

Game Based Learning Using Cost Effective Tools for Electronics Engineering Topics

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Abstract- GBL (Game Based Learning) has recently become a popular topic of discussion within the eLearning community. The new age students enjoy playing games because the process is engaging and challenging at every moment. Consequently, eLearning professionals and next generation instructors are trying to incorporate an equivalent level of engagement in their teachings as well. However, a major prohibiting factor in doing so is the considerable time and cost that goes into making a game, in addition to the team size and variety. The result of this marriage of academic teaching objectives with negligible use of gaming techniques is boring games and drill-and-kill learning [3]. However the learning games which have been developed and tested point to the immense potential in this field, as compared to traditional teaching methods, video lectures or even standard eLearning practices, students learning through GBL have greater retention, application, time-management and resource-management skills.

The small amount of learning games that have been developed till now are either for the K12 level or are simulation based exercises in the medical field. The engineering field has seen minimal progress from video lectures on the

eLearning front. Given the tremendous amount of demand for skilled engineers in the technical sector today [10], the need to implement effective practice-oriented teaching methods is pressing.

This paper will –

- Briefly discuss characteristics and features of game-based learning
- Introduce techniques and methods available to create GBL along with constraints
- Discuss ideas for creating games across various topics in electronics engineering
- Propose cost-effective and time-saving alternatives to create Game-Based Learning Modules
- Provide resources and tested templates for making learning games
- Explain the building of a sample learning game created for Automotive Electronics Engineers
- Develop a process map for the development of GBL for engineering for application across platforms

Keywords- eLearning, Electronics engineering, Game-based learning, Higher Education, Human-computer interaction, Instructional Technology, Usability

I. INTRODUCTION

The significance of games in order to create engaging and highly interactive content for learners has been known since the early 1980s but the research is disjointed and the field lacks well-defined boundaries [1]. As pointed out by [2], the worst of all alternatives happens when games are married with learning objectives wherein the user is required to read through “green screens” of “scrolling text”. However, the major issue in creating Digital Game-Based Learning experiences (DGBL) is maintaining the balance between focusing on the learning outcomes while immersing the learner or the player in the environment so much so that he/she is fooled into learning, retaining and applying the *real* objectives. Today the DGBL experiences are either created by gaming enthusiasts or hardcore academicians the results of which are either games with an immersive plot but with negligible focus on learning objectives or boring drill-and-kill games [3] which are as far away from the concept of a game as possible. Therefore, in order to create serious / learning games that are *compelling user experiences* we need a balanced mix of academic objectives with gaming concepts of how to create immersive environments, characters and plots around serious topics. The future of “Serious Games” may not be in games companies per se (although it’s still possible), but may very well be in those learning organizations that understand the mechanics of how games work and the implications of games culture for the next generation of employees [8]. One other aspect to consider while creating a DGBL experience is that while a host of short interactive learning games exist for the elementary level, higher education and especially engineering has comparatively seen very little progress on this front [4]. Since the learners in higher education have significantly greater exposure to modern standards of gaming environments and engaging experiences in entertainment than their K12 counterparts, it becomes even more essential to create gaming experiences which are in tune with the current level of

visual appeal of the present day games. A key question to ask here in talking to teachers/ professors about developing instructional technology, is how much game do you want [5]? Since most learning objectives do not require “actual games” to be built, instead essentially involve putting some good ‘gameplay’ around interactions that are helpful to learning. The final aspect in developing a game-based learning experience is the gender imbalance. It has been observed [6] that gender differences do not influence interest in the games, but do influence different lines of play or preferences, for instance girls focusing more on the design aspect of a simulation game (The Sims) while boys initiating the game more quickly, getting to the simulation part immediately. While themes of blood, gore and violence attract a large majority of the male game-playing population [7], the same themes are repulsed by the opposite sex. Hence it is suggested to keep the themes of learning games as “gender neutral”, meaning focusing more on the real life simulation part with rewards, customizations and clear objectives. In an industry that is growing at a rapid pace, serious games form a very small percentage of developed games in the current scenario. The biggest deterrents for learning organizations to create games are cost, time and the vast variety of human resources required. For an idea of the magnitude of resources it takes to make a 3D video game today, a 3D first person shooter game would take anywhere between \$ 1 million to \$ 20 million regarding cost, a team size anywhere between 30 to 100+ regarding labor, and somewhere between 6-9 months to 6 or 7 years regarding time requirements. Such mammoth investments are beyond the scope of many, if not all educational institutions or learning organizations. What is needed is a holistic approach providing the feel of a rich visual environment, which takes into account the aspects of game-based learning [4] and achieves the objectives as efficiently and in as cost-effective and time-effective a manner as possible. This very approach is exemplified in the succeeding sections.

II. THE GAME

In the following sections, the basic structure of a game is explained, along with tenets of game based learning. In order to build a learning game, it is important to understand two essential topics – how a game engages the human mind, and how we *really* learn.

A. Game Structure

A game may be categorized in many different genres like RPG, Fantasy, First Person Shooter, Sports, Simulation, Action, Adventure etc., but the essential characteristics of a vast majority of games remain more or less similar regardless of the classification [4]. The primary element to every modern game is the storyline or the plot. Each game starts off with a story or background information where the environment, the characters and the plot is introduced just like in a play. It may or may not be based on an actual historical event. You have helpful tips, tutorials or practice modes to help you become familiar with the game environment and controls. Further a game either has a protagonist or the lead character / team which the user controls in order to accomplish a series of tasks with a substantial amount of choices and / or defeat a predefined antagonist. Further, there is a host of rewards and incentives offered at predefined steps in order to keep the user engaged. Lastly, the user can save his/her progress and restart from the same point later on. In some modern games the lead character / team is allowed to be customized by the user to create a personalized look.

As indicated in Fig. 1 for a popular game series GTA or Grand Theft Auto, the game starts off with a storyline which sets the tone for the central character to take revenge against betrayal. However in order to accomplish this final task he has to go through a series of small missions and subtasks in an open world like dropping people off at destinations, races etc. and each task has its reward to keep the player motivated. The last picture in the figure refers to viewing statistics, maps and pausing or restarting the game according to the player’s convenience to know where he is at that point in the game. These attributes need to be kept in mind while designing games as they are pivotal to creating a game-like feel for the learner/ player.

B. Our Game

We created a learning game titled “Gone Baby Gone” with the learning objectives of making a student aware of what a G8D problem solving approach is, how to apply it and how to make a G8D report. The background given to the student at the beginning was that of a story playing out about a couple who lose their baby due to a multitude of reasons coming together. The player is then given the role of a consultant hired by the town mayor to solve the problem and prevent any future crisis from happening. This is where the story part of the game ends and the interactive part begins. The player is asked to make decisions at each step of the way and resources are given to him/her to help him along the way. A progress meter shows him/her where he/she is at the moment as shown in Fig. 2. The player can choose to view the G8D report draft at any moment of the game, and the report gets filled based on his inputs and choices. After certain critical points in the game, the mayor calls him/her for a review and based on the decisions the player has taken, he/she gets reprimanded or rewarded accordingly. The player is also asked to choose a team from a large array of choices, choose symptoms based on videos, maps and facts and backed by a high tempo

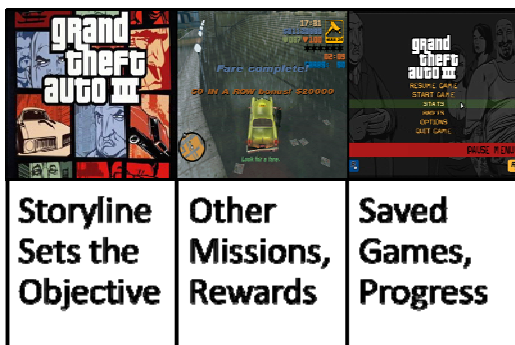


Fig. 1 Major Attributes of Grand Theft Auto 3

soundtrack, the environment created is very similar to an actual game. The overall aim of the game is to prevent any incidences and recommend and implement measures so that the baby counter, an indicator to point out the effectiveness of each action based on the number of emergency incidents happening like the one described in the story, is down to zero. However, in keeping with the aspects of game-based learning, the learner is fooled into thinking that he's saving the town from further incidents whereas realistically he's learning a highly valued problem solving tool used extensively in the automotive industry by electronics engineers and managers. The game works by way of testing his decision making capabilities and providing him feedback via the mayor, or a press outrage or angry town residents at his inability or inefficiency or laudatory comments and praises vice versa.



Fig. 2 Snapshot of the progress page for “Gone Baby Gone”

C. Techniques and Savings

This game was created by a team of 3 in less than a month using only 3 tools. The base for the entire game or the platform was Microsoft PowerPoint 2010, which is widely available and is the new version of the company's presentation authoring tool. Using the powerful animations, triggers, transitions and hyperlinking capabilities inside this tool, we were able to create an environment which looked like a game, felt like a game and behaved like a game in almost every aspect. The other tool we used to present the game was Articulate Studio '09. This powerful rapid eLearning tool was

used by us in creating interactive decision based quizzes with customized feedbacks, inserting flash-like interactions for ease of information and integrating audio narration and background music into the presentation to make it come alive. Articulate Studio '09 can be bought but we operated on the free fully functional 30-day trial of the tool for the purpose of this game. Last but not the least, we used a host of other free tools like Gimp to edit pictures, Audacity to record narration, Screnr to record and embed screencasts, Designcomics.org for the comic characters and the Microsoft Office Online Image Library for other pictures, clipart and images. Comparing our in-house creation with the previous example of GTA 3, it too had a storyline which played out like an animated movie; it contained a lead character with a defined mission but lots of other objectives to fulfill just like in GTA 3 and lastly, you could go to the progress bar or quit the game and restart at any time according to your convenience, fulfilling the last major attribute as well. Therefore apart from PowerPoint 2010 which some might argue isn't a free tool (available from Microsoft for \$140), we worked with trial and free software programs to complete a game which was capable of engaging learners while teaching them the exact objectives we wanted to inculcate. The savings in time, cost and labor as one can estimate for oneself were remarkable.

The process diagram of how we created this game is shared as well as shown in Fig. 3. It is believed that game-based learning can incorporate all the three types of activities described [9] namely, absorb, connect and do in a single package. It is widely known that when the human mind is engaged and pays full attention to a topic, learning automatically occurs. This is exactly the motivation behind game-based learning. In order to make this innovative approach even more flexible, the technique described in the process diagram should suffice in pointing out the major stages of development in creating a learning game from scratch.

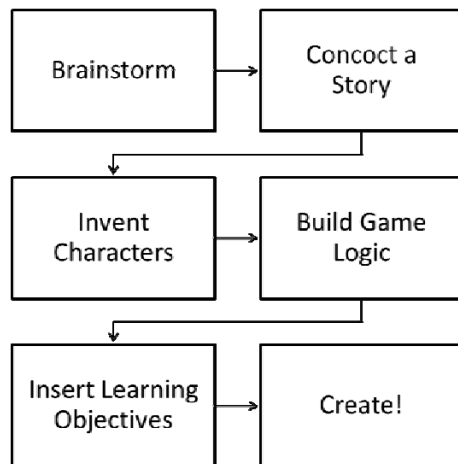


Fig. 3 Process Diagram of Game Building

The process diagram basically explains the rough outline to how any DGBL experience should be approached for optimal results. We started off with brainstorming for ideas about the game and eventually concocted a story regarding this baby incident. Once the story and the characters in the story were clear, we created all other characters in the game that might be required. After the stage was set and the actors were on it, we developed the script for the game, or in other words, the game logic. How the game behaves, what happens when the player selects a particular path, choices etc. were all covered in this section. Once the objectives were clear and the script was clear, we simply took the learning objectives and inserted them as auxiliary tasks – tasks that were needed to be performed by the player in order to accomplish the final goal. This is where the fooling of the learner takes place. Once everything was decided in this manner, we started developing the game using the tools and resources mentioned above.

IV. CONCLUSIONS

This paper therefore attempts to demystify the techniques used behind game development and how the same end can be achieved through cheaper, time-efficient means. The example of the game shown (Gone Baby Gone) illustrates how higher education subjects can be tackled effectively and interactively using such techniques. The sample game was shown to automotive

industry experts and having received their approval and commendation, it is proposed to test the results of the interactive game on final year engineering graduates in local universities to further investigate the impact of game-based learning on retention and application. Based on the feedback from the tests, we plan to modify and improve the current sample and develop such specimens for all electronics engineering subjects to help create engaging content that truly makes learning fun. After careful study and the resources available on game-based learning, it does seem as if this field will be the next step in learning and consequently more cost-effective and time-effective techniques need to be researched into in order to make this approach a popular one.

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