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A simulated learning environment of history games for enhancing players' cultural awareness

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This research attempted to create the historical context of Southern Taiwan in the late nineteenth century based on the martial art novel "Xiao-Mao" (Pussy) by designing a role-play digital game "Taiwan Epic Game" about the war time; in which, Taiwanese history, geography, and culture are presented in an innovative way with virtual scenarios. Questionnaire surveys were conducted to investigate the effects of the digital game. The simulationist immersion premises were chosen to be the primary concern, with which the designers should pursue the supreme creation of situation, character, setting, and system. The results showed that the game can effectively enhance players' cognitive growth, as well as cultural awareness in terms of the sense of existence of the environment, local culture, folk arts, faith and festivals, and architectural characteristics. It can be concluded that the three-dimensional simulated learning environment created in the digital game can successfully merge "reality" and "virtuality."

Keywords: digital game; Xiao-Mao; role-play game; simulation; cultural realism

1. Introduction

The presentation of Taiwanese local culture, just as other cultures, includes humanistic arts in the whole spectrum, such as architecture, sculpture, music, drama, dance, and literature; from tacit to implicit objects, all exhibit the distinct features of Taiwanese culture. The natural and historical contents of a culture are normally transmitted through text and discourses which can explicitly express the special affections. When facing the impact of digital technology, textual narratives were transformed into multimedia forms. With the addition of visual and audio presentations, the geographical looks and humanistic touches of an environment were successfully visualized through the computer screen. The simulated world transfers the "real" to "virtual" and uses the "virtual" to provide "real" experiences. Unlike in the literature, players of digital games can freely explore and interact with the world to obtain the experiences of stimulations, challenges, and achievements.

Entering the digital era, games transformed themselves from manipulative tools to virtual reality, and have rapidly become daily life entertainment.

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A few years ago, de Freitas (2006) indicated that the major barriers include a lack of empirical data to support the fact that digital games work for learning and a lack of understanding of how these games might be utilized most effectively in the educational contexts. Yet, related research reports multiply after the year 2008; so it is our goal to investigate the effects of digital games on students' learning, to know how digital games bring about better learning outcomes and how digital games can be meaningfully designed to transmit educational goals.

It is found that game-based learning (GBL)-related papers were mostly published within the past decade or so. From 2000 to 2009, the top publication sources, such as *Computers & Education*, *British Journal of Educational Technology*, *Computers in Entertainment*, *Lecture Notes in Computer Science*, *Virtual Reality*, *Computers in Human Behavior*, and other six journals with more than 10 papers in the database, have contributed 313 GBL research studies using the descriptors of "game-based learning," "digital game," "game playing," and "computer game." Observing the literature sources across the time span, researchers (Chang, 2010) found that studies concerning digital games increased largely only after 2005. Related studies about computer games, online games, and simulations started from the year 2000; studies about three-dimensional (3D) games were found after 2003; studies about role-play games and simulated games were found after 2004; PDA games after 2005; serious games, Lego games, and Wii after 2006; and whiteboard games after 2008.

To look further in depth, in recent years, more studies have been found using role-play games for the purpose of learning; nevertheless, many so-called role-play games simply refer to the use of the first-person perspective exploration in the simulated learning environment. There are some simulated games used for language learning (e.g. Connolly, Stansfield, & Hainey, 2011; Smith et al., 2013); some used massively multiplayer online role-playing game (MMORPG) for cooperative learning in human–computer interaction courses (e.g. González-González, Blanco-Izquierdo, Carina, & Francisco, 2012) and in spatial concept learning (e.g. Echeverría et al., 2011); some used a simulated learning platform, such as Second Life, to improve social interactions in class (e.g. Herold, 2010; Lorenzo, Sicilia, & Sánchez, 2012). There are also a few studies that applied a 3D role-playing game (RPG) for a history course. For example, Fassbender, Richards, Bilginc, Thompsond, and Heidene (2012) investigated whether the application of background music and hardware equipment would influence students' learning when playing games for learning. Unfortunately, there was little introduction to the content of the game as well as evaluation of the gaming process or learning effectiveness. On the other hand, Sung and Hwang (2013) used a 2D RPG for plant learning, but little did it provide the simulated environment that this study purported to do. Hence, this study attempts to create a 3D RPG game that can more closely simulate ancient times with true historical stories for the players to meet the historical characters and immerse in the cultural historical content.

A small number of players were even deeply involved because digital games had tremendous power to attract and amaze the players. Due to this immersive characteristic, digital games were used in this research to present simulations to increase players' cultural awareness.

The categorization of digital games is complicated and subjective; they can be sorted out into dozens of categories. They can be classified based on platforms, number of players, player types, subject matter, and sociality. Although most games emphasize on their entertaining feature, they more or less embedded with learning functions and implications. Prensky (2001) said that a game is the learning method the brain likes the most. A game has been known to play an important role in human activities, and is the most

natural way for humans to build knowledge and skills (Cai et al., 2006). A game can contribute to the educational realm since it can intrigue learners' motivation, promote their active participation (Hämäläinen, 2008; Mann et al., 2002), and help to enhance learners' self-directed learning and problem-solving abilities (Amory, Naicker, Vincent, & Adams, 1999). Analyses of the cognitive and perceptual motor aspects of the activity indicate that, rather than being an intellectually lazy pursuit, playing computer games requires high levels of skill and players elect to meet increasing challenges (Greenfield, 1984, 1994; Turkle, 1984). Klabbers (1999) described that playing a computer game is an activity involving skill, knowledge, or chance, in which players follow fixed rules to solve a puzzle or an organized event, in which competition involving several strategies will take place. In the pre-designed context of instructional games, the students explore, think, and make decisions (Mayer, 1991).

Current digital games have both entertaining and educational functions. They can successfully transfer traditional lecture-type education into a learner-based learning model. Integrating digital games in classroom teaching can offer opportunities for learners to develop both their critical and creative thinking abilities. Unlike traditional learning models, digital games are more interesting and interactive, to more effectively enhance players' learning motivations, thus being more focused on learning content and improving learning outcomes. Thus, computer game software is also an effective learning tool to remedial education and teaching about complicated subjects.

It has been speculated that computer game play has negative consequences for young people (Durkin & Barber, 2002; Hastings et al., 2009), although little evidence was obtained to support it (Johnson, 2005; Neo, Neo, & Yap, 2008). Computer game play is an active and well-adjusted lifestyle. Instead of signifying academic problems, game play is associated with more positive engagement with school (Ang, Zaphiris, & Wilson, 2010; Durkin & Barber, 2002; Gosling & Crawford, 2011).

However, to create a complete instructional design to digital games and a set of useful evaluation criteria to students' learning results, designers have to integrate the art of instructional design and the science of technology. To integrate learning materials into games does not only require good script, production techniques, character design, and environment modeling, but also knowledge management ability. For this reason, one of the main goals of this research was to provide an instructional design model for the creation of digital learning games.

Currently, there are many researches that try to integrate digital games in teachings of various subjects, such as math (e.g. Cai, Indhumathi, Chen, & Zheng, 2008), biology (e.g. Ke & Grabowski, 2007), and computer science (e.g. Papastergiou, 2009), and find that games can have better learning effects than traditional teaching, especially for subjects that are complicated. Other than that, we also found studies using 3D games in learning about cultural heritages and geographical history tour guides (Bellotti, Berta, Gloria, D'Ursi, & Fiore, 2012; Froschauer, Merkl, Arends, & Goldfarb, 2013; Mortara et al., 2014). Therefore, this research tried to use digital games to allow students to experience the histories and geographies that they cannot experience in person.

This research used Taiwan Wu-Xia (martial art) novel "Xiao-Mao" (Pussy) (Shih, 2008) as the main story structure, inspected the historical reality in the content, and transformed it into a 3D RPG. The content depicted the heroic act of a common man in the big time integrating Taiwanese cultural history. The players took the heroic character, Xiao-Mao, as the avatar. Through their valiant acts, the players explore the simulated world of nineteenth-century Southern Taiwan. As they became immersed in the virtual scenarios such as Songjiang Troupe and Gongpaocheng (Castle Attack), they learned the intrinsic value of

history, geography, and culture, and thus enhanced their cultural awareness and learning motivations after they played the game.

Other than creating a virtual learning environment for the players to experience nineteenth-century Southern Taiwan, the goal of this game was to put the essential digital role-play game elements, such as the entertainments, challenges, and simulations, in realization. Consequently, this research aimed to investigate whether the design of Taiwan Epic Game with the simulationist immersion elements would successfully increase players' cultural awareness, permit the players to identify with the simulation design as they expected, and allow the players to reach a satisfactory level in the overall design.

2. Literature review

2.1. *Cultural awareness*

Cultural content is diverse. "The physical or tangible cultural heritage, such as historic sites and buildings, monuments, documents, works of art, machines, and other artifacts, are considered worthy of preservation for the future"; and "other factors deeply characterize a culture and have a non-physical nature are the intangible cultural heritage, which include social values and traditions, customs and practices, philosophical values and religious beliefs, artistic expression, language and folklore" (Mortara et al., 2014). Intangible heritage, they further illustrated, covers the range of cultural awareness, historical reconstruction, and heritage awareness including artistic/archaeological heritage and architectural/natural heritage that are particularly difficult to preserve. Therefore, it is important to find tools that have the potential to deliver and communicate these concepts effectively.

Culture is created by the common consciousness and effort of a group (Tuan, 1977), which includes the living environments, historical cultures, traditional arts, natural environments, etc. In recent years, awareness of Taiwan local culture has been elevated. Related issues and contents, such as cultural history and folk arts, have been gaining importance. So Taiwan local culture content was included in the K-12 education system. Through cultural education, students learn to understand more deeply about the places they live in, and the people and things around them. Their sense of cultural appreciation gradually becomes the sense of cultural identity which generates a more proactive love for "home."

As Bruner (1996) said, personal feelings and cultural identities come from the generation and protocol of cultural meanings. Culture is the activities and behavior of human communities, which is a model of life throughout history. Hall (1990) mentioned that cultural identity is "becoming" and "being." It is a phenomenon of the social members who participate in the process of cultural activities, and keep on learning, pursue meanings, and internalize the objectives and values of the cultural activities. They perceive the relationships of cultural activities and personal lives, and spontaneously generate emotions and identities that further become part of their personalities (Connor, 1997). The formation of cultural identity partly occurs by the man-made environments and unique living styles that are influenced by the specific social, cultural, historical, and environmental factors such as customs, values, traditions, attitudes, beliefs, and ways of communication (Krug, 1997).

Culture connects and strengthens the feelings of people with others and with the environment through the presentation of external forms, and offers a toolbox to construct the world people see. Franz Boas (1904) mentioned cultural relativism, pointing out the notion of the non-existence of universal value of culture; in other words, "one would

bias his perception to the world since his cultural cultivation has given him a certain taste and view to things about him." Every cultural model or folk system has its own value without any judgments of good or bad (Bohannan, 1973). Therefore, in order to know a culture, it is necessary to start out from that specific culture with the standard and value of itself. Further, Margolis (2001) refers to cultural realism saying that although culture is abstract and invisible, it is as real as nature, and comes from nature.

Since people are used to their living environments, they are often unaware or neglect the important cultures that exist around them. Therefore, "virtual worlds have already been used in the cultural heritage field, allowing the broad public to appreciate remote (in space and time) cultural content with an immersive experience" (Mortara et al., 2014). Second Life, virtual museums, and simulations, for example, offer the opportunity of exploring in first person a remote site, appreciating and manipulating artistic contents and much more. Nevertheless, these applications still lack a powerful mechanism to engage the users into an active state of learning. Conversely, such engagement can be seen in the application of computer games, especially those with educational purposes, which provide compelling experiences for cultural immersion (Mortara et al., 2014).

In order to stimulate people's awareness to the cultures around them, Cheng, Shih, and Wang (2013) stated that creating the simulated situation in the game would intrigue players to experience the culture embedded in the world, and thus enhance players' cultural awareness. The living world was simulated in the game world so that the players would start to notice the commonly ignored elements in daily life. The players would suddenly realize that history is not distant, only existing in the textbook, but just next door and around them. Through the gaming experience, the players start to indulge their affections into their surroundings. Thus, cultural awareness refers to how the players regard their own ethnical groups and cultures. According to cultural relativism theory, players would start to look at cultural diversities from their own cultures, and start to sense the existence of local culture and history. Yet, cultural realism defined in this study does not refer to the political or sociological sense.

Therefore, digital games can create simulated situations in which the players are placed in the carefully crafted environment where they can feel and experience the culture, and increase their cultural awareness. The game can bring the player to see his/her own culture and sense its particularity, and enhance the awareness of the cultural presence.

2.2. *Simulated role-play game design*

The main feature of an educational game is its objective of supporting the player to achieve learning goals through a fun experience. The fun aspect of the game can be determined by several factors like storyboard, graphics, usability, collaboration/competition mechanisms, and interaction devices; and the learning aspect implements a pedagogical approach by structuring the educational content and organizing its presentation (Ibáñez, Capdevila, Marne, & Labat, 2011). Murray (1997) and Crawford (2005) said that narrative in computer-based systems is essential in which players can experience what they do not have in real life and project their affections in it. Players face problems, get tasks from the story, and acquire equipment through actions and fighting. Because the characters can greatly influence the effects of the whole game, game designers have to create characters which the players can identify with. Also, simulation games offer possibilities to students to interact with the game by exploring and manipulating objects in order to test their hypotheses. Thus, while experiencing the game world, students become active participants in the learning processes and their motivation may shift from extrinsic to intrinsic rewards (Bruner, 1961).

The design process of an educational game has an intrinsic balance between learning and gaming. The learning content in an educational game has a predominant role in the game play, and the game interactions and mechanics should not overwhelm the learning theme.

Other than that, RPGs consist of map (maze), free actions (movements), and adventures, and the main design point is the development and exploration done by the characters. Rollings and Adams (2003) pointed out that the key to the RPG are storylines and character developments. Although stories are sometimes neglected by the designers, the development, adventure, and fighting of the characters are necessary. Themes, backgrounds, interaction models such as character management, guidance, control, and objects, as well as viewpoints are essential to the design. Other research suggests that active learning approaches such as role-play can enable students to retain more knowledge over time (Semb & Ellis, 1994). Since simulation games constitute both multimedia and active learning instructional approaches, they should have the advantages of both (McCall, 2011).

In order to understand players' gaming conditions, one of the gaming theories that is widely used is Csikszentmihalyi's (1990) flow theory. It describes the levels of players' immersion into the game in the effects of players' skill levels versus the challenge levels. However, to understand the players' choices and reasons for motivation, as well as methods and strategies to develop an attractive game, flow theory is insufficient for explanation. Therefore, the GNS role-play game theory (Edwards, 2001) was adopted as the design framework for this research. Three parts were described in the GNS theory:

(a) Gamist: This aspect focuses on the competition among players, which includes winning strategies and loss conditions, as well as short-term resource sharing and long-term victories.
(b) Narrativist: This aspect focuses on the storyline which is creative, immersive, and identifiable. Players are the main characters in the story and compose the story in the gaming process. Narrative conflicts are always implemented as important materials.
(c) Simulationist: This aspect focuses on the exploration of and the interaction with the world. It concerns the game world's internal logics and experiential consistency with the real world.

The premises of each aspect for sustaining players' interest in the game include a few elements which are as follows. In Gamist, the designers should implement resources and means that define the success of action, strategies through which players can manipulate the actions of characters, and feedback generated for players' gaming strategies. In Narrativist, the designers should pay attention to characters' background setup which would also influence the world view or myth that attracts the players. In Simulationist, the designers should pursue the supreme made of situation, character, setting, and system. It refers to the design of the game world to simulate the real world so that players can interact with the multiplicity of objects, characters, and storylines without having to worry about the real causalities.

In this research, in order to remake the nineteenth-century Southern Taiwan and revive the history of war time, the simulationist premises were chosen to be the primary concern.

Digital game is an approach to build the simulations using 3D models, which combines the characteristics of "virtual" and "reality." Through programming, the games can simulate scenarios with images and sounds that allow players to immerse in the interactive virtual stories, characters, and objects. For this reason, simulated games were often used in military

exercises (Ricci, Salas, & Cannon-Bowers, 1996) and industrial businesses (Prensky, 2003) and resulted in high achievements. In the design of digital games, artistic requirements are often the last concern. Nevertheless, in simulated games, the artistic effects strongly influence players' motivation to continue the game; so the quality of simulation is imperative. As defined by Edwards (2001), "simulationist" refers to scenes, actions, and interactions that follow the internal logic of the game world and should be consistent with players' experiences and expectations. The experiences come from several factors of the making of the game:

(a) Situation: The game clearly defines the rules and tasks of the role-play, and the extended plots brought about as it progresses, which includes problems that might be encountered by the characters.
(b) Character: The game allows players to internalize and identify with the characters or to experience the characters in the process.
(c) Setting: The game has a strong focus on the game world's detailed outlooks and depth of scenarios, which give vitality to the game elements.
(d) System: The game sets up all kinds of internal causal relationships according to the nuances within the game world, which is a set of rules that cannot be changed by the players.

3. Design of the Taiwan Epic Game

In order to create simulations that can enhance players' cultural awareness, this history game is designed in the four aspects suggested above to increase the immersive experience of the players.

The development of the game has been categorized into five stages that correspond to the four simulationist immersion aspects in the GNS theory. The game production procedure is shown in Figure 1.

(a) Game context design. In this stage, game scripts were designed using the history of Southern Taiwan Anti-Japanese War, and role-play game was chosen to be the genre used.
(b) Game map implementation. In this stage, architectural models were built using 3Ds MAX and the simulated environment was established with the game engine.
(c) Game stages' and tasks' setup. The game stages were set up according to the locations of war history, and corresponding learning tasks were defined in each stage.
(d) Game roles' and objects' setup. Game characters, objects, and properties parameters were defined according to the storyline.
(e) Game mechanisms' and algorithms' setup. System operation mechanism and time as well as system functions and interface were set up to enable the activation of the game.

This game used Unity as the game engine for the development. Unity has many pre-installed and player-shared objects for designers to use, such as architectural and agricultural materials, character examples, properties, costumes, and action scripts. Using this game engine, designers can effectively and successfully build the scenarios and characters in Taiwanese styles. At the same time, martial art stories and actions can be easily established so that players can be immersed in the historical stories and the war fighting atmosphere.

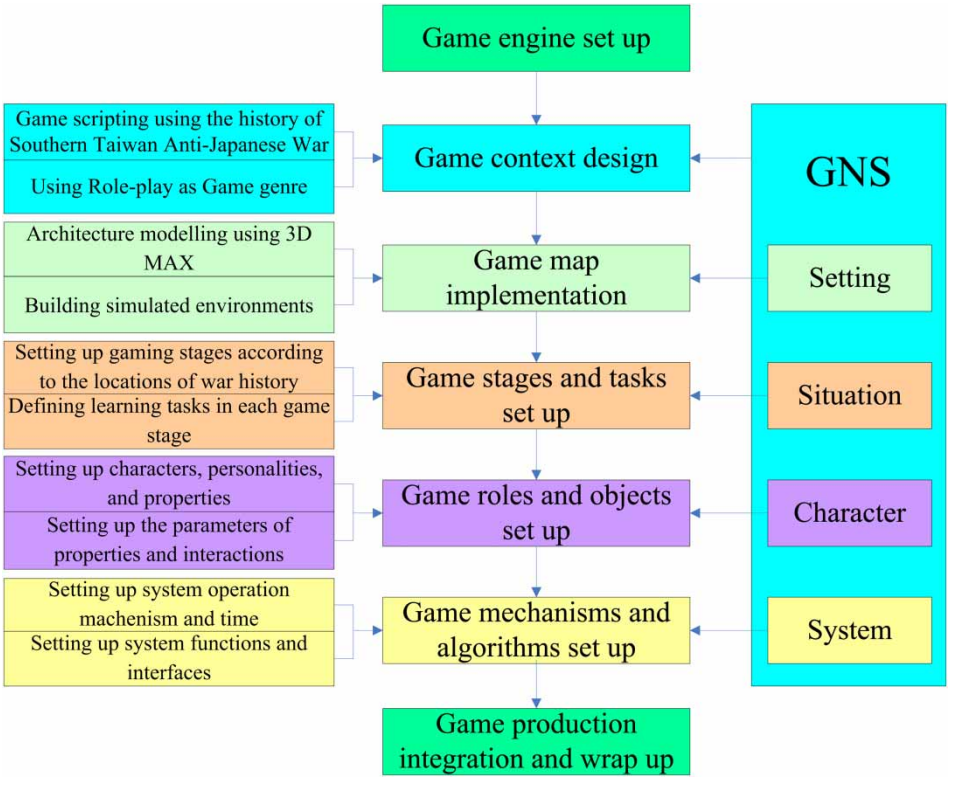

Figure 1. Game production procedure.

The designs of the Taiwan Epic Game in terms of the four simulationist immersion aspects are described below.

3.1. *Situation*

The design concerning the situation aspect of simulation is the most important part of a digital role-play game because it sets up the game background which would affect the architectural styles, character ethnicities, and character appearances.

In the Taiwan Epic Game, seven major locations in today's Pingtung, Kaohsiung, and Tainan areas were identified to compose the game world and were used to define the game stages. The seven locations were Wan Tan, Dong Gang, Wan Luan, Ping Tung, Chao Jhou, Da Wu Shan, and Hou Bi Lin. This game used the Wan Tan portion of the Qian Long Taiwan Map as the location base which was the most compliant with the time period of the story. It most successfully reproduced the game's historical sense of environment.

Corresponding tasks were arranged to form the main storyline to which the characters of the game progress and complete along the route. The content and tasks of the game stages were designed in accordance with the social science learning objectives of Taiwan's primary and secondary education. The main learning content includes the following:

(a) Understand the natural environment and atmosphere of Taiwan, and analyze the impact of the over-use of natural resources on the country.
(b) Understand the hardship of cultivating new land and appreciate Taiwanese culture.

(c) Understand the historic development of Taiwan from the Paleolithic Age, Iron Age, to the Modern Age of the aboriginal tribe life.
(d) Understand the social, cultural, economic, and political development of Taiwan from The Great Voyage Age, Ming Dynasty, to the Qing Dynasty.
(e) Understand the human environment of Taiwan.
(f) Understand the Japanese Colonial time of Taiwan.
(g) Understand the social lives of Taiwan.

As all tasks in the stages were designed according to the social science capability index of schools, the game stages were linked by narrations and animations. Players could follow the plot to progress or jump between stages by using the main map.

All the story contents were reviewed to check their historical accuracies. Stories for the game were written into seven major game tasks according to the historical events. Different tasks were assigned according to the characters' backgrounds and personalities. For example, Xiao-Mao has to help his father to butcher pigs in one scene, and has to follow the command of Master Hou-Shi (Master of Monkey Town) in Dong-Gang (East Harbor) to participate in the famous temple fair with their Songjiang Troupe in the other. Characters would encounter problems when certain interactions were chosen. For example, in the Parade Formation of Songjiang Troupe, someone was in trouble since he violated the taboo. Xiao-Mao tried to make the peace talk but failed due to his bad gestures and verbal expressions and, in turn, caused bigger troubles. In another case, the King Boat was seriously damaged so that the King Boat Ceremony could not continue as expected. Players thus needed to use their respective skills to collect construction materials to rebuild the King Boat according to the boat design. In the process, the players had to search and understand the originality, meaning, procedure, and construction of the King Boat Ceremony.

3.2. *Characters*

The characters of the game were designed keeping in mind the aim of creating the players' sense of acknowledgment of the characters in the game, and inducing the players' involvement in the story. There were two kinds of characters: non-player characters (NPCs) and players. NPCs refers to all the characters in the story. After investigating the historical materials, all NPCs were designed to have their own distinctive images (Figure 2), talking styles, and behavioral patterns. For example, Xiao-Mao had his unique cat-like face, casual appearance, and valiant personality.

In this game, all characters, creatures, and properties had their own parameters. Characters were imbued with certain personalities so that they lived in the simulated environment as in the real world. Players would interact and have dialogues with the NPCs and get feedback from the game system. Personalities of all the characters would trigger different situations when they encounter different characters and objects at different times. Therefore, no identical conditions would occur between different players and different entrances to the game world.

In the story, there were about 20 character types including Taiwanese, Hakka, aboriginal tribes, Japanese people and soldiers, as well as volunteer troops. According to the various ethnicities' characters set up in the game, their specific attributes were defined accordingly. The NPCs in five ethnicities, such as Southern Fukienese, Hakkanese, Taiwanese Aborigines, Japanese, and Western Ministries, all had their own distinct personality features in terms of hairstyles, appearances, statures, skin colors, and clothes (Figure 3). The players

Figure 2. Character designs in 3D models.

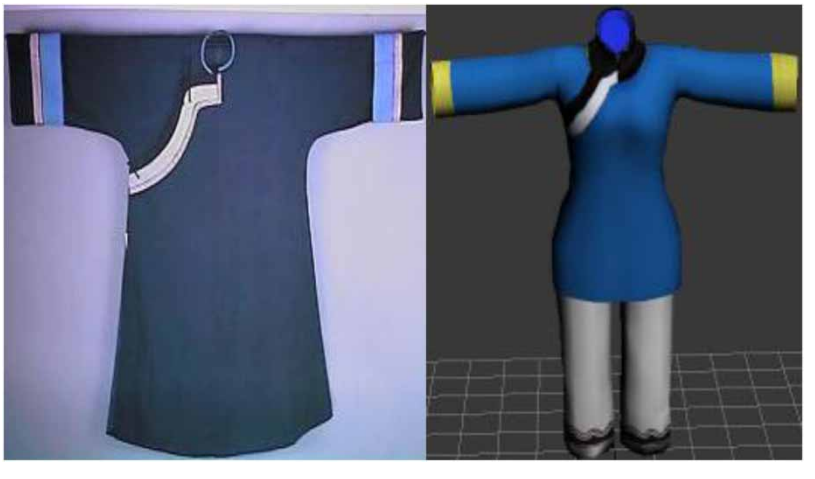

Figure 3. Costume design from real (left) to the 3D model (right).

can thus experience the status of the ethnicity and identify with their different living conditions, historical positions, and different attitudes to ethnicity conflicts in the storyline. The attributes of their health, and attack and defense abilities were also different according to their innate skills. The combination of various innate skills with martial art skills can generate different challenges and fun for the players.

In the game, players focused on enhancing skills through completing tasks such as communicating with pre-defined NPCs, successfully escaping from attacks, or accomplishing many other feats. Among those skills, there were life skills such as forging,

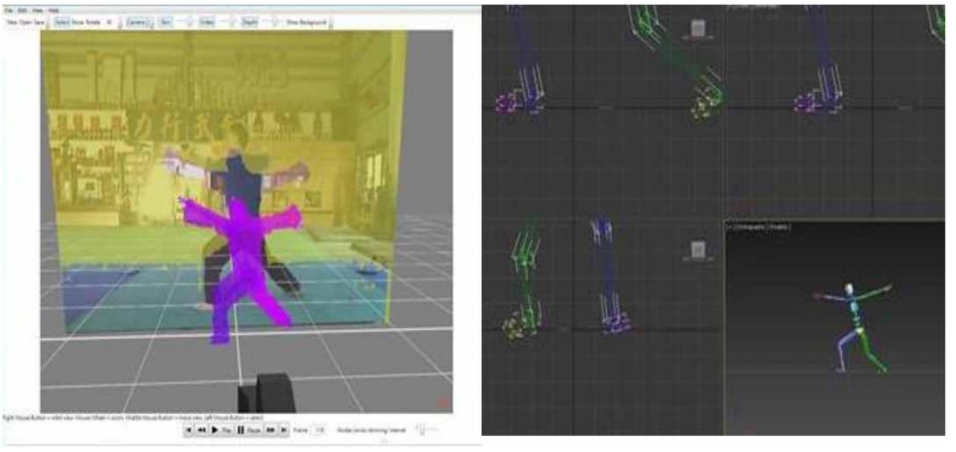

Figure 4. Kinetographic detection of martial arts with the KungFu master.

gathering, and fishing; and martial art skills such as Songjiang Troupe, Hakka Boxing, and Iaido. The promotion of skills was acquired through the points obtained in the gaming process. Player levels would be promoted through the mastery of the skills by multiplying the practice time. Players can choose only the skills they need, and in correspondence with other people's skills, they can form a living circle. Also, martial arts skills mentioned in the 36 Celestial Dippers and the 72 Nether Evils can be honed until the player masters them.

In order to be faithful to reality, the martial arts movements were investigated thoroughly and categorized by names, types, originalities, users, moves, and effects. Then, the technique, footwork, and agility of all martial arts movements were demonstrated by a KungFu master and were recorded using Kinetography. Related movie clips were analyzed to create and maintain the action coherences (Figure 4).

As the action coherences were completed, the martial arts movement database such as run, jump, halt, attack, etc. was established (Figure 5). Aftereffects were also implemented to either repel the enemy, sprint forward to pursue, or backward to evade, to generate the diverse action responses in the game.

3.3. *Setting*

The game world was built based on the nineteenth-century Southern Taiwanese history context. In order to allow the virtual environment of the game to be close to reality, the special architectural features in different areas in the early times were designed including the scenes, object placements, buildings styles, lifestyles, and so forth. All scenes were placed in the most accurate location based on the historical maps as well as Google map (Figure 6). By doing this, the simulationist element of the game in terms of space was constructed to its best so that the players can explore the environment with geographical reality.

In order to allow the virtual environment of the game to be close to reality, 13 places and 24 scenes out of the 7 main story locations were selected from the novel including Wanjin Basilica, Pingtung Tsz Fung Temple, and Akauw market. The terrain environments were featured in accordance with Google Earth. The game world was created simulating the real world in terms of the area ratio, land shape, and heights.

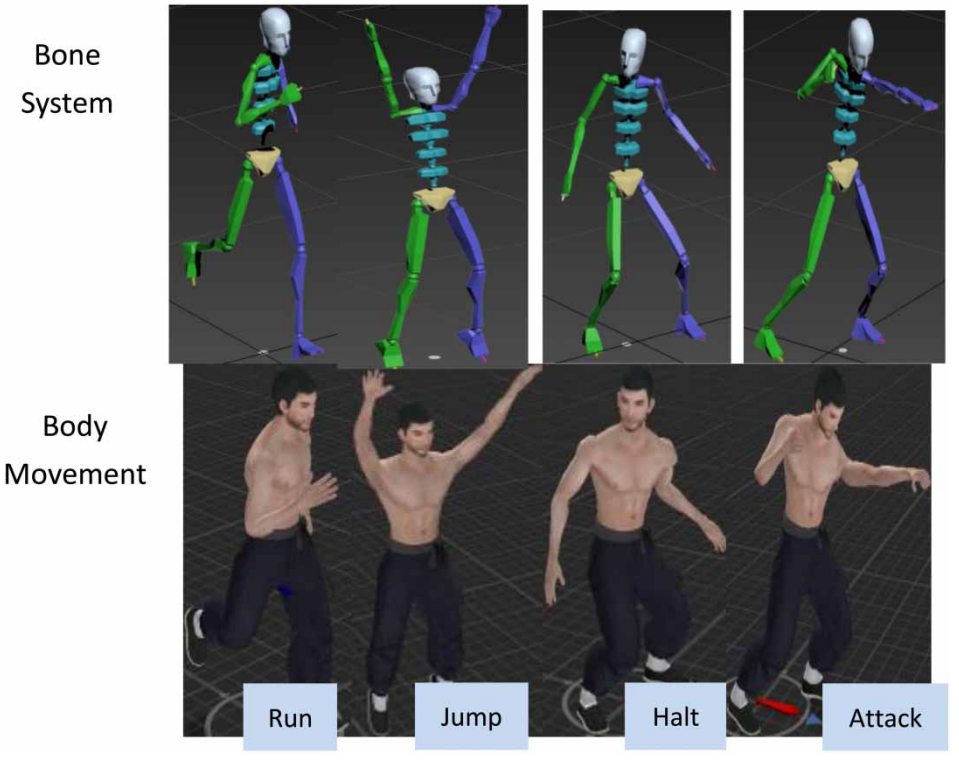

Figure 5. Martial arts movements database examples.

The types of plants were planted according to the areas, land heights, and seasons. The roads and major land spots of the towns were planned and modeled as authentically as possible. Locations and placements of buildings and objects such as houses, shops, schools, and temples, as well as farmlands and vegetation were positioned to fit the historical sceneries.

The virtual game world was built to be alive and interactive as in the real world such that all the objects and buildings had real functions and interactive effects. For example, the residents in the game world had their own lifestyles and could walk freely with dynamic rule settings. The players could do trading in the market and the sense of closeness between the players and businessmen would affect the trade values. Object placements would cause different results; for example, meat that was not able to preserve its freshness would attract mice. Through such realistic and interactive settings, all the objects in the game were "alive" in some sense.

All items of architecture and objects were categorized in terms of their uses and functions. By conducting field trips and collecting historical documents, details of the architecture and objects were captured so that the 3D models can be made close to its reality (Figure 7).

3Ds MAX was used to re-create the game world such that all major buildings were built as real as the true architecture (Figure 8). By doing so, students could experience 3D scenarios and environments in the historical time which cannot be done by simply reading textbooks.

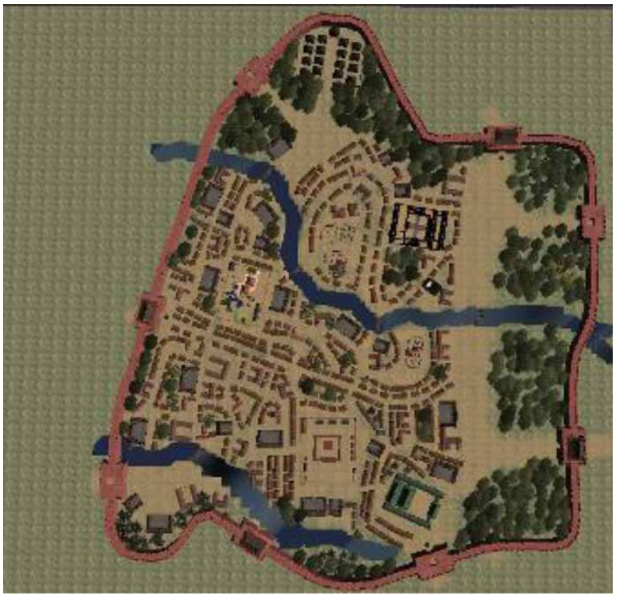

Figure 6. Game world establishment: Tainan city shown in the game.

3.4. *System*

System design includes natural and social settings. In the game world, the environmental change would correspond to certain natural and physical rules. For instance, the sun would rise and set in the right time; there would be shadows when there is sunshine and smoke when there is fire; water would flow from high altitude land to the low. Players could not walk through the walls and could only jump to a certain height. The game world had conditions and regulated changes as in the real world.

On the other hand, the game world has internal causality of social rules and laws. In the game world, the players had to follow certain judgment standards and receive corresponding responses to their actions. For example, when there was a theft or an attack, NPCs' blood level and sense of closeness would decrease; prison time would be imposed according to the seriousness of the crime.

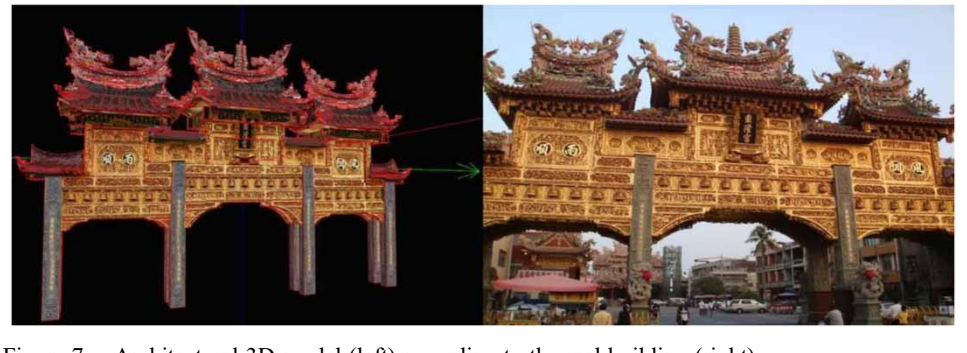

Figure 7. Architectural 3D model (left) according to the real building (right).

Figure 8. Game scenes of Wanjin Basilica (left) and Fort Provintia (right).

This game used JavaScript and C# game scripting language to edit the game system interface and pre-defined value. The algorithm was used to set up standards for the working rules of the game world. It also linked the hypertext conversational narratives in the game which turned on the next script once the task requirement was fulfilled. As the plot flow chart was completed and the debugs were done, the gaming process setup would be ready.

4. Research design

In order to investigate the effectiveness of the simulationist design of the digital game, and the effects on the enhancement of the players' cultural awareness, this research used the GNS theory to design the Taiwan Epic Game to re-present the scenes from one century ago. Since this Taiwan Epic Game is a 3D simulated role-play game, whose system manipulation and content difficulties require higher cognitive conception and better gaming skills, 25 college and graduate students, aged between 21 and 25, were invited to test-play the game. Participants were invited from the College of Science and Engineering; so they were mostly experienced digital game players. There were 20 males and 5 females.

Before playing the game, the players filled out the pre-test questionnaire with three parts in it. The Player Background Survey was used to understand the players' basic skills and experiences of playing digital games. The Evaluation of Cultural Awareness tested the players' perceptions of the cultures and histories in their neighborhoods. The Effectiveness of Simulation includes the four simulationist aspects of the GNS theory, which was used to understand players' expectations from this digital game. The questionnaire was examined by digital learning experts to ensure its quality.

Then, the players started playing the Taiwan Epic Game at their own pace (Figure 9). There was no time limit; the average gaming time was 1.5 hours. The gaming process was documented by the computer recording software, DVD recorders, and researcher observations. All data were triangulated for better credibility and validity.

After playing the game, the players filled out the post-test questionnaire with three parts in it: the Evaluation of Cultural Awareness, Effectiveness of Simulation, and Game Satisfaction. The first two parts were equivalent to the pre-test, and the last part was to understand the players' satisfaction levels with the game.

At the end, semi-structured interviews were conducted to obtain more in-depth views about the players' thoughts about and recommendations for the game. Qualitative analysis was done to supplement the quantitative data of the questionnaire.

Figure 9. The research experiment.

5. Research findings

5.1. *Cultural awareness*

Evaluation of Cultural Awareness had five aspects, including locations and environment, local culture, folk arts, faith and festivals, and architectural characteristics. In order to know whether the players had significantly different cognitive levels regarding the culture after playing the game, paired *t*-tests were conducted for the pre- and post-test questionnaires. The results showed that the post-test score ($m = 79.84$) was significantly higher than the pre-test score ($m = 46.88$) ($t = 13.19$, $p = .000$) (Table 1), which showed that the Taiwan Epic Game can effectively enhance players' cultural awareness.

Investigating the five aspects of cultural awareness, it was found that all aspects except "locations and environment" ($t = 1.66$, $p = .11$) had reached significant differences. From the interviews, players stated that the evaluation content was mostly presented either in the dialogue or pop-out information so that players had difficulties in relating the information to the geographical concept. Other aspects, such as local culture ($t = 7.10$, $p = .000$), folk arts ($t = 12.69$, $p = .000$), faith and festivals ($t = 8.06$, $p = .000$), and architectural characteristics ($t = 5.73$, $p = .000$) (Table 2), had all reached significant differences showing that the 3D simulated learning environment can effectively provide the exploration experiences as Mortara et al. (2014) mentioned about the effectiveness of virtual worlds in disseminating and communicating both tangible and intangible cultural heritages.

Table 1. Pre-test and post-test of the sense of cultural reality ($n = 25$).

Item	Mean	SD	*t*
Overall scores of Pre-test Sense of cultural reality Post-test	46.88 79.84	11.46 8.60	13.19***

***$p < .001$.

Table 2. Results of different aspects of the sense of cultural reality ($n = 25$).

Item	Mean	SD	*t*
Locations and environment			
Pre-test	10.4	4.00	1.66
Post-test	12.32	2.81	
Local culture			
Pre-test	9.92	4.49	7.10***
Post-test	17.6	2.31	
Folk arts			
Pre-test	5.28	3.41	12.69***
Post-test	15.04	3.52	
Faith and festivals			
Pre-test	10.56	4.14	8.06***
Post-test	18.08	3.49	
Architectural characteristics			
Pre-test	10.72	4.43	5.73***
Post-test	16.8	2.58	

***$p < .001$.

5.2. *Effectiveness of simulation*

In order to investigate the gaming elements designed in the simulated game, the Effectiveness of Simulation was surveyed through the questionnaire which encompassed four simulationist aspects defined in the GNS theory. Analyses were done with the corresponding interview findings. The results showed that only the situation aspect had reached the significant difference between the pre- and post-tests. The results are as listed in Table 3.

The situation aspect concerns the players' emphasis on the storyline of the game. The results of the pre-test ($m = 23.28$) and post-test ($m = 24.48$) had reached a significant difference ($t = 2.11$, $p = .045$). They showed that the Taiwan Epic Game designed in this study successfully presented a novel-like dramatic plot that the players would follow along with the conversational narratives to explore the game world and complete the tasks. Players would read the content carefully, understand the development of the story and history, and interact with NPCs. The game narratives were better than their expectations. Meanwhile, some players stated that the game world was huge such that only one major

Table 3. Results of the effectiveness of simulation ($n = 25$).

Item	Mean	SD	*t*
Situation			
Pre-test	23.28	3.51	2.11*
Post-test	24.48	3.38	
Character			
Pre-test	23.84	2.70308	−0.69
Post-test	23.44	3.31763	
Setting			
Pre-test	22.92	3.63	0.70
Post-test	23.48	3.22	
System			
Pre-test	22.52	3.47	0.47
Post-test	22.84	3.52	

*$p < .05$.

plot was not enough to guide them to walk through the whole game world. Therefore, more sub-plots and occasional incidences were designed to intrigue them into more exploration.

The character aspect concerns players' emphasis on the character design of the game. The results of the pre-test ($m = 23.84$) and post-test ($m = 23.44$) had not reached a significant difference ($t = -0.69$, $p = .499$), and also had negative results. From the interviews it was found that although most players thought that the characters in the game were designed to meet the historical background, some players felt distant from the characters since the main figures in the story were not introduced before. Without knowing much about the novel itself, it was somewhat difficult for the player to identify the characters' images and identify with their personalities.

The setting aspect concerns players' emphasis on the simulation level of the game environment as if in the real world. The results of the pre-test ($m = 22.92$) and post-test ($m = 23.48$) had not reached a significant difference ($t = 0.70$, $p = .49$). From the investigation it was found that the players dealt with a new environment in two kinds of behavioral styles. The first kind of players aimed to complete the tasks. They searched for system hints for task assignments, followed the directions, and reached the goals. Thus, they explored less of the game world where the tasks were not reached. The second kind of players aimed to explore the game world. They wandered around to check their location positions and saw the differences between scenes. They only triggered the events when they encountered the NPCs. Nevertheless, no matter which kind of behavior style the players adopted, they thought that the game could fully re-present the environmental context of the old time. The design of the game world was as good as their expectations.

The system aspect concerns players' emphasis on the environmental variance and social regulatory rules. The results of the pre-test ($m = 22.52$) and post-test ($m = 22.84$) had not reached a significant difference ($t = 0.47$, $p = .65$). From the investigation it was found that following the main storyline alone could not intrigue the players to explore the environment. The players preferred to roam around, touch and trigger events, and discover the internal rules of the game world to fulfill their curiosity and sense of achievements. Even so, most players showed positive feelings to the system guidance, content, and hints for exploring the world.

5.3. *Game satisfaction*

This section presented the questionnaire results of players' satisfaction with the digital game, and the effects of the game elements that gave the players internal motivations. The averages of all items were above 4.4 on a 6-point Likert scale (Table 4), which showed that the players were satisfied with the game. The results also showed that the players were so immersed that they would forget about time. Similarly, the players discovered stories about their own living environments and had more motivation to relate more of the history with their own lives.

6. Conclusion

This research presented the creation of a Taiwan Epic Game which was a simulated learning environment that actualized nineteenth-century Southern Taiwan for its culture and history at the time. The design of the game was based on the GNS theory which was to implement the premises and elements of simulation in the role-play game in order to allow the players to be immersed and to sense the culture and history. It was a form of cultural creation and added new vitality to the mechanism of cultural transmission. Through the support of digital

Table 4. Results of game satisfaction.

Item	Mean
Q21. The game control method was natural and easy to comprehend	4.72
Q22. I had a lot of fun when playing the game	4.44
Q23. I felt relaxed and happy when playing the game	4.44
Q24. I was focused and immersed when playing the game so that I forgot about time	4.80
Q25. The game motivated me to learn more about culture and history	4.76
Q26. Overall, I felt satisfied with the game	4.72
Q27. I would recommend my friends to play this game	4.76

technology, this digital game transformed the textual narratives into multimedia and offered opportunities for the players to experience the "real" world in "virtual" form.

After the game experiment, the research results showed that the game could effectively enhance players' cultural awareness. The players had better cognitive growth and sense of existence with respect to the locations and environments, local cultures, folk arts, faith and festivals, as well as architectural characteristics. Meanwhile, the questionnaire about the Effectiveness of Simulation in terms of the situations, characters, settings, and system aspects revealed that the results were close to players' expectations even though only the result of the situation aspect reached a significant difference.

In terms of the design of the situation aspect, players appreciated the narratives and dialogues that presented the historical content of the game. The only lack was that the epic game encompassed such a wide range of geographical areas that one main storyline was deficient for the players to explore the whole game world. In terms of the character design, players agreed that the role of character images affected their identification of the characters and the immersion speed to the game. However, since the epic game had long narratives that covered wide time spans, the personality growth and story development of the characters seemed to be weak. Also, the orientation of the roles and tasks of the characters was insufficient; so the players' entry into the story was slow. On the other hand, the players thought that the design of the game setting closely re-presented Southern Taiwan in the nineteenth century, but the interaction with the objects in the world could have been more varied. The system designwas well simulated in terms of the natural and social conditions. Therefore, the overall satisfaction level was high, with the expectation that the game can effectively attract players and motivate them to learn about cultures and histories.

Because digital games can involve players in its amusement, it can induce learning motivation and enhance active participations by its nature. Games satisfy the basic requirements of learning environments and can provide an engaging environment for learning (Kiili, 2005). It is expected that digital learning games can increase learning effectiveness since the game content is not imaginary. The use of stories in games is a fundamental part of the game design, and computer games may create a new learning culture that corresponds better with students' habits and interests (Prensky, 2001). The Taiwan Epic Game created in this research presented a simulated world of the real histories and geographies of Taiwan. The entertaining effects, challenges, interactions, and feedback of the game successfully enhanced the players' learning motivation and sense of immersion in history and geography.

It can be concluded that the 3D simulated learning environment created in the digital game could successfully merge "reality" and "virtuality." This paper offers a theoretical foundation to the design of the game and elucidates the game production process model.

In the Taiwan Epic Game, youngsters could experience the local culture of the past and immerse in the game world that conveys educational meanings.

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