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History Educational Games Design

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***Abstract:* - Digital games, an interactive technology can foster learning process effectively and interestingly especially among young learners. Digital Game Based Learning (DGBL) approach utilizes the game as a medium for conveying learning contents. The area of educational technology is still lacking of research on how to design game environment that foster knowledge construction and deepen understanding and problem solving while engaging and entertaining the player at the same time. The learning outcome need to be integrated as a goal from the start of the design process and pedagogy need to be formally incorporated into games. In this paper, we reviewed features of educational game design and history learning. Then, we discuss the application of pedagogical elements in educational game design. The result is a history game design model and level design for History Multimedia Interactive Educational Game (HMIEG). The model consists of four main elements: interaction, knowledge, engine and level. The history educational game design model integrates the pedagogical elements and game design features to ensure HMIEG can be used as a history learning tool effectively.**

***Keywords:* - Digital games, DGBL, ID, History educational game design**

I. INTRODUCTION

Video game industry in United States approaches yearly revenues of 15 billion [1]. Digital games (video games or computer games) are positively accepted among children and teenagers [2, 3]. In United States, the game playing population falls between the ages of 10-34 years old with the majority of population between 14-19 years old [1]. According to the 7th Online Game Research Report of China, 43% of the gamers were from the age of 19 to 25 [4]. Similarly, in Malaysia, a study was conducted in five schools of Selangor which involved 582 students shown that majority of these students (92%) have experienced playing computer games [5].

Digital games, an interactive technology within the multimedia learning environment could foster learning process effectively and interestingly especially among young learners. The interest for digital games not only found among children and general population, but also in the academic research [3]. Researchers and game designers have noted this promising technology and proposed some frameworks and models to foster multimedia learning environment [6]. Research data also showed that the use of games in education is perceived as a useful tool for learning and helped to engage students in educational experiences towards achieving specific learning goals and outcomes [3, 7, 8]. The potential for the integration of games and learning becomes ever more significant. Game environments have great potential to support immersive learning experiences. To engage in the act of gaining knowledge or skill, learners must be motivated. Motivation has long been considered as a crucial step in learning [9].

DGBL is a paradigm which utilizes the game as a medium for conveying the learning contents [6]. DGBL is all about leveraging the power of computer games to captivate and engage end users for a specific purpose, such as to develop new knowledge and skills [10]. DGBL is also defined as an application which uses the characteristics of video and computer games to create engaging and immersive learning experiences for delivering specified learning goals, outcomes and experiences [11]. DGBL satisfy the basic requirements of learning environments and can provide an engaging environment for learning as well. However, it is argued that most educational games too often resemble digital exercise books and do not utilize the power of games as interactive context-free media. This is the reason why educational technology still lacks in research on how to design game environment that foster knowledge construction and deepen understanding and problem solving while engaging and entertaining the player at the same time [12].

Moreover, there is still a problem of how to combine education in game without losing the fun but still create a simple, engage and immersive educational game. Some yielding students are entertained in game but do not obtain any academic skills or knowledge [13]. There is a challenge to design an educational game that fulfills the curriculum topics since learners perceived the game environment as not a serious activity. Some students fear that they cannot achieve learning objectives [14]. Lack of technical resource in school is also a problem that unable to execute these high demand games [15, 16]. Some educational games are also to be too long, complex and difficult [15, 17, 18]. For example, teaching with Civilization III takes 20 hours for students to learn the complex interface [18].

The intention of DGBL is to address new ways of ICT based instructional design and at the same time to provide learners the possibility to acquire skills and competencies [14]. Learning always takes place in well-designed game, we agree that if learning content is to take place as a result of playing games, a new design paradigm design must be developed. The educational effectiveness strategy needs to be integrated as a goal from the start of the design process and pedagogy need to be formally incorporated into games.

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In this paper, we will discuss features of educational game design and history learning and applying pedagogy in educational game design model and level design for History Multimedia Interactive Educational Game (HMIEG). We also discuss the history learning effectiveness from this game design.

II. THE FEATURES OF AN EDUCATIONAL GAMES DESIGN AND HISTORY LEARNING

Game design can be defined as the formal methods utilized in the specification and planning of a game's content and features [13]. Game designers produce game specifications that demonstrate the initial look and feel of the game interface, identify system behaviours for rules of interaction and procedures for game play and game controls that users will navigate in the virtual world [19]. There are many researchers in game design, either on user-centered game design or heuristic for game design. A typical game design normally includes three phases: conceptualization, prototyping and play testing. User-Centered Game Design (UCGD) is an advanced and a much better design to be used in game design. UCGD consists of observational studies, conceptualization, prototyping and usability play testing [19]. UCGD involves user participation in user-centered design, participatory design and usability testing. Rankin et al. [19] defined UCGD to be specific application, affordance game play and effects of game play. UCGD emphasized the purpose of the game, benefits of the game play such as social interaction that support learning process and collaborative learning, as well as experience and outcomes that involve formal or informal assessment.

Heuristics is a set of usability principles that used by the evaluator to explore an interface through an inspection technique [20]. Many common usability inspection techniques are not appropriate for games since they rely on formal specifications on task sequences. According to Pinelle et al.[20], heuristics for game design needs skilled evaluators who inspect the user interface and identify usability problems. This technique is inexpensive and can be carried out in a short time, so inspections can be used iteratively during design process. However, heuristics evaluations also have some problems. Heuristics evaluation does not encourage people to take a comprehensive view of how the software will be used and sometimes can cause the evaluators to miss problems or to identify false problems. The heuristics evaluations also uncover some usability problem in game, they focus on game play, engagement and storyline but is not comprehensive.

Game-based learning cycle was developed by Kiili [21] to understand mechanism of learning with games. Kiili also suggested some educational game design guidelines, that involve challenge, goals, feedback, sense of control, playability, frame story and gamefulness. Byl [22] also proposed Embedded Authentic Serious game-based Learning Experiences (EASLE) that includes story, scenes, icons, theme, game rules, game play mechanism and genre. Moreover, Miller [23] suggested game elements should involve artificial intelligence, attract mode, back story, challenge, cut scenes, game rules, Heads Up Display (HUD), Point of View (POV), levels, Non Playable Character (NPC), narrative, outcomes, trailer, story mode and tutorial mode.

Therefore, there is a need to design the History Multimedia Interactive Educational Game (HMIEG) properly to ensure teaching and learning history become easier and more interesting. History components which are designed by integrate the historical facts and game can produce an immersive learning environment for history learning. Investigations of the features and design component for HMIEG using GBL approach are essential to produce an educational game that can sustain learners' interest and to achieve learning goals. In our preliminary analysis of 582 form four students and fifteen teachers from five local secondary schools in Selangor, 84% of the students stated that they like to play digital games, one reason given is fun, while 63% play games just to fill up their free time [5]. Student like to play digital games because of they like adventure activity and fantasy world too. Findings from this analysis also showed that main requirements of HMIEG are: illustrate history facts clearly, increase students' interest to learn history and learn history through creative experience [5]. The history educational game design should be balance between game and history education.

III. APPLYING PEDAGOGY IN EDUCATIONAL GAME DESIGN

History educational games development process focused on development methodology to produce game-based multimedia educational application. An educational game design and development model is developed based on ID and game development methodology, called digital game based learning-Instructional Design model (DGBL-ID). Each phase consists of activities needed to be accomplished before moving to the next phase. The DGBL-ID model consist of five phases, which is analysis, design, development, quality assurance as well as implementation and evaluation. Each phase consists of a few activities that need to be completed before beginning the next phase. The phases mentioned include all the main activities for instructional part and game part so that the educational game can enable students to learn when they are playing games [5].

From past research studied, they have study and show the model or steps for educational game development, but did not explain details for each phase or step. For DGBL-ID Model, we will test the quality and content of the educational game before we launch to the learners. After the quality assurance phase, we will launch the game and do the usability and effectiveness evaluation of the game to make sure the learners learn effectively when they are playing the immersive game.

In design phase, teaching and game design were determined. Delivery method and teaching strategy which is used in educational game were determined so that the outcomes of the design can help to achieve learning outcomes.

Constructivism, information processing model, Tolman learning theory are the teaching and learning theories used in the design of History educational game. Inquiry, narrative and problem solving are the teaching strategies used in history educational game development. In game design, we need to design the game's story, game play, user control, user interface, game level, art, audio and technical features, product features and budget for educational development. Game play design also play a vital role at this design phase, it shows how a player play in an educational game. Game play is choices, challenges or sequences that players face while navigating a virtual environment. If a player need to shoot an enemy, design of the game must be determined either to use mouse click or joystick. Besides that, art design is a design process of game's character, game's environment, game's background and game's object such as car, gun, ball and ship. Character's features and motion need to be designed before development phase.

In addition, the features of game's level also need to be designed and determined. Each game's level needs to be designed well from the beginning until the end of the game, such as trap and the types of challenge. Game's technical specifications such as types of tools which need to be used are determined. For example, hardware and software specifications need to be determined for computer platform used for the digital game based courseware. At the same time, the suitable programming language for the development of history educational game was determined. The types of lesson plan and teaching resources which needs to be inserted in game menu must be provided before development of educational game prototype. Everything about the lesson plan such as learning outcomes, teaching syllabus and teaching plan need to be inserted in the educational game. Teaching resources such as historical photos of people, history building photo need to be collected before the development of educational game.

IV. HISTORY EDUCATIONAL GAME DESIGN MODEL

Previous research studied the researchers exposed the potential of digital games to encourage students in learning experience. Researchers studied how to develop a model to support instructional system design for effective design and integration game process in learning environment. Therefore, the author agreed that DGBL approach have potential to solve the problems in history learning, specially the younger IT generations.

We proposed a HMIEG design model which have two main components, pedagogical and game. For pedagogical component, HMIEG must include the 8 features, engagement, learning goal determination, motivation, critical thinking, psychological needs, explorations, challenge and competition. The eight features are important to develop an educational game. Engagement and goal determination are the elements used by four previous researchers; challenge, competition and motivation are the elements used by 5 of the researchers; critical thinking and exploration used by two researchers; and psychological needs element used by one researcher only. Psychological needs are important for student's cognitive and behaviour development. This will affect the learning outcome and effectiveness. If students are interested in any learning object, they are willing to learn and increase the learning process [6]. Games with motivation cognitive function can stimulate intrinsic curiosity because of challenge and game fantasy. Game play also influences learning via experiment reaction and creativity as well as support the development of critical thinking through problems that manipulate objectives, determine goal and competition [24].

Engagement, challenge, competition, exploration and motivation are the usual elements in an educational game. This is because a game with challenge and competition among the students can motivate and involve them play games and enable exploration of the game. In learning process, psychological needs and critical thinking should be addressed to develop students cognitive ability when they play games. Constructivism theory, information processing model and Tolman learning theory are used in HMIEG design to enable students to remember historical facts and thus enhance learning.

For game design component, HMIEG applied 15 features of game design, feedback, fantasy, fun, rules, security, entertainment, immersive, active participation, control path, track and manage progress, interaction, task, narrative, control and imagination. Feedback enables student to obtain information as requested on time, less wrong understanding and enables students to apply information accurately [6]. Feedback is prepared for wrong answer to encourage students to continue playing game [25] and is used to developed positive self evaluation [26]. Fantasy, imagination, fun and entertainment are essential features for educational game. Fantasy can satisfy the feeling of virtual situation imagination and environment [26]. Fun and entertainment enables players to play and immerse themselves in playing games, encourage active participation and then applied the different knowledge for detailed understanding [25].

Explanation and rules for each game are important because they are the guidelines and rules for students to follow when playing games. Security also ensures that students play games in a secure situation, via the use of password before they enter the game. This enable students to play games without disturbing others. In addition, control is used for controlling path, track and manage game progress via navigation when they are given the tasks to complete [25] and satisfy the students with freedom and priority, meaning and enable them feel in control of level competitiveness [26].

Interaction is vital and is defined as how students control the games and learn from that, help to attract students, motivate students for next game. Tasks are used to help students absorb the learning content [6]. Narrative is crucial specially for game back story telling. It can show how history events happened. Every history events, date, location and time need to be designed correctly so that the facts are consistent with history syllabus.

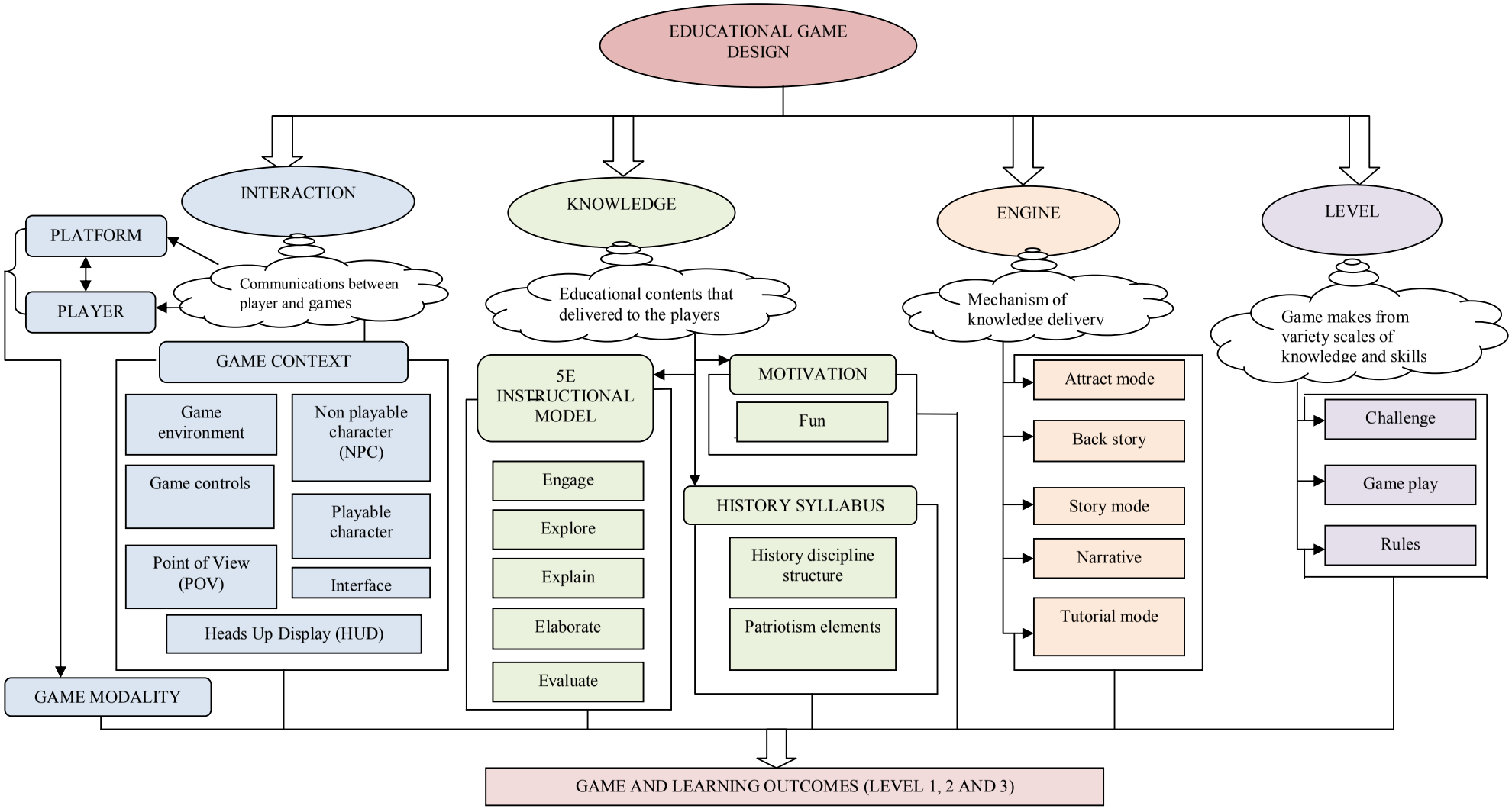

Fig. 1 History educational game design model

Fig. 1 shows the history educational game design model. Educational game design consists of four main elements, interaction, knowledge, engine and level. Educational game interaction can be defined as communications between player and game. Multiple players and game platforms establish multimodal interaction. Game modality is a form of interaction between player and game. Game context is a set of conditions and facts that are relevant to specific situation and can affect interaction between player and game. Game context design involves game environment, game interface, game control, Non Playable Character (NPC), Playable Character, Point of View (POV) and Heads Up Display (HUD). Game environment defined as situation of game environment, physical environment and game social. Interface and game control designed enable player interacts with game. POV enables game scenes to be zoomed in and out. HUD is defined as the statistics of game such as asset, power and player score shown on game screen.

Educational game knowledge can be defined as educational contents that delivered to player via game. In the knowledge design of educational game, motivation, syllabus and 5E Instructional Model need to be emphasized. Motivation is effective in educational game as it related to fun, an intrinsic motivation potential. The delivery of education content needs to follow the syllabus that involves history discipline structure and patriotism element. 5E Instructional Model used to design the educational game knowledge because of all elements stated are appropriate and important to develop an educational game that involves engagement, exploration, explanation, elaboration and evaluation.

Educational game engine is the mechanism of educational content delivery. To design educational game, attract mode, back story, story mode, narrative and tutorial mode need to be emphasized. Attract mode is one that runs when the game is on but not in a state of active play. Back story is the story which underlies the game and sets the stage for the main game goals. Story mode is a part of the game play that the player is exposed to specific story elements. Narrative used to narrate the history facts (game contents) throughout the games. Whereas the tutorial mode enables the player acquire sufficient knowledge and skills to manage the basic game play.

Educational game level allows the creation of game at multiple scales of knowledge and skills. Player needs to face certain challenge to high score to win the game. In game level design, game play need to be emphasized and game rules also need to be determined. After completing the educational game, the level 1, 2 and 3 learning outcomes will be attained.

A. HMIEG level design

Fig. 2 shows the HMIEG design structure. HMIEG consists of six levels, middle epoch, Renaissance epoch, Reformation epoch, exploration and discovering epoch, agriculture revolution and industrial revolution epoch as well as imperialism epoch. The game title is History Multimedia Interactive Educational Game (HMIEG) – Chapter 9: Development in Europe. The game concept is the player will enter the six epochs accidentally from current world or "back to old time world through the history tunnel". At each level, the player has to solve the problems or obstructions that happened in game world to continue the journey to the next level so that he/she can come back to the current world. During the process of solving problems or obstructions, the player will be taught the history facts and events that happened at that level or during the epoch. Help and tips are given to guide the player. The HMIEG platform is a personal computer and use control tools such as mouse and keyboard. The game environment is modelled as the environment of epoch followed the game levels. HMIEG has many obstructions along the way where player cross through the levels. History events or history facts are introduced and taught in the journey of "history tunnel". Fig. 3 shows how educational elements are embedded in history educational game design process.

At the cover page HMIEG, the player will see the introduction of HMIEG via 3D animation. This introduction is the back story of Chapter 9 HMIEG – Development in Europe. Beside the introduction, the player also can enter the attract mode that give the picture of certain chapter 9 history events. The HMIEG game level followed the epoch in Europe.

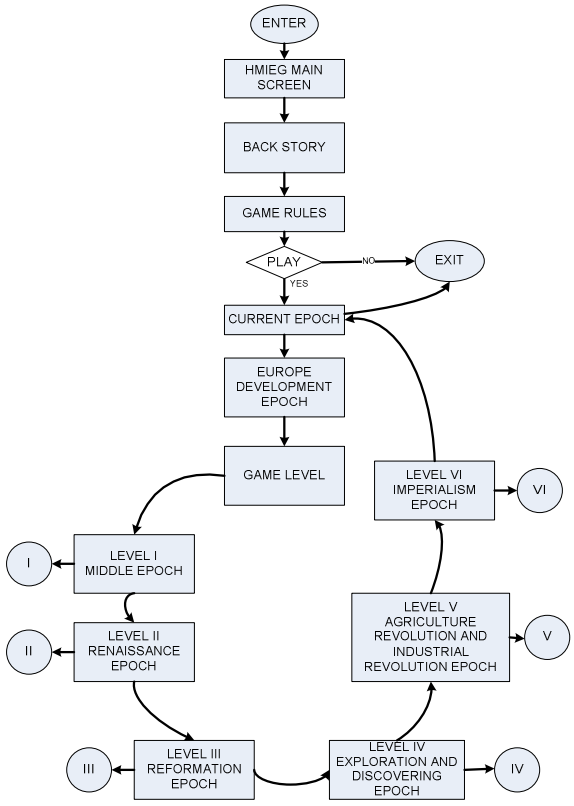

Fig. 2 HMIEG design model

V. CONCLUSIONS

Educational games have become a huge research which enables players to learn some knowledge when they play in an immersive game environment. Since the students and teachers perceived history as a boring subject because it is difficult to memorize facts, we believe that history educational games can be used as an alternative to foster history learning in an entertained experience. Therefore, we propose a history educational game design model and level game design for HMIEG. The history educational game design is based on all studies about educational game which integrate the pedagogical elements and game design features to ensure HMIEG can be used as a history learning tool effectively.

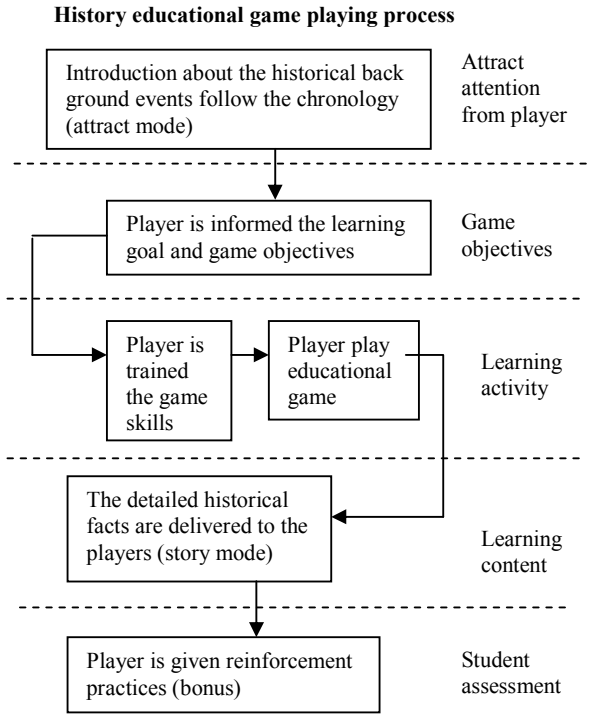

Fig. 3 Embedding educational elements in history educational game design process

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