

Game design in Game-Based Learning

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ABSTRACT: *Game-based learning (GBL) is offering motivated learning method for educator. Even though, this methodology is inactivated efficiently in public education. A reasonable possibility is the poor design of noncommercial educational game. In this paper, we have referred to the important motivating features in digital game and have attempted to involve them in the educational game design. Be-side this, we presented some considerations and proposed an enhanced frame work for designing an educational game. The frame work tries to overcome these important designing considerations.*

Keywords: Game-Based Learning, Educational Game Attribute, digital games, Game flow, Assessment

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1. Introduction

Traditional teaching system is seeking to achieve its goals, which are improving teaching efficiency and learning performance in a managed way. For that, verities of researches have been developed in differ-ent filed. One of the hot fields is; to benefit from the game engaging attributes and combine them with the capability of digital technology.

Until know, there is no agreed definition of digital game but it can be described as digital program that visualizes information to one or more players, accepts input from the player(s), and uses a set of pre-defined rules programmed in its code (game rules) [1]. Usually, Digital games follow a general flow structure. First, the game starts with the introduction phase, where the main goal of the game is pre-sented and the game rules are clarified. Then, the body of the game is provided. It may consist of simple/structured or single/repetitive phases. In this phase, the game produces a problem, task or challenge and the player tries to accomplish it. During the body phase, a feedback about the player progressing is pro-vided frequently. Finally, the conclusion phase presents the overall player level and the game ends. As we see, digital game is a solving problem environment.

There are different types of digital game depending on many classification attributes [2]. In general, dig-ital game can fall in one or more of the following game type; adventure games, board games, word games, action games, role-playing (RPG) games, strategy games, simulations games, sport games, fight-ing games, casual games, god games, educational games and puzzle games, etc. This classification de-pends on different criteria; objective, style and purpose, etc. For that, some type can be sub-type of oth-er. For instance, fighting game is sub-type of action game.

In general, many gamer play for several reasons such as fantasy, challenge, curiosity, fun, socializing (with friends and family) and entertainment, etc [2]. In addition, players may play for other reasons such as having a sense of purpose, goal to complete, player choice, ability to contribute to action/plot and sense of collaboration, etc [3].

Furthermore, some players associate their motivation to the game characteristics such as interaction through dialogue, pace

(scary, adventurous, exciting games), good quality graphics, use of narration rather than lots of on-screen text and characters (including appearance, motives, contribution to plot and worth as an opponent) [3].

As a result, we can describe digital games as engaging methods to solve problem by recalling prior learning in a social environment. This made them good learning tools. Digital game-based learning (DGL) or GBL usually refers to different kinds of software applications that use games for learning or educational purposes. GBL is composed of three elements. i.e. digital, game and learning.

2. GBL Motivation

GBL attempts to benefit from games engaging environment to motivate learners. As discussed above [2], they encourage learner to study uninteresting material, incite them to spend more time and invest more effort in learning. Furthermore they enhance intrinsic rather extrinsic motivation by making learning more enjoyable.

Role playing game (RPG) is a type of digital games where player select a real character role and react according to it and reveals advantages when used as learning tool. Whereas game based framework objects are associated and can represent learning system usual concepts [11]. Furthermore, RPG offers recreation type process, large usability of the tool and its adaptation to the student's speed.

Other general advantage of using GBL is socializing. Game usually is a multiplayer environment where participants can communicate with each other in chat dialogs to share knowledge or find a solution, compete each other as individual or group and cooperate to achieve a common goal. As traditional classroom, student can exchange data with other students and ask his/her instructor for help through the game. [1].

2.1 GBL obstacles

As any teaching method, there are some encountered disadvantages. For instructors there is a difficulty to identify how a game is relevant to the statutory curriculum. In addition, the lack of time for instructors to familiarize themselves with the game is another obstacle. Furthermore, the instructor no longer has the usual and helpful student feedback (eyes, general attitude) [2][4].

Institutions must take into account a lot of issues, for example availability and configuration of game laboratories, availability of game equipment, technical support and instructional designers and integration into the curriculum [1]. Currently, students are digital native and are familiar to digital and online games. Therefore, they can learn to play game with ease and progression process is not an issue to them. Even then, still it's the responsibility to educational institution to teach the students how to use them.

GBL is used in various fields and subject areas, these includes business and higher education as technical education, military training biology labs and medical schools, etc.

2.2 Educational Game design

Different designs exist for educational game but. some researchers categorize them into three groups:

- Edutainment (integration the words education and entertainment), refer to initiatives focus on translating the official educational content into a game-like environment. These titles are designed from their content and later on top of that contents, playability is added. The entertainment aspects fail to be skilled at design; most of the advantages of game-based learning in terms of motivation and engagement are lost.
- Redesign pre-existing commercial games. The improvement of these games did not reflect a potential educational use, sometimes their contents and models are so sophisticated that they can have an educational value if handled properly. Examples of these approaches are sim city and civilization.
- An in-between category of specially designed games that tries to balance between fun and educational content. Unfortunately, this is not easy because game design is not a precise science, which is mostly due to the character of fun. Some interesting examples are: The monkey wrench conspiracy and the Virtual leader. [13]

2.3 Problem statement

Although of the existence of successful educational game, there still some lacking in benefitting from GBL public education. One of the main reasons is the poor design of educational game as compared to commercial game and the difficulty to balancing between the pedagogical requirements and motivated factors of usual digital game.

In the rest of this paper we presented an overview of related work in this filed. However we provided a discussion about the main aspects in educational game design. Finally, we presented our proposed frame work for designing digital educational game.

3. Related work

A lot of research in GBL is going on which provide similar results about the features that effect educational game design.

3.1 Researches that propose frame work

N.Azli, et.al [2] proposed a modified framework for designing digital games based learning. The frame work concentrated on the association between game engagement and motivation with clear goals, rules, appropriate feedback, good usability/playability, focused attention, potential control and a perception of challenges, etc. Furthermore, the game provided a cognitive framework for problem solving through the narrative story line. The challenges of their framework were based on educational objectives theory of play and the story.

Another research in the same field proposed by T. Marty, et.al [4] focused on immersion as a key point for motivation. They indicated that immersion should take into account through three main phases i.e game design, game play and coherent metaphors. Game design, build up a coherent world by integrating real places or people. Game play propose an overall educational scenario taking place in the premises defined in the game design and pick rules of the real world you need to reproduce it in the game to improve the authority of the virtual world or for supplying learning process requirement. In metaphors, identify metaphors associated with the general story and with the different learning objects.

3.2 Researches that use theories in analyzing GBL

Y.Bae, et.al [5] used the activity theory to explain educational and entertaining elements in GBL. Their analysis assumed that the relation between student and learning is mediated by game, the relation between teaching-learning and learning by cooperative learning, and the relation between student and teaching-learning by game rules. Based on this explanation and analysis, they present a design of digital educational game framework.

In the same way S.Hsu et.al [6] utilized activity theory to analyze the factors of the tradition and digital GBL activity systems. The activity system here constructed according to the view, which transformation from traditional to digital GBL. Furthermore, they discussed the contradictions in building digital game base learning. The first-order contradictions are cognitive dissonance between staffs and the instructor roles; the second-order contradictions are save time and manpower vs. student's performance in learning and learning performance vs the consumption of activity preparing time, and the third-order contradictions are the learning plan. Finally, they gave some suggestions to instructors and activity designers to solve the contradictions and to make game based learning more useful and meaningful.

G.Denis, et.al [12], selected to look at motivation through Deci and Ryan's self-determination theory. They indicated that it is expressive in the area of game as well as in learning. Depending on this, they studied how motivation-driven design influences learning and outline the new educative situations video games offer. There approach applied to the case of music education via the Cha-Luva swing festival project. The project challenge is to spur players' musical curiosity and increase their motivation for traditional instrument study, helping them overcome learning plateaus. As result, they recommend general guidelines for redesigning learning situations through fun.

3.3 Experimental researches that study the effects on learning outcomes

Other researches focused on studying the effect of GBL on learning outcomes. Y. Cheng, et.al [7] provided a study to explore student achievements using online educational game as learning tool for natural science. The result showed that the students were more confident and interested. Furthermore, the studied result referred to some point which should be considered while developing an educational game.

In the study by M.Charles, et.al [8], they aimed to move from traditional face to face learning to totally e-learning with minimum

tutors. The first two steps are to produce educational game for teams & individuals; the result showed that students achieved significantly improved results in learning efficiency and in their study skills.

Furthermore the paper provided by T.Connolly, et.al [9] proposed an online educational game depend on problem solving as learning methodology. The design of this game depend on some guidelines illustrate in the paper. F.Ke) [10] studied shows that uses benefits of cooperative, competitive, and individualistic goal used in educational method to design educational games. Results demonstrate that cooperative gaming was the most effective tool in enhancing positive math attitudes. In addition, some study attempted to take advantages of new technology as mobility in game design. J. Sánchez, et.al [11] provided study designed around the concept that combining video gaming and mobility offers opportunities for the development of problem solving skills. The proposed learning method was designed, implemented and evaluated. The result illustrates that using this method help to solve problem with a richer level of interaction and more time dedicated to the evaluation and more participation.

4. Discussion

4.1 Educational Game Attribute

As we mentioned earlier, GBL attempts to benefit from game engaging attributes. Therefore, educational games should consider all these motivated attributes within the design process. The educational game should be entertaining since that majority of gamer play for fun and pleasure [2], voluntary to give the learner, since of control [1], challenging in a way matching the player skill (not too easy so it will be boredom not too hard then it will be frustrated) [8], cooperative activity (this will support the learning efficiency and knowledge transferring between student) [10], curious (to make learner spend longer time in learning uninterested topics) ,contains rules about the allowed actions and has clear goals (to make the game playable) [5]. These attributes are agreed between most of research referred in section 2.

4.2 Consideration while designing GBL

First concern is the contradiction between the cognitive dissonance between (student, instructor, activity designer, programmer, and activity supporter) where each of them has different view for educational game. A solution of this problem is to discuss with each other before constructing the activity [6].

Secondly the appropriate selection of game type as mention in [1], each game style is useful for some educational goal: card games enhance memorization, concept matching, pattern recognition, Jeopardy-style games facilitate quick mobilization of facts, labels, concrete concepts, action games improve speed of response, automaticity, and visual processing, adventure games promote hypothesis testing and problem solving, word games are good for language learning and pattern matching, strategy games increase the ability of decision making. An important side in GBL is to consider how to add games to the educational tool set, blending them with other activities.

A solution of this is that the activity designer and curriculum stakeholder cooperate together in the development plan [1].

The representation of objects or problem in an educational game should be constructed from a real world or to reuse the look and feel of well-known games. This provides immersive feeling while playing the game [3] [4]

The game should take in account providing the opportunities for interaction and collaboration. The learner should have the ability to play as learner-learner, learner-instructor or learner-system. This must be within a motivating, challenging and engaging environment.

Feedback is an important concept for the learner. In educational game, learner should have feedback on his/her level of progression after any activity. So, providing feedback mechanism is a basic concern in game design. Furthermore, the game should support mechanism for learner to using coaching and scaffolding. [9]

Since that instructor doesn't have the usual feedback from student, so assessing learners on their level of progressing is inaccurate. For that, an integrated assessment mechanism depending on some playing information as (number of hints or prompt, the time to solve the problem... etc) will improve the game design [7] [9].

In the game body, the event should have related meaning within the context of the story, rather than a collection of random, events. To enhance the intention of learner, a criterion of surprising event be taken to change the rules both with the educational domain and the game will be good design idea [3][9].

4.3. Frame work for design GB

A proposed design frame work in [2] show that the core task in game design is sustaining the motivation and engagement of the player by providing appropriate challenges matches the player's skill level at the appropriate pace. The game player has the ability to test solutions produced and observe the outcomes of actions performed, to construct knowledge and enable the discovery of new and better solutions.

System framework in [7] includes a database server, a website server, and a game playing server. The three servers are connected with one another and to the internet. Students register online for playing the games with other. The online playing time, process of answering question, and number using the prompts for all competitors will be recorded to realize the learning procedure and students achievements and can be the reference for improving the system.

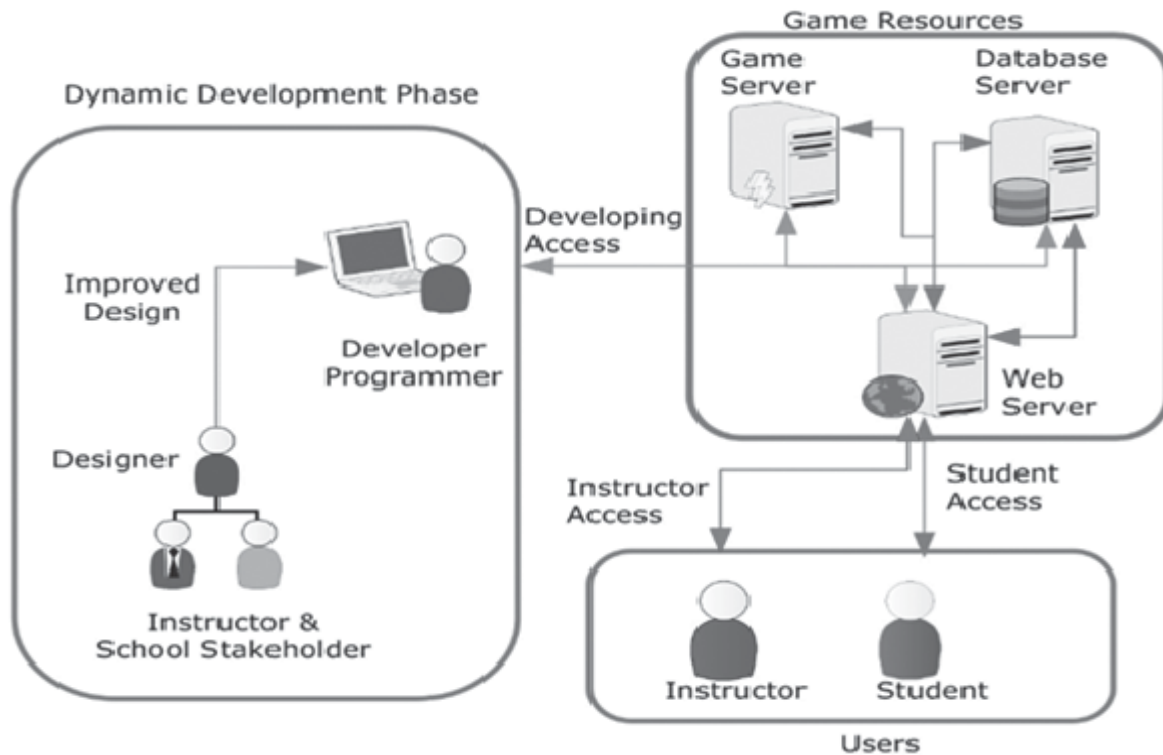


Figure 1. Proposed frame work for designing educational game

5. Proposed framework

Depending on the discussion in section 3, we proposed a framework for designing educational game in GBL. The proposed frame work attempts to benefit from the produced one in [2] & [7]. The system presented in Figure 1.

The frame work involves different character from education environment (educator, instructor, learner or student) and from game developing environment (game/activity designer and programmer). The development resources are placed on distributed servers for better enhancement of the game design and performance.

The framework adopts design, playing and assessment concepts. The design of the GBL approach is repeatedly improved by designer (activity or game designer) and (instructor and educator) to balance between the different perspectives of each of them, furthermore, to ensure better involvement of curriculum in the game metrical. In addition, the student will involve in the design possess in somehow (explained below).

The system provides capability of game playing and progression assessment during the enhance design phase. To start playing, the learner logs in to his/her account (usually online through Internet connection). Then, the game presents the

available game sub problems that match his\her progression level, and he\she selects his\her preference. The student then tries to solve the problem if its solution is accepted then he\she will be transferred to next level.

On the other hand, his\her solving attempts are saved as invented solutions (to using them as resources in designing new solution). All learner actions (number of prompt, time to solve the problem, number of invented solution ...) are used as resource in the assessment process.

Instructor have the ability to obtain the learner assessment and add recommendations for learner if it is needed. The whole flow of the system is shown in the flow chart represented in Figure 2.

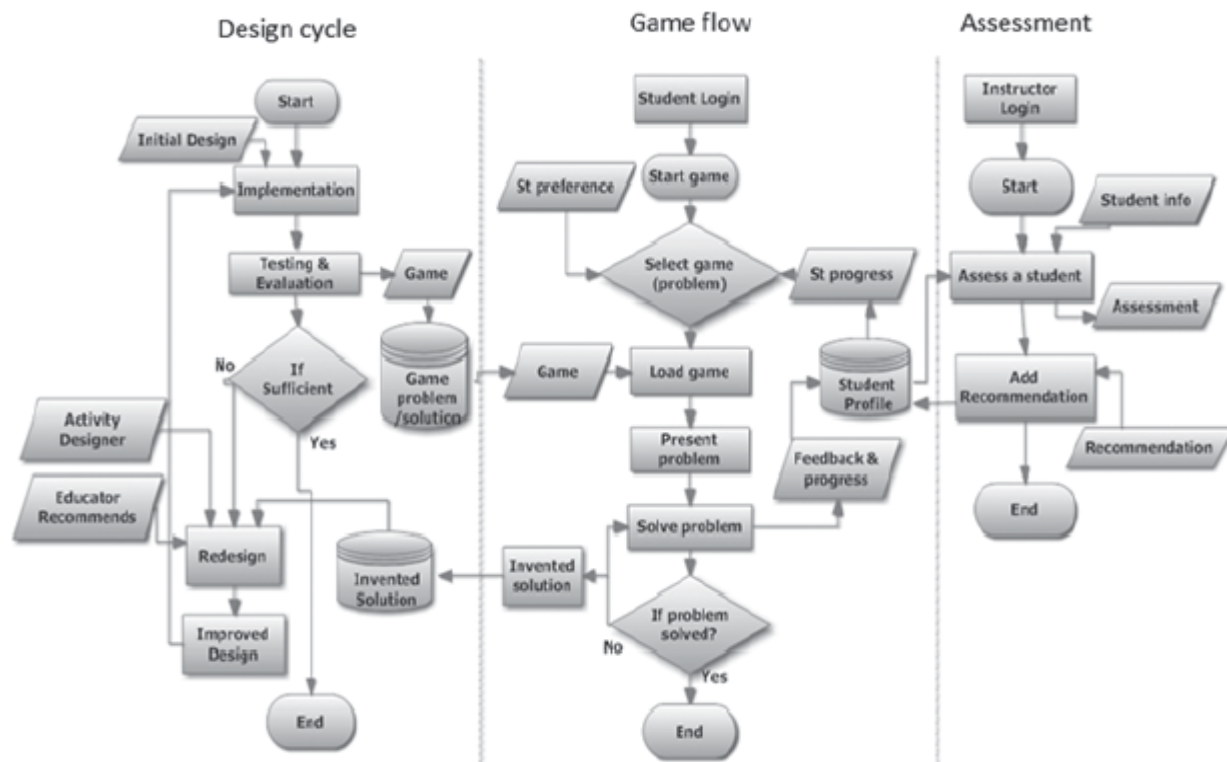


Figure 2. The flow of the proposed framework

6. Conclusion & Future Work

GBL is offering motivated learning method for educational environment. Even though, this methodology is not utilized efficiently in public education. A reasonable possibility is the poor design of noncommercial educational game.

In this paper we referred to the most important motivating feathers in digital game and indicate to involve them in educational game design. Also, we presented some recommendations which should be taken into consideration in the GBL. We also proposed an enhanced frame work for designing an educational game. The frame work tries to overcome the important designing consideration.

As a future work, we suggest to improve the framework by providing more details in the assessment process and the constructing of invented proposed solution.

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