen one here. This game engine allows game and app creations suitable for diverse computer operating systems running various browsers, mobile devices, and VR platforms.

The access to Unity 3D is free for companies with revenues up to US\$ 100000.00 by year. Besides that, a vast documentation, models, textures, codes and free or paid training modules are available for serious developers. C# language constructs knowledge are however required.

3. Results and Discussion

The platform game PLATAGAM is the result of this work and is available on the itch.io website at: <https://patriciapaladino.itch.io/platagam>. Itch.io is a site where users host, sell and download video games.

The game was originally designed to run under windows system (.exe) and on android phones (.apk). Once the game is created Unity3D allows implementations to other platforms.

When the game starts, the player's avatar is initially in the center of the representation of the Cobalt 60 Multipurpose Irradiator, as shown in Figure 1. The IPEN Cobalt 60 Multipurpose Irradiator, as its name implies, is used for several purposes, however, in this work only four were addressed: irradiation of cultural collections, food and beverage irradiation, irradiation of Nile tilapia skin, and irradiation of surgical materials.

The scenario is divided into eight regions: the irradiator, the fruit region, the market, the tilapia region, the pollution region, the industry region, the museum, and the hospital.



Figure 1: First game scene

The avatar must go through the scenarios using the mobile platforms and tile maps and must perform to accomplish the missions. The player can move left and right using the arrow keys and can also jump using the space key or run using the W key.

The player has four missions to accomplish: collect the apple, take them to the irradiator to radiate and then deliver them to the Market; collect the tilapias, take them to the irradiator and then deliver them to the hospital; go to the insect-infested museum, collect the collection, bring it to the irradiator and return it to the museum; and collect the boxes with surgical material in industry, radiate them in the irradiator and then deliver them to the hospital.

As each mission accomplished, something happens in each respective scenario, and the player gets a life. The game ends when all four missions are completed or life's count reach zero.

Some difficulties were created to entertain the player: the game starts with 3 lives; thorns cause damage by taking a player's life; and if the player falls into the polluted river, he or she loses all lives and then the video game ends.

The difficulties encountered in the making of this final product are those related to the manifold skills required for the construction of the video game such as the rendering of the graphical interface with the game engine domain, the use of C # programming language for game structuring, and the theoretical study of the applications of gamma radiation, involving in site visits and interviews with the professionals involved.

4. Conclusions

The product of this work is the video game PLATAGAM, a curriculum material for spreading the benefits of gamma radiation. Curriculum materials, as methodological variables, are often unduly neglected even though it is curriculum materials that dictate teachers' activity. The existence or not of these tools defines the degree of flexibility and creativity of the teacher when planning the didactic sequence.

The video games are interactive, motivating, generate a series of events arising from the narrative, viz., to collect elements, take them to the irradiator, deliver them in the appropriate places; all these actions depend solely on the player, who by discovering the missions and how to solve them, memorize the good results of gamma radiation applications. Being multisensory, the game's image, sound, music, sound effects and playability with immediate feedback, the game is indeed very attractive. On losing, the player can always try again.

Although educational games and video games are the subject of much research, there are few initiatives by companies, educational institutions, and researchers dedicated to the creation of this kind of material. There is a clear lack of a strategy that could bring together the conditions not only for discussing but also to elaborate these materials.

This work essentially was a proof of concept, hopefully showing that it is possible to develop some teaching materials with low cost, for all the software used is free. The very realization of this video game shows the possibility of creating digital games in various domains of knowledge and that the learning process can be enjoyable and amusing. Future development of both 2D and 3D games will be continued, and some testing is already underway for the creation of DGBL Virtual Reality games. Play and enjoy the game at: <https://patriciapaladino.itch.io/platagam>.

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