

# Constructing an Evaluation Framework for Cultural-Inquiry Pervasive Game

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**Abstract:** As colonized by various maritime powers as early as 17<sup>th</sup> century, Tainan is famous for its historic relics in Taiwan. This paper took these historic vestiges of Tainan as the interactive spots to perform a cultural-inquiry pervasive game (PG). PG is a mobile game, in which virtual and physical scenarios were seamless mixed together. Group competitions and the location-identification functions of social websites will be applied to enhance students' interests and joyfulness, and learn more about the historic relics through playing the game. The aim of this paper is to design an evaluation framework for cultural-inquiry pervasive game following three fundamental criteria that were synthesized from various PG literatures: technology convenience, cultural richness, and game fluency. According to these three criteria, a questionnaire was designed to justify the elements as well as to examine the user satisfactions and its relations to students' gaming experiences and computer literacy.

**Keywords:** pervasive game, cultural inquiry, mobile game, collaborative learning

## 1. Introduction

The historic relics are the evidence for the cultural development and progress. Tainan, located in the south-west region of Taiwan, has always been a proof of Taiwan history. It went through the governance of Holland and ruling of the Cheng. Thus, it became "the town of historic relics". What's more, Tainan turned to be an important location for exploring Taiwan's historical culture. Corey thought that the exploration of urban culture would need to combine the stark knowledge with practical experiences [3]. In Tainan city, it has the highest density of historic relics which would be appropriate to apply PG strategies to allow students to experience both virtual and physical scenarios.

This paper took the relics from Tainan as the partial context. The smart phones would be the interface to the virtual world. Discussions will be made on how it would influence the students' motivations and learning outcome in the game by adding gaming elements such as group competitions, and employing most frequently used social community website - Facebook as the communication channel. A questionnaire was designed to investigate the user satisfactions according to the criteria of technology convenience, cultural richness, and game fluency aspects. The outcome would be generated to build an evaluation framework for the design and development of cultural-inquiry pervasive game.

## 2. Literature Review

The following section is a review of recent literature on mobile-game-based learning, PG design issues, collaborative and cooperative learning in PGs, and inquiry into local

history and culture. The goal is to generate the criteria for the evaluation framework for the cultural-inquiry pervasive game.

### *2.1 Mobile-game-based Learning*

The advancement of mobile technology has brought about not only the booming of m-business but also the imaginary space of mobile games. Okazaki, Skapa, and Grande recognized that mobile games have quickly opened up new dimensions for entertainment applications and have rapidly become an attractive alternative to PC-based games [14]. The mobile device is subject to no constraints in time and space. One can play games whenever and wherever they wish. Recent research indicated that the mobile game has positive user effects, especially in the educational applications. For example, Schwabe and Goth combined mobile learning and mobile game [16]. In their study, students were divided into groups to play the game. They obtained information from the website regarding the mission and geographical coordinates of the locations. They then used GPS to complete a task and uploaded the result back to the workstation before they could get the location information of the next mission. The winner was who completed the task first. Huizenga, Admiraal, Akkerman, and Dam also claimed that mobile and location-based technologies provided opportunities to embed learning in authentic environments and thereby enhanced engagement and learning outside of traditional formal educational settings [8]. They conducted a quasi-experiment, the students from 10 of the classes played the mobile history game whereas the students from the other 10 classes received a regular, project-based lesson series. The results showed those pupils who played the game to be engaged and to gain significantly more knowledge about medieval Amsterdam than those pupils who received regular project based instruction.

### *2.2 Pervasive Game and Its Design Issues*

#### *2.2.1 Pervasive Game*

PG is a mobile game in which virtual and physical scenarios were seamless mixed together. According to Walther, pervasive gaming (PG) implies a mixed-reality gaming space, that is, the gameplay connects the virtual scenarios with the tangible world [18]. He further indicated that the mobile mechanisms, including software, hardware, and information, should be in place throughout the gameplay to facilitate and ensure there are fluent communication channels between the virtual and physical worlds.. The most citable literature of PG so far may go to Montola's article. He argued that PG is a game "expand the magic circle of play socially, spatially or temporally"(p. 4) [12]. He further explained that magic circle of play is a social and cultural contract that separates ordinary life from play [12]. PG, however, unlike traditional video and computer games, they are not solely played in the magic circle, they tend to involve outsiders.

#### *2.2.2 Pervasive Game Design*

There are various papers discussed the design issues of PGs. From the aspect of technology applications, Walther constructed a model and identified the "four axes of PG" [18]. The four axes are restated as follow: 1) Distribution: refers to the network which can widely distribute the gaming information; 2) Mobility: refers to computing mobility; 3) Persistence: refers to total availability all the time; and 4) Transmediality: refers to a media circle that multi-link the world of virtual social networks. Nevertheless, Gentes, Guyot-Mbodji, and Demeure discussed PG from a totally different angle. They asserted that an instructional PG

should focus more on local urban culture recognition [6]. They further suggested that for a urban-cultural PG, three key features should be included: 1) Collaborative contents: the contents should be designed by people actually living on the premises; 2) Team exploration: the gameplay strategies can be more "group oriented"; 3) Cultural narrative: there is always a first narrative that sufficiently describes the culture of the city therefore game players are able to have a clear idea of the fashionable places, the living or working areas, and the cultural spots.

Despite there are important PG issues regarding the technical and culture aspects, subsequent discussions should focus more on the PG design per se. Sweetser and Wyeth originated a Game Flow Model, initiating that concentration, challenge, player skills, control, clear goals, feedback, immersion, and social interaction are key factors that may affect the effectiveness of a computer game [17]. Based on Sweetser and Wyeth's work [17], Jegers constructed a "Pervasive Game Flow Model, which specifically describes 10 additional key factors for a PG [9]. Jegers claimed that a PG should 1) support the players in the process of switching concentration between in-game tasks and surrounding factors of importance; 2) stimulate and support the players in their own creation of game scenarios and pacing; 3) help the players in keeping a balance in the creation of paths and developments in the game world; 4) be very flexible and enable the players' skills to be developed at a pace set by the players; 5) enable the players to pick up gameplay easily; 6) support the players in forming and communicating their own intermediate goals; 7) not imply or require players actions that might result in a violation of social norms; 8) enable the players to shift focus between the virtual and the physical parts of the game world; 9) enable meaningful and purposeful social interaction within the gaming system; and 10) motivate the players to communicate and interact socially.

The above literature helps us construct a theoretical framework for designing the Tainan local culture and history inquiry PG in this study. The framework defines that a cultural-inquiry PG should accommodate technology convenience, cultural richness, and game fluency. A set of criteria were also set to verify the game flow, the game roles and contexts, and game collaboration.

### *2.3 Collaborative and Cooperative Learning in Pervasive Games*

In pervious section, it is discussed that key features of PG should include collaborative contents and team exploration [6], this means that collaborative or cooperative learning should be included in an instructional PG. According to Pragnell, Roselli and Rossano, cooperative learning is achieved by dividing learners into small groups to accomplish the best results by means of mutual assistance among the group members [15]. This fosters both a team spirit and a more questioning approach to learning.

There are many collaborative and cooperative learning studies, only a few discussed in the game context. Dyson, Griffin, and Hastie indicated that students can compete more effectively working as a team against another team in a game unit [4]; Huang, Shih, and Lai conducted a cooperative game to fire up the learning effectiveness of an engineering class, the result was that students in cooperative learning class significantly outperformed students in other classes. Students' feedback also showed that cooperative learning effectively lifted learning motivations [7]. The results of these collaborative or cooperative game studies seemed to be coherent with Gentes, Guyot-Mbodji, and Demeure [6] and Edwards [5] claimed. That is, team cooperation, collaboration, and competition are essential for a gameplay.

### *2.4 Inquiry into Local History and Culture*

According to Collingwood, history is a kind of science that involves inquiry into the past. Providing students with opportunities to think and act like historians is a rewarding pathway to the past [2]. Corey argued that both urban and environmental histories in particular lend themselves to hands-on approaches that link the classroom with tangible examples of historical events and trends through pedagogy of place [3]. However, Axtell contended that the biggest mistake history teachers can make is to not engage the curiosity and imagination of students with experiences that initially drew us into history [1]. This mistake may have severely hampered our history education for a long period of time.

Fortunately, since the early 1990s, active or inquiry-based education has received a great deal of attention. This active learning method opens a new way for social science learning. National Council for the Social Studies believed that students should "systematically employ processes of critical historical inquiry to reconstruct and reinterpret the past, such as using a variety of sources and checking their credibility, validating and weighing evidence for claims, and searching for causality"(p. 40) [13]. However, Molebash found that unguided online historical inquiry does not guarantee meaningful learning. Appropriate guidance is necessary for a historical inquiry [11]. Manlove, Lazonder, and de Jong asserted that supporting tool incorporated goal-lists, hints, prompts, cues, and templates reinforce the cognitive regulation skills of students during a fluid dynamics task [10]. According to their assertions, it can be reasonably assumed that the innovative PG design could be an appropriate "supporting tool" for benefitting players' information acquisition.

### **3. Methods**

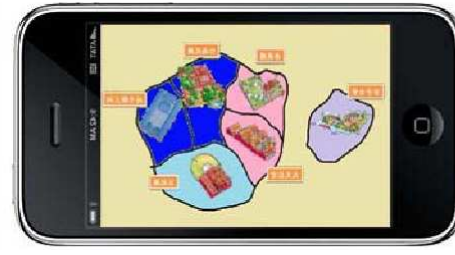
The main goal of this study is to construct a cultural-inquiry PG framework to allow students learn history and culture contents in a joyful atmosphere, with which framework to understand how students would satisfy with our PG in terms of learning effectiveness and playfulness of the game. A three-step PG scheme is designed to accomplish the main goal. Secondary school students will be potential subjects for the study. Students will be randomly assigned to exploring teams. In physical world, each team needs to either follow the main maneuver of the game to occupy redoubts (historical sites) and defense attacks by other groups, or to select a branching mission such as finding all ancient gates of Tainan instead. In the virtual space, Facebook, the most commonly used social network, will be the platform to achieve instant communications among groups. Popular Facebook functions such as check-in, uploading photos, and distributing messages will all be applied. This will allow exploring teams to share their progresses and conquests instantly.

### **4. Cultural-Inquiry Pervasive Game Instructional Design**

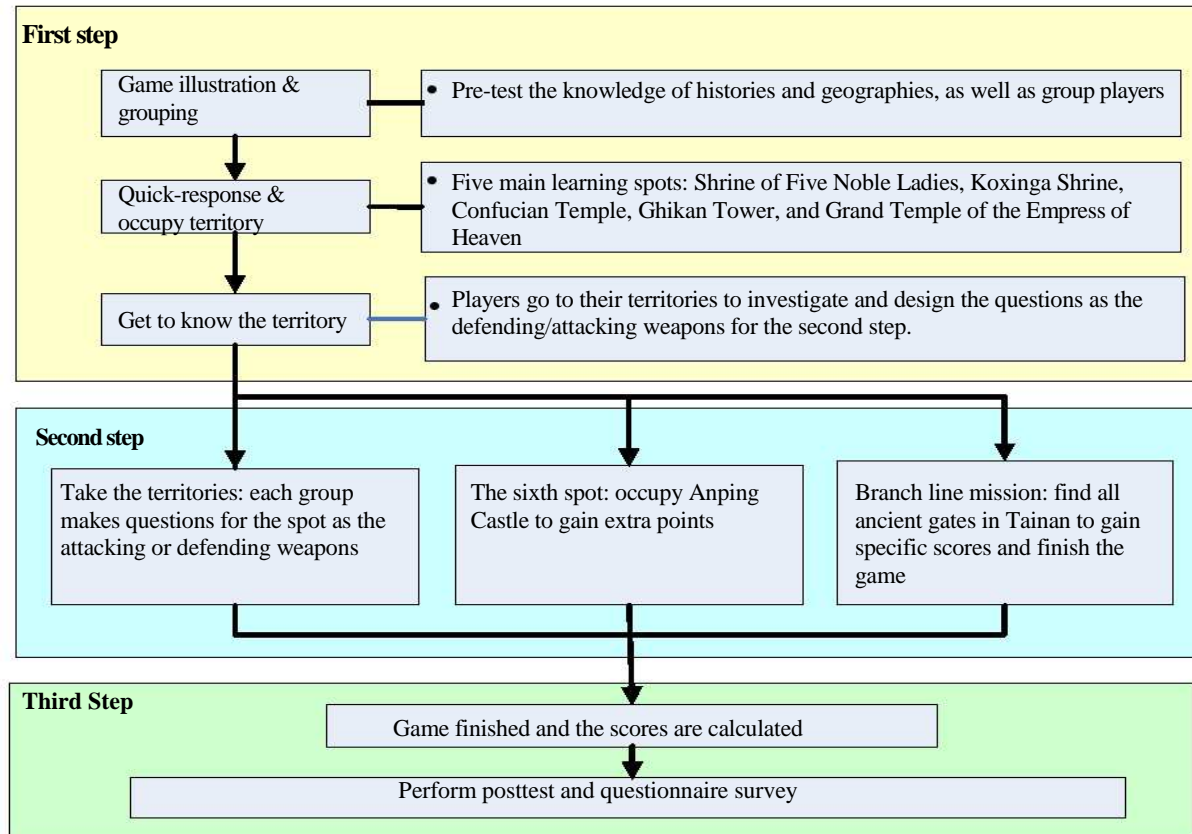
The process of the gameplay includes three steps. The game locations are set in Tainan City of Taiwan. In the physical world, the students, gaming groups, and the historic monuments would have sufficient interactions. In the virtual world, 3G mobile devices with Facebook would be used as the communicational media. Checking-in locations, uploading photos, and distributing messages are required to link the virtual and physical world (Figure 1). A map of historical spots on a mobile device (Figure 2) will be provided to the students. The gaming process are defined as three major steps.



**Figure 1. Gameplay in the physical world with mobile devices**



**Figure 2. A mobile map of historical spots**



**Figure 3. The Gaming Process**

## 5. Cultural-Inquiry Pervasive Game Evaluation Framework

In order to effectively evaluate students' gaming conditions and the effectiveness of the innovative instructional strategies using cultural-inquiry pervasive game, the following operational variables were defined.

### 1. Technology Convenience:

- a) Distribution: the game should be able to disseminate information from mobile devices effectively;
- b) Mobility: sufficient mobility should be given to all students and mobile devices;
- c) Persistence: both hardware and software should be able to work smoothly and consistently.

### 2. Cultural richness:

- a) Collaborative cultural contents: students should be able to create intermediate game contents by employing abundant local culture elements;
- b) Guidance: the game should be able to guide the students contact genuine cultural

information;

c) Team exploration: Students should divide into "inquiring groups".

### 3. Game Fluency:

a) Concentration on surrounding context: the game should be designed that students will concentrate on surrounding contexts;

b) Own creation of game scenarios and pacing: students should be able to allowed to control part of the game pace and flow;

c) Clear goal: the game should allow students to define intermediate goals;

d) Smooth virtual/physical transition: students should be able to transit in between virtual and physical worlds;

e) Competition: competitive pressure should be given to the students.

**Table 1. The checklist for the game content**

Technology Convenience	Distribution	Use Facebook as the connecting media
	Mobility	Use 3G mobile device to receive messages
	Persistence	3G mobile communication in Tainan is well-covered.
Cultural Richness	Collaborative cultural contents	Each group has to make their own quick-response questions. As soon as the game finished, the results is uploaded onto the Facebook.
	Guidance	Suggestions are made for guiding the students searching information via the Internet.
	Team exploration	Students are randomly assigned to groups for team exploration.
Game Fluency	Concentration on surrounding context	Students need to be aware of the information regarding position of the spots, branching routes, attacking routes, and the related historic and cultural backgrounds.
	Own creation of game scenarios and pacing	1. Each group needs to make its own quick-response questions. 2. The attacking tempo of each group may vary depending on different game routes.
	Clear goal	Each group decides its own attacking strategies(attacking the main spots/earn extra scores/developing alternative branches) and goals (the order of the attacking sequences)
	Smooth virtual/physical transition and competitions	1. Students need to check-in at Facebook to challenge or track up other groups, and to announce the accomplishment of each query mission. 2. Students undergo the attacking and defending tasks in the gameplay and learn historic culture of each spot.
	Competition	Each group is able to obtain other groups' progresses via mobile communications

According to the evaluation framework, a detailed checklist for the game content is prescribed for evaluation purpose. A questionnaire will be performed to collect data. The questionnaire has three sets of questions to be consistent with the operational variables defined corresponding to the evaluation framework: technology convenience, cultural richness, and game fluency.

## 6. Expecting Results

The proposed study will use the questionnaire to collect the data of students' satisfactions toward the game. The questionnaire includes three parts, individual information (gender, age, experience of playing online games, and the use of social websites), multiple choices, and open-ended questions. The quantitative data will be analyzed with descriptive statistics. It includes mean, standard deviation, and overall mean of each aspect. Also, in order to do the further analysis about how the individual variables could influence the gaming satisfaction. The qualitative data of the opening questions would be used as the auxiliary to

explain the quantitative data. This research is aimed to design a cultural-inquiry PG to make game students to know more about the relics of Tainan, Taiwan. In the physical world, students would accomplish the learning tasks inadvertently. Students would try to learn related historic culture as much as possible to design quick-response questions in order to occupy or defend for their territories. In the virtual world, Facebook will be adopted to record the whole process of each student. When the game finished, all records will become the gaming products of each student. These records could also be shared with friends and families later. This could help disseminate the knowledge of particular local cultures even after the gameplay.

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