

EDUCATIONAL COMPUTER GAMES DEVELOPMENT: A REVIEW OF FIRST STAGE

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Abstract:- This paper introduced game and clearing reviewed necessary components of computer games that made it different from all other software issues. While other some software issues are also essential, these made computer games indeed games. When they are not included at the design stage then such cannot be said to be educational games though with educational content. They are better in edutainment. Elements of games and its design issues are critically examined while learning features of computer games are reviewed. It is essential that students be engaged tirelessly on learning process. This can be easily done using educational computer game as indication shows that a large number of students are involved in playing computer/digital games because of its fun, entertaining and pleasure components. Game developers should make effort in developing curriculum based digital games.

Further study can be done in the area of game evaluation in ensuring that educational games are indeed enhancing learning process.

Keywords: Computer Game, Education, Design, Software Edutainment

1.0 Introduction

To understand the meaning of a typical computer game, there is need to first have the understanding of the game. According to Salen and Zimmerman (2003) "A game is a system in which players engage in an artificial conflict, defined by rules, which result in a quantifiable outcome." To play a game is to engage in activities directed toward bringing about a specific state of affairs, using only means permitted by specific rules, where the means permitted by the rules are more limited in space than they would be in the absence of the rules and where the sole reason for accepting such limitation is to make possible such activities. In most cases, the permitted rules are not the best approach of accomplishing the activities (Cornett, 2004; Dondlinger, 2007). Crawford (2002) defined a game as a closed formal system that subjectively represents a subset of reality. He explained each term of this definition carefully. By 'closed' he meant that the game was complete and self-sufficient as a structure. The model world created by the game was internally complete; no reference needed be made to agents outside of the game. Some badly designed games failed to meet this requirement. Such games produce disputes over the rules, for they allow situations to develop that the rules do not address. The players must then extend the rules to cover the situation in which they find themselves. This situation always produces arguments. A properly designed game prevents this possibility; it was closed because the rules cover all contingencies encountered in the game. Formal in this definition means that the game has clear rules. There are informal games in which the rules are loosely stated or deliberately vague. Such games are far removed from the mainstream of game play (Wilkins, 2002). Game as a system is a collection of parts which interact with each other, often in complex ways. Games are targeted towards a particular accomplishment; the primary aim of most games is entertainment (Dondlinger, 2007).

Section 2 discusses the essential elements of computer games, section 3 overviews types of games and section 4 reviews design issues of computer game while section 5 is on applicable area of computer games.

2.0 Elements of Computer Games

A typical game is expected to contain some elements that actual differentiate it from other forms of activities. These are the components that make game indeed game. This section will discuss these elements. Prensky (2005) identified twelve elements of a typical game. There are:

2.1 Fun

This is a mood for finding or making amusement. People only succeed in whatsoever they are doing if they enjoying doing it. The fun component of a game makes the player attached to it. This gives enjoyment and pleasure (Pinelle *et al.*, 2008; Prensky, 2005; Squire, 2003)

2.2 Play

This is activity engaged in for enjoyment and recreation, especially by children. Play is an enjoyable and pleasurable activity. Play sometimes includes frustrations, challenges and fears; however enjoyment is a key feature. It has a 'what if?' quality. The play has meaning to the player that is often not evident to the educator. Active-play requires action, either physical, verbal or mental engagement with materials, people, ideas or the environment (Shipley, 2008). This gives intense and passionate involvement (Ram *et al.*, 2007).

2.3 Rules

This is one of a set of explicit or understood regulations or principles governing conduct within a particular activity or sphere. This can be enforced. To make the players avoid some pitfall if eventually they will continue and follow up the goal of the game Pinelle *et al.*, 2008; Plass *et al.*, 2007; Hamlen 2011; Sicart 2011; Papastergiou, 2009). This gives structure to the game.

2.4 Goals

A goal is a desired result a person or a system envisions, plans, and commits to achieve a personal or organizational desired end-point in some sort of assumed development. The actions that players take in a game are directed toward achieving a goal. In most games, the goal is a higher score than the other players at the time the game ends—whether that score is represented as money, points, control of key spaces on the board, spaces advanced along a track, or points remaining from a starting pool (as in a combat game). But goals can also consist of trapping an opponent's crucial piece (e.g., most forms of chess) or reaching a point before all other players (e.g., a race) or aligning pieces into a particular pattern (e.g., tic-tac-toe). These can be viewed as "scores" only by torturing the definition of that word. The key point is that the goal be clearly defined and that it shapes the actions of the players in trying to reach it. The outcome gives motivation to players (Robertson and Howells, 2008; Shaffer, 2006; Sandvik, 2006).

2.5 Interactive

This means acting and responding to one another. Applications that are interactive are always in response to a user's action or request; presents choices (paths) depending on where in the program the user initiated the action. By following different choices, the user can accordingly control or change the action of the device or outcome of a game or program. This gives doing (Robertson and Howells, 2008; Shaffer, 2006; Sandvik, 2006; Shaffer *et al.*, 2005).

2.6 Adaptive

In the simplest terms, it is to bypass limitation and adjust oneself to the challenge of the system. An adaptive system is flexible system that improves its performance (or chances of survival) by monitoring and adjusting its configuration and operations in response to feedback from its environment. That gives flow.

2.7 Outcomes and feedback

Outcomes provide direction in the planning of a learning activity. It is the final consequence of a sequence of actions or events expressed qualitatively or quantitatively. Possible results include advantage, disadvantage, gain, injury, loss, value and victory. There may be a range of possible outcomes associated with an event depending on the point of view, historical distance or relevance. Reaching no result can mean that actions are inefficient, ineffective, meaningless or flawed. That gives us learning.

2.8 Win states

This means a successful result in a contest, conflict, bet, or other endeavor; a victory. This is a derivative for effort of every person. With this every player put effort to ensure the win state is reached. That gives us ego gratification (Virvou et al., 2005).

2.9 Conflict

Conflict refers to some form of friction, disagreement, or discord arising within a group when the beliefs or actions of one or more members of the group are either resisted by or unacceptable to one or more members of another group. Other words that can be used in place of conflict include competition, challenge or opposition. Conflict can arise between members of the same group, known as intragroup conflict, or it can occur between members of two or more groups, and involve violence, interpersonal discord, and psychological tension, known as intergroup conflict. Conflict in groups often follows a specific course. Routine group interaction is first disrupted by an initial conflict, often caused by differences of opinion, disagreements between members, or scarcity of resources. At this point, the group is no longer united, and may split into coalitions. This period of conflict escalation in some cases gives way to a conflict resolution stage, after which the group can eventually return to routine group interaction once again. That gives us adrenaline (Van Staaldunin and de Freitas, 2011; Whitton, 2007).

2.10 Problem solving

This is working through details of a problem to reach a solution. This may sometimes include mathematical or systematic operations and can be gauge of an individual's critical thinking skills. This process of finding solutions to difficult or complex issues sparks creativity.

2.11 Interaction

This is a kind of action that occurs as two or more objects have an effect upon one another. A closely related term is interconnectivity, which deals with the interactions of interactions within systems: combinations of many simple interactions can lead to surprising emergent phenomena. This involves communication of any sort, for example two or more people talking to each other, or communication among groups, organizations. The feedback during the operation of machines such as a computer or tool is also interaction among the components of a system.

2.12 Representation and story

Representation is the use of signs that stand in for and take the place of something else. It is through representation that people organize the world and reality through the act of naming its elements. Signs are arranged in order to form semantic constructions and express relations. To represent is to bring to mind by description also to symbolize. A representation is a type of recording in which the sensory information about a physical object is described in a medium. The degree to which an artistic representation *resembles* the object it represents is a function of resolution and does not bear on the denotation of the word. Story is any account of connected events, presented to a reader or audience in a sequence of written or spoken words, or in a sequence of (moving) pictures.

Computer games must consist most of these elements before they can be categorized as game otherwise such is said to be non games.

3.0 Type of Computer Games

According to White *et al.* (2007), Computer Game is a virtual environment in which players interact with digital objects or each other for entertainment. While according to defined Computer games as complex cultural objects: they have rules guiding behavior, they create game worlds with values at play, and they relate to players who like to explore morals and actions forbidden in society.

There are many types of computer games available, ranging from traditional card games to more advanced video games such as role playing games and adventure games. In this section, types of computer games are discussed. The architectures of computer games are also described. Finally, the programming environments to build the computer games are highlighted.

Although computer games mainly provide entertainment and fun, they also improve hand/eye coordination and problem-solving skills. Each game has its own strategy, action and fantasy that make each game unique and interesting (Consalvo, 2005). Generally, computer games can be classified into the following types: card games, board games, puzzles, maze, fighting, action, adventure, role playing, strategy, sports and simulation games. However, the classification is a fuzzy concept, as many games are hybrids that fall into more than one class. For example, *Doom* can be classified either as a maze game or an action game, while Monopoly can be classified as a board game or strategy game. The different types of computer games are **Card games, Board Games, Puzzles, Maze, Fighting, Action Adventure, role playing, Strategy Sport Simulation**



Fig. 2.2: A typical Card Game (Solitaire)



Fig. 2.3: A Typical Board Game (Scrabble)

3 Design Issues

It is important for us to be absolutely clear about what is meant by “game design”. Schell (2008) and Consalvo (2005) defined game design as “the act of deciding what a game should be”.

A computer game can be just a computer application program. It consists of the following components: Input, Game Logic, Graphics/Sound Support, Game Output and Networking. They are briefly described as follows:

3.1 Input

Users interact with the game program through input devices. Common input devices include keyboard, mouse or joystick.

3.2 Game logic

It implements the game logic or game code that handles most of the basic mechanics of game. Generally, before the game logic is developed, the story line on how the game is played and how the players should interact should be designed. Simple physics, networking support and animations should be planned. In some advanced games, Artificial Intelligence (AI) and collision detection are also implemented in this step.

3.3 Graphics rendering engine

It has complicated code to efficiently identify and render the game objects and background from a two-dimensional (3-D) model of the environment. It supports transformation of objects that are moved, rotated and scaled when required.

3.4 Graphics and sound drivers

The graphics drivers receive requests from the rendering engine to the graphics library using APIs. Windows APIs and Microsoft Foundation Classes (MFC) provide two-dimensional (2-D) graphics support for PCs. For supporting both 2-D and 3-D graphics, OpenGL and DirectX are the two most popular graphics libraries. DirectX also provides libraries for music and sound support.

3.5 Game output

The generated 2-D or 3-D graphics is output to the display. The generated sound effect or music is output to the sound card.

3.6 Networking

It provides networking protocol support that allows several users in remote locations to play and interact in the same game environment. In a networked game environment, a server is needed to maintain information on which the virtual game world is supporting, communicates with game clients that are used by players to provide them with information about the shared environment. The server also needs to synchronize the information, and maintain the consistent scenes of the virtual game world among the networked clients.

When a game program begins execution, it should first initialize the memory, loads images and sound files, starts the graphics and set up variables such as scores. After initialization, the game logic then starts. When the game session ends, housekeeping is also needed to update sound effects, update and display scores, update data structures, etc. The user can end this session or go back to the game logic to start the game again.

3.7 Story line

To design a successful computer game, it is important to have a good story line, together with good 2-D and 3-D graphics, and sound effects to make the computer game seem realistic. The story line should be first developed before starting to develop a game. To develop a story line, there is need to determine the following:

i. Type of the game: There is a need to classify the nature of the game into one of the categories that have discussed earlier. Different types of game have different requirements, for example, role playing games requires realism in graphics and sound effects, whereas some strategy games emphasize on strategy rather than realism, and simplified display would be enough for such games.

ii. Goal of the game: There is need to tell the player what to do to succeed in the game. In a space war game, the goal is to shoot down as many space invaders as possible. In a fighting game, the goal is to defeat or kill the opponent. In this work the goal is to group related icons into their different social classes

iii. The player's performance in the game: There is need to decide how to rate the players for their performance. This should indicate how close they have achieved the goal of the game. In general, score is used as a player's performance indicator. In addition, when the player has achieved the goal, rewarding the players is also necessary to determine.

iv. Rules of the game: It is necessary to tell the players how to play the game (Schaefer and Warrant, 2004; Shaffer et al., 2005). Instructions on how to operate the keyboard or mouse in order to play the game should be explained.

v. Computer graphics and sound effects: Visual effects of graphics and special sound effects are important to help establish the story line and provide the illustrations that make the player to feel part of the game. Many simple games rely only on 2-D graphics, which draws points, lines, and filled shapes such as rectangle and polygons in a plane (Doughty, 2004). Graphics functions provided from Windows Application Programming Interface (API) or Microsoft Foundation Class (MFC) library on Windows environment support 2-D graphics. Advanced computer games often require handling 3-D objects. Microsoft DirectX supports advanced 3-D graphics on Windows platform. Instead of just supporting the Windows platform, OpenGL supports 2-D and 3-D graphics on both Unix and Windows environment.

Apart from 2-D and 3-D graphics, image display and manipulation is another important technique for game development. In many games, scanner can be used to digitize pictures into images and used them as graphical elements in the display. Images can also be manipulated through scaling and rotation. Animation of images is another popular technique employed in many games. Windows API and MFC library provides functions for image display and manipulation.

Sound is another important element that can make a computer game look realistic. Windows and MFC library only support the generation of only one tone at a time.

However, with an optional sound card, most computer games can generate more complex sound effects. To support game development, Microsoft DirectX provides the DirectX Audio subsystem that supports music and stereo sound effects. OpenGL library does not provide any support for sound effects.

4 Application Area of Computer Game

Computer game has enormously powerful tools that affect human endeavors in different ways (Doughty, 2004, Hamlen, 2011, Ke 2009). It can be used as a medium that can express many different messages. These messages are based on the story line and the challenges it overcomes. Due to this flexibility, computer games are applicable to the following areas: Entertainment, simulation, learning and teaching.

5.0 Features of Game for Attractive Learning Applications

According to FAS (2006) today's video and computer games were so engaging to many people. There are features of these games that could be exploited to improve the outcomes of education and training. Advances in intellectual and learning science have identified features of optimal learning environments. Game developers have instinctively implemented many of these features in game play. These features as identified in FAS (2006) are:

5.1 Clear learning goals: In a good game, goals are clear; players know why they are learning something and there are opportunities to apply what they learn.

5.2 Broad experiences and practice opportunities that continue to challenge the learner and reinforce expertise: In games and simulations, learners are presented with a broad set of experiences and practice opportunities — you can operate powerful equipment or fly through the interior of a cell — learning from a world that has color, complexity, and challenge, rather than a set of abstract facts devoid of real world context. The "lesson" can be practiced over and over again until mastered.

5.3 Continuous monitoring of progress, and use of this information to diagnose performance and adjust instruction to learner level of mastery

Games continually monitor progress, and feedback is clear and often immediate. A good game moves at a rate that keeps the player at the edge of his or her capabilities, moving to higher challenges as mastery is acquired.

5.4 Encouragement of inquiry and questions, and response with answers that are appropriate to the learner and context

Compelling games often motivate their players to seek out information on game strategies and concepts from other gamers, friends, tip guides, web sites, and other resources.

5.5 Time on Task: The ability to hold the attention of players is a hallmark of modern video and computer games (time-on-task). Some game players spend hundreds of hours mastering games. Game designers understand how to keep an audience engaged, while delivering critical information for attaining the game's objectives.

5.6 Motivation and Strong Goal Orientation: Games also have features that are highly motivating; that is, game players continue to play games, even after failure, to get better and better at them. This is an attribute that could contribute significantly in the teaching and learning of difficult and complex material. For example, Scholastic developed an elementary-level reading product in partnership with game designers. The company borrowed elements from a popular commercial game — including the motivating reward structure, both predictable and surprise rewards — to incorporate into the reading product.

5.7 Scaffolding: Games and simulations can offer support, providing learners with cues, prompts, hints, and partial solutions to keep them progressing through learning, until they are capable of directing and controlling their own learning path.

5.8 Personalization: There is significant interest in how technology can be used to tailor learning to the individual. For example, while there are divergent views over the existence of or the need to adapt to “learning styles”, there is strong belief in the learning style concept in the education community. As a result, schools want to adapt material to the student, rather than teach students to work with different modes of knowledge and skill acquisition. Differences in other factors — such as prior knowledge, general ability, and motivation — may have an even more important effect on how materials need to be presented. Nevertheless, it appears that games and simulations could offer educational experiences and materials in a number of different formats that may appeal to different learners.

5.9 Infinite Patience: Another feature of games and simulations that is valuable for learning is infinite patience. Teachers lose patience, and may conclude that a student “just isn't cut out for math”. The teacher's impatience may intimidate a learner or influence how the learner perceives himself or herself. Machines — such as computers and video games — don't lose patience, and offer learners innumerable opportunities to “just try and try it again”.

These types of learning environments are unaffordable and impractical in today's standard classroom situation. However, game technologies may make these learning environments affordable.

6 Conclusion

This paper introduced game and clearing reviewed necessary components of computer games that made it different from all other software issues. While other some software issues are also essential, these made computer games indeed games. When they are not included at the design stage then such cannot be said to be educational games though with educational content. They are better in edutainment.

7 Recommendation

In repositioning Nigerian educational system, it is essential that students be engaged tirelessly on learning process. This can be easily done using educational computer game as indication shows that a large number of Students are involved in playing computer/digital games because of its fun, entertaining and pleasure components. Game developers should make effort in developing curriculum based digital games.

Further study can be done in the area of game evaluation in ensuring that educational games are indeed enhancing learning process.

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