The Effects of Gamified Exhibition in a Physical and Online Digital Interactive Exhibition Promoting Digital Heritage and Tourism

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Abstract – **The concept of gamification is to apply game-design elements and game principles in non-game contexts. Applying this concept in interactive exhibitions has enormous potential to attract visitors and improve their fun level, engagement, and learning. The purpose of this paper is to study the effect of the case study in which we applied gamification in two types of physical and online digital interactive exhibitions, both in the form of short events. The case study was conducted using gamified exhibition for both physical and online digital environments. We implemented the Game-trip which consisted of two parts: a physical exhibition of an interactive map and a digital online application. We also carried out a user study at the Chiang Mai International Exhibition and Convention Centre. We evaluated the user study by collecting qualitative and quantitative visitor behavior data from online survey questionnaires, and we also used user behavior data and semi-structured interview. The results suggest that the physical interactive exhibition provides engagement and fun but does not support learning goals.**

The interview data suggested that we provide more devices for the participants in the physical environment in order to avoid long waiting time. For the online digital interactive application, it also helped visitors to get familiar with the other exhibition in the event. Finally, the gamified exhibition can be used as a design to improve the overall visitor experience in exhibitions.

Keywords – Gamification, Physical exhibition, online digital exhibition, User behavior, Interactive exhibition.

1. Introduction

In the present, the advancement of technology has been brought about to assist humans in several ways, making life more convenient and easier. In other words, the development of technology significantly supports and helps humans effectively manage or analyze their digital information. To make learning and studying more enjoyable, gamification, one of the advanced technologies, has been widely applied in many fields of study, such as education, business, healthcare, etc. Interestingly, gamification can be beneficial in keeping people or users focused and engaged in a certain area of study because of the unique feature of gamification, which is a reward granted to the user who can finish and complete the game's missions. Such a reward feature can motivate and influence the user to participate in the game and pay attention to the knowledge or content offered. Nonetheless, it is rare to find gamification applied in the tourism industry and cultural institutions. Cultural institutions, including museums, are the places where a lot of priceless and ancient artifacts are collected, providing knowledge of history. Therefore, using such advanced technology can support museums in providing individualized services and therefore complete their objective by creating a high-quality museum of teaching, research,

and admiration of history for a wide audience [1], [2]. Equally important, researchers are becoming increasingly interested in gamification because video games are gaining market popularity, evolving from being only entertaining to becoming a source of knowledge and instruction [3]. Also, learning through engagement or playing by using serious games (SGs) is a common technique in academic contexts [4], [5], [6]. The incorporation of narrative in gameplay and its use in the cultural sector, in particular, is the most creative kind of cultural exhibition techniques to enhance the traditional methods [7].

In this research, we investigate the effect of using gamification in public exhibitions. Our objective is to study the user experience through the application of the gamification concept to two types of exhibitions, namely a physical interactive and an online digital exhibition. We study user experience in terms of engagement, learning and application usage. Thus, we developed a physical, interactive map-based exhibition, where visitors who visited the exhibition could play an interactive game and obtain small real gifts and we also developed a digital online application of quiz questions, in which visitors must find the answer of the questions by discovering the exhibition. In this application, visitors can collect points so that they compete with each other by the use of a leaderboard. Both applications were played by visitors at the Chiang Mai International Exhibition and Convention Centre.

The data were collected in the event of "Trip Northern" with 867 participants and 15 face to face interviews. Then, we gathered both qualitative and quantitative visitor behavior data from an online survey questionnaire, and a semi-structured interview. All three sets of data were used to study the user behavior of both the physical interactive and the online digital exhibition in terms of engagement, learning and application. We have organized our paper into eight sections. Section 2 describes the literature review of gamification in the context of digital heritage and exhibition. Section 3 and 4 describe the purpose of study and gamification design. Section 5 provides the user study procedure and the tool for data collection. Section 6, 7 and 8 show the results, discussion and conclusion.

2. Literature Review

2.1. Gamification for Digital Heritage and Tourism

Museums employ a broad range of exhibition and learning approaches depending on the past experience tourists can receive through the use of technology [41]. Gamification, for example, can be a useful technique in providing knowledge and engaging tourists at the same time. Gamification is described as "the use of game-based mechanics, visuals, and game thinking to attract individuals, stimulate behavior, enhance learning, as well as address issues" [8]. It incorporates game features (e.g., rewards or tokens) into non-game applications [9], which include formal learning settings, namely schools [10], or it utilizes games to give a player interactive experiences set in diverse historical circumstances or times. Its efficacy is recognized as a learning tool in a variety of sectors, including education, security, wellness, experimentation, traditional culture, and tourism [11], [12], [13], [5]. In addition, when using both navigation and exploration together with gaming aspects, the ultimate result is intriguing in terms of user experience and involvement [48]. According to Sigouros et al. [42], ICT tools are essential in promoting historical literacy to reduce the time required to obtain information sources, offer precise and simple feedback to the user, and enable teachers to offer external learning incentives, which develops emotions of happiness for students. In accordance with the current idea of edutainment, nowadays cultural institutions have already progressed further to include the joyful aspect, referred to as gamification, in their pursuit of unlike and more interesting styles of storytelling and languages [28], [29], [30], [31]. Additionally, the rise in the use of gameplay in the cultural sector is also explained by the economic and tourism benefits [14]. In this respect, game tourism, defined as a growth in visitor arrivals to video game sites [15], [16], is a concrete proof of efficacy of video games in drawing travelers and enhancing their experience at an actual location [17], [18], [19]. Nevertheless, whereas the gaming market has vast monetary capacity and international purchasing power, the cultural field has limited funds and a limited impact on game tourism. As a consequence of applying digital application and technology, gamification and serious games have altered how people appreciate museums as well as other cultural material either on-site or off-site by delivering entertaining, engaging, and unforgettable moments that overcome time and space limitations [32]. Besides, many studies have shown that digital gaming technologies are frequently more successful than traditional educational approaches in promoting education and retention [20], [21], [6]. Sylaiou et al. [25], in particular, have proven how technology may improve learning in online virtual museums. With the intention of providing immersive and interesting experiences [22], [23], [24], [26], [27] serious games can offer such experiences by being displayed in a range of formats, including console games, applications, or web-based solutions. Besides, they can be on different platforms, varying from basic and advanced versions that use virtual reality and

simulation frameworks, which can be used in applications for cultural heritage [33], [34]. In addition, it has been discovered that, by using a location-based method, mobile digital devices enable games to be integrated into museum experiences, involving objectives and rewards in the game plot, in order to improve traveler motivation and learning [35], [9].

2.2. Gamification and Exhibition

In the case of video games, they have become an efficient way of interpreting original history through game-immanent storylines and visuals, as well as through gaming and gaming-related activities [43]. To support Old Pecucetia's local heritage in Apulia among students by the methods of gamification, "Discovering The Territory of Old Peucetia" was developed to offer network activity and workshops for education set up in towns of Old Pecucetia's historical buildings, allowing them to learn and study the historical events and the surroundings of the site [44]. After a couple of years, museums began to take a more active part in serious game development, becoming not just game industry consultants, but also serious game co-designers. Video games were produced and released using game-based learning design from the start, with the objective of providing learning-by-play methods for wider audiences [4], [5]. Additionally, an interactive kiosk can enable travelers to play whilst touring the museum as well, making this the first instance of a video gaming area in a non-technical or scientific museum. The visitors were allowed to engage with computerized reproductions of actual archaeological artefacts from Mesopotamia's history (therefore learning by playing via contextualized historical knowledge) [34]. Following that, the British Museum introduced Time Explorer, an online game for kids arranged as a time adventure to protect valuable items from the museum's Roman, Aztec, and imperial Chinese collections; as the player progressed through the levels, he or she was encouraged to connect the items to the relevant period in history [37]. Based on Sánchez Mateos [36], 2010 was a turning year for gamification: on an infrastructure level, mobile phone technology enabled several apps and the shifting of numerous activities, particularly games, to the mobile. They were formerly the unique realm of PCs equipped with Macromedia's Flash technology, or gaming consoles, namely the PlayStation, or several Nintendo devices ranging from the GameBoy to the Xbox and the Wii. The gaming industry normally produces advancements that have been adopted by other niche markets: for example, a few gaming gadgets, namely the Xbox and Wii, are, actually, predecessors to gesture-based interaction technology used in the sector of cultural heritage, namely the Italian project Etruscanning [34]. The Nintendo Art Academy video game, which allowed digital reproductions of artworks during 2010 and 2011, expanded across European and American museums, although it was solely meant as a learning tool, not a commercial tool. In 2015, Samsung employed augmented reality to create A Gift for Athena, a didactic game for the British Museum. During the renowned Panathenae celebrations, kids become worshippers of the goddess Athena in a form of digital treasure hunt [37]. Nevertheless, the examples given are of serious games that are viewed only as educational tools by cultural institutions. Subsequently, cultural institutions, particularly museums, were engaged in its design, with the goal of not only teaching but also generating a return in terms of tourists. This shift took place in 2015, when Educa Thyssen, the academic department of the Thyssen Museum in Madrid, teamed up with Nintendo to produce the first episode of the Nubla Art Game. The Museum certainly counted on a great advertising strategy, according to the Nintendo brand exposure, using interactive storytelling between avatars and paintings, in which gamers were imprisoned [36]. One of the serious games created by cultural organizations is Prisme7, a game for adolescents and people enthusiastic about contemporary art, created by Bright for the Centre Pompidou in Paris with support from the French Ministry of Education. Users are capable of learning about and interacting with 40 masterpieces from the permanent collection. Similarly to Nubla, the Gallery's goal is to increase digital awareness first, and subsequently actual tourists, by developing the game to be available in 149 countries in English and French [37].

3. Purpose of the Study

The aim of our study is to investigate the effects of implement the gamification concept to exhibition events. Thus, we designed Gamified Exhibition for Digital Heritage and Tourism to visitors participating in and visiting the exhibitions. The purposes of the study are the following:

1. To investigate the effects of the implementation of gamification into the physical interactive exhibition in terms of engagement, learning and application.
2. To investigate the effects of the implementation of gamification into the online digital exhibition in terms of engagement, learning and application.

To verify the effects, we have developed the Game-Trip exhibition application which consists of two parts: an interactive map-based physical exhibition and a digital online application quiz to be played at the Chiang Mai International Exhibition and Convention Centre during the event of Trip Northern.

Trip Northern is a project to promote the expansion of both domestic and international tourism markets for upper northern provinces (Chiang Mai, Lampang, Lamphun and Mae Hong Son), which is an important group of provinces with a potential in tourism. There are important natural attractions in the country. It has a unique local culture including language tradition, arts, and history, looking back for a long time, including the availability of accommodation sources, public utilities and air transport systems. Thus, there are more than thirty exhibitions organized by entrepreneurs and agencies participating in the event.

4. Gamification Design, Materials and Methods

4.1. Purpose of the Game-Trip exhibition

We developed a Game-Trip exhibition which consisted of two applications. There are two applications for each objective, namely an Interactive map-based physical exhibition and a Quiz. The Interactive map-based physical exhibition is based on a personal computer custom kiosk connected with a multi-interactive touch screen. The application allows visitors of the exhibitions linked to Trip Northern to engage with an interactive map that provides information while they are visiting the main exhibition. The objective of this application is to provide visitors with information on the Heritage and Tourism locations of Northern provinces. The game provides important knowledge on intangible culture (food, language and dance) and tangible culture (architecture of temples, monuments and landscapes) in Upper-Northern Provinces. Visitors can touch the icon in the interactive map to show the information and they can also touch the map between two places of interest for generating the route be-tween the places.

The second application is a Quiz containing questions. In order to find and correctly answer the quiz, visitors are required to download and install the mobile application of Trip Northern. The game contains question regarding culture heritage and general knowledge related to the exhibition material. There were 10 random questions in the mobile application to be answered for each day during the three-day event. Visitors could answer the quiz in the mobile application embedded in the Trip Northern application because one of the main reasons was to promote and install the application by the visitors. Each question contains four possible answers. The visitors could find the correct answer in the exhibition and some quiz questions were related to nearby exhibition materials. Each day the event randomly gave two types of re-wards for those with correctly answered questions between 0-7 and 7-10.

Figure 1. Visitors participating in the Interactive map-based physical exhibition (Left), Visitors seeking for the answers of the questions related to nearby exhibitions in the Quiz application

4.2. Design Hardware and Building Materials for the Physical Exhibition

To design the Interactive map-based physical exhibition, the basic requirements were often specified by the exhibition director and were limited by the project budget. Our exhibition was set up at the Chiang Mai International Exhibition and Convention Centre, with more than 5,000 visitors per day and we organized an event for three days. However, based on previous information, we considered designing the exhibition based on two fundamental requirements: low costs hardware for the short event and the use of lightweight building materials.

As regards the first requirement, we focused on the visualization and interaction device. However, due to the various types of commercial devices for visualization (projectors and HD monitor) and interaction devices (mouse, touch screen and gesture recognition device), we created a summary of suggestions for the device to be used at the exhibition (Table 1 and Table 2). Starting from these considerations, we selected the 65-inch multi-touch screen with a 10-point multi-touch screen which refers to the ability to respond to ten simultaneous points of contact. For this choice, we considered the fact that the event is short and lasts for three days, and that cost should be low and the development of the application needs to be quick, but the device should be able to support various types of users such as families or groups of students.

Table 1. Comparison of devices for visualization

	HD monitor	**Projectors**
Layout	Many	Limited
Resolution of display	Up to 8k (high brightness and contrast)	Up to 4k (up to 300 inch diagonal size)
Environment	Small	Large
Cost	Low	High

Table 2. Comparison of interactive controllers

	Mouse	multi touch screen	gesture device (Kinect, motion leap, camera)
cost	low	high	medium
Effort to develop the device	Easy	Normal	Hard
Machine learning required	No	No	Yes
Quality of interaction	Unattractive	Very intuitive	Intuitive
Number of participate	1	1-3	Many

For the second requirement, we considered the use of wooden materials due to their lightweight allowing for flexible movement and exhibition setup. We asked architecture to design the wooden kiosks which enhance the experience of locals and tourists who visit the Trip Northern event. The virtual prototype of the Game-trip is shown in Figure 2.

Figure 2. Prototype of the Interactive map-based physical exhibition (left), exhibition setting in the Convention Centre (right)

4.3. Gamification Design

The core concept of the Game-Trip is that it provides and promotes the information of the Heritage and Tourism place of Northern provinces with attractive and interactive game design for both Thai and foreign tourists. Given to visitors, the Game-Trip simulates the route and provides additional information at each tourist attraction point from start to finish related to such categories as shopping, food, and cultural heritage. In addition, we employed the MDA framework for the design. A step-by-step description of the gamification design can be found below.

The MDA Framework is based on the reason to promote the exhibition. We decided to design the Game-Trip not too deep and complicated so that the participation time of the physical exhibition does not exceed five minutes because we didn't not want to have a the long queue due to the 5,000 visitors in the event per day. The MDA framework [38], consists of three components: Mechanics, Dynamics and Aesthetics. First, Mechanics (M): we selected the two game elements implemented in the Game-Trip: Coin and Leaderboard. For the Coin, it is used during the participation in the physical exhibition. Visitors can click on each important place in the map then it randomly offers real rewards such as keychain and candy to visitors if they found a small gift instead of the coin. In terms of the leaderboard, we implemented it in the Quiz application to inform users on the rank showing how many questions they answered correctly compared to others. Second, Dynamics (D): The Interactive map-based physical exhibition visualizes the important places of Heritage and Tourism in Upper-Northern provinces. The visitors can click the destination as the icon in the map and then a small car is displayed to simulate the route trip with additional information during the route such as shopping, food, and cultural heritage places. In addition, we designed the Quiz question application to encourage visitors to visit other exhibitions to be able to answer the questions. Finally, the component of Aesthetic (A) is defined as the emotional experience response of the users. We selected the sensation and fellowship as the core types of aesthetics to be implemented in the game. The design of sensation provides an immersive and attractive graphic style for the interactive map and kiosk and fellowship refers to connecting visitors to the community and exploring other exhibitions in order to find the correct questions.
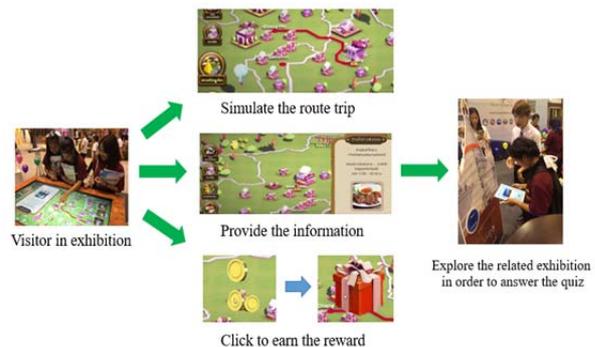

Figure 3. Game-Trip game flow

Gamification User Type Hexad There are various types of players which is very important to understand to design personalized solutions so that the game can fit each type of player. We employed the Gamification User Types Hexad framework [39] which was developed by Marczewski and was motivated by Relatedness, Autonomy, Mastery and Purpose on human motivation, types of players, and practical design experience. Regarding the Game-Trip, we developed the game design based on the six user categories of the Gamification User Types Hexad framework as shown in Table 3.

Table 3. Description of the user types Hexad

User types	Description
Philanthropists	Visitor who is determined to help other visitors Providing guidance and support for others in answering the question.
Socialisers	Visitor who loves to socialize and share information with other visitors during the exhibition.
Free Spirits	Visitor who prefers learning and improving the knowledge of intangible culture and tangible culture.
Achievers	Visitor who wants to challenge herself by trying to collect all types of the gifts and reach all features in the game design.
Players	Visitor who loves to collect rewards or lottery and compete with other visitor's scores displayed on a leaderboard.
Disruptors	Visitor who tends to try various methods to get as many score points as she/he can and challenges the game system.

System architecture and data flow The Game-Trip consisted of a client and server system architecture. As we described before, the Game-Trip have two client applications, first, the application of the Interactive map-based physical exhibition which was developed with the Unity game engine (https://unity.com/) and the data exchange of the server system with the JSON (https://www.json.org/) interchange format in order to collect the user study of behavior data. Second, the quiz questions were developed based on the web application with bootstrap (https://getbootstrap.com/) which also exchanges the data with JSON (https://www.json.org/) but is embedded in the mobile application of Trip Northern.

For the server side, we developed the server for collecting the data and monitoring the behavior of users. The server computed the rank of the user in the dashboard which showed the percentage of correct answers and the time used for finishing the question. The server was developed with apache PHP 7.0 and MySQL on Ubuntu Server. The overview of system architecture is shown in figure 4.
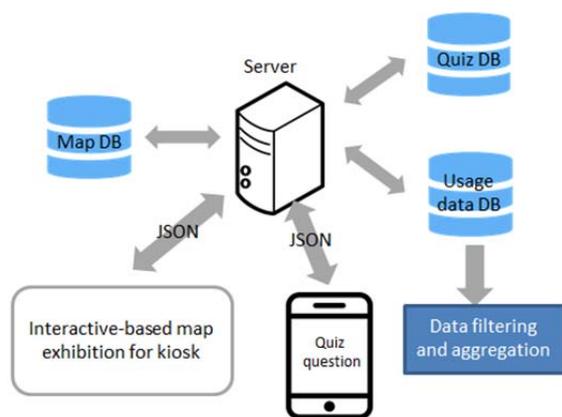

Figure 4. System architecture and data flow between the client and the server of Game-trip

5. User Study Procedure

To study the effect of the design of the gamified exhibition, both physical and online, we implemented the Game-trip and carried out a user study at the Chiang Mai International Exhibition and Convention Centre. We decided to collect both qualitative and quantitative user behavior data. Thus, our study design consists of two phases: a quantitative phase and a qualitative phase. In terms of the quantitative phase, we collected and analyzed quantitative data (survey questionnaire) and conducted a digital usage data analysis. For the qualitative phase, we collected the semi-structured interview (summary of the feedback) and executed an analysis of qualitative data. To summarize the tool for evaluation of this experiment, we refer to 1) survey question 2) usage of user behavior data 3) semi-structured interview. In addition, we collected data over the three-day event of Trip Northern taking place in the Chiang Mai International Exhibition and Convention Centre.

5.1. Procedure

The game-trip was set up as an exhibition as part of the event of Trip Northern in Chiang Mai International Exhibition and Convention Centre. The game-trip consists of two parts, namely an interactive map and quiz questions. In the exhibition booth of the interactive map, we asked every visitor who participated in the exhibition if they would agree to join the research study. However, if the visitor refused to join the research study they could participate in the use of the interactive map but could not participate in the second part of quiz questions. In addition, only those visitors who agreed to join the study in the interactive map part would receive the code to participate in the quiz question part. An agreement was required as it was presented with an informed consent popup where the participation in the study must have been agreed.

When the visitor started the Game-trips, we provided "how to play" information and information on the research purpose that required to be accepted in order to participate in the gameplay. Then, we asked the visitor to install the application of Trip Northern on their phone and give the electronic code in order to join the quiz of questions. After that, we let the visitor play the two-part game-trip: interactive map and quiz questions. Visitors were free to play the game of two parts and explore the exhibition but they needed to submit the final answer by 18.00 every day before the system randomly gave the two types of reward for those who answered between 0-7 and 7-10 questions correctly, assigning five items per each type. Finally, the visitors answered the survey question in the application.

During the experiment study, we only observed the participants without giving suggestions or interacting with them unless they had questions or problems such as technical issues (e.g., application installation, login problem). Since there were many visitors to participate in the quiz during the three-day event, the automation usage of application data was used to be analyzed later after finishing the event.

5.2. Participants

We recruited the visitors during three days of the event to join the Game-trip. A total of 867 (n = 867) participants were recruited through verbal invitation during the exhibition. In addition, we did not allow visitors aged lower than 15 to participate in the study and filtered off participants who did not finish their survey or did not complete the study in order to guarantee the quality of the experiment. Taking into account the sociodemographic background, the 369 male and 498 female participants had a mean age of 30.02(SD = 9.08; range = 15-45). As a next step, participants who completed the Game-trips and survey questionnaire were asked for an interview that lasted approximately 10 minutes to get the feedback of Game-trips. There were 18 (n=18) participants, 8 male and 10 female, who agreed to participate in the face-to-face format interview including a conversation and making notes on paper.

5.3. Measures and Instruments

Survey questionnaire: As we mentioned in the previous section, visitors were informed to complete the survey questionnaire after answering the questions in the application. Thus, we employed the online survey questionnaire to evaluate the visitor experience. The survey questionnaire consisted of two parts, one referring to the visitor's experience of the interactive map-based physical exhibition and the other referring to the quiz. The Likert-scale questionnaire measures the visitor experience with a five-level scale ranging from ``strongly agree" to "strongly disagree". Responses were recorded as a "1" for the lowest response (Strongly disagree) to a "5" for the highest response (Strongly agree). A total score for each participant was generated to measure the effectiveness of visitor experience in both applications of the Game-trip.

Table 4. Survey questionnaire

		Mean (n = 876)	SD
Part 1: The questionnaire responses regarding the interactive map-based physical exhibition			
Q1	The application I played was fun to use.	4.04	0.81
Q2	The application I played helped me to become familiar with the exhibition.	4.03	0.82
Q3	The application I played can obtain knowledge of culture heritage in upper northern provinces.	3.51	1.015
Q4	The application I played was engaging and I want to come back to play again.	3.92	0.76
Part 2: The questionnaire responses regarding the quiz			
Q5	I liked the quiz about the exhibition.	4.02	0.87
Q6	I enjoyed the physical exhibition.	3.76	0.95
Q7	The quiz helps me to investigate other exhibitions.	4.10	0.82
Q8	The quiz helps me to socialize with other visitors.	4.07	0.96

Digital data usage we collected the statistical data of visitors who used the Game-Trip. The server monitored the visitors who submitted the answers to the system in order to compute real-time ranking to be shown to the competitors in the dashboard. We displayed the graph of daily usage showing the percentage of visitors who finished the quiz and of those who did not finish the quiz day by day until the Game-Trip event finished. The graph is shown in Figure 5. In addition, there was a total of 1017 visitors from whom 867 visitors finished the quiz and 141 visitors did not finish the quiz.
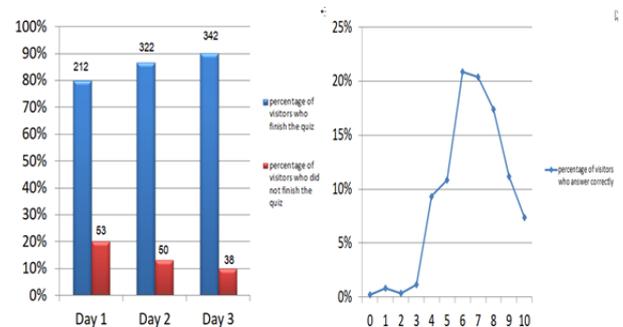

Figure 5. System architecture and data flow between client and server

Interview data we employed a semi-structured interview method for an in-depth understanding and exploring of user experiences. The interviews have 4 questions which provided the necessary content of user experience and application issues after they finished the Game-Trip. The interview length ranged approximately 10-20 minutes with individual differences. Visitors were compensated with THB200 (Ap-proximate USD 6) for their time.

6. Results

6.1. Results from the Survey Questionnaire

Table 4 presents the results of the survey questionnaire for the Game-trip and exhibition. We divided the results into two parts, namely to responses concerning the application of Game-trip and regarding the effects of the exhibition quiz. As regards the application of the Game-trip, the result was convincing in terms of fun (m=4.04,sd =0.81) and in terms of making visitors familiar with the exhibition(m=4.03,sd=0.82) and also proved to engage visitors to play again(m=3.92, 0.76). Unfortunately, we found that some visitors felt that the application cannot provide the knowledge of cultural heritage (m=3.51, sd =1.015). In terms of exhibition responses, the quiz helps visitors investigate other exhibitions at a highly satisfying level (m = 4.10, sd =0.82), helps to socialize with other visitors (m=4.07,sd=0.96) and visitors also liked the quiz(m=4.02, 0.87). However, the visitors did not feel that the quiz can improve the level of joy related to the physical exhibition (m=3.76,sd=0.95).

6.2. Results from the Digital Data Usage

As shown in Figure 5, the server collected the usage data of 1017 visitors during the three days of the event. For the first and second day of the event, there were 212 and 322 visitors who finished the quiz and 53 and 50 visitors who did not finish the quiz respectively. On the third day of the event, the number of visitors who finished the quiz was the highest (342) and the number of visitors who did not finish the quiz was the lowest (38) compared to the whole event. Based on the analysis of usage, the visitors tended to finish the quiz slightly better each day, increasing from 80% to 87% and 90% respectively from the first day to the final day. In addition, we also analysed the percentage of visitors who answered the quiz questions correctly. The highest percentage of correct answers were six (20.88%) and seven answers (20.42%). However, the graph showed a slight increase from three to six and de-creased until ten which means that the visitors

tried to carefully answer the quiz. The data distribution shows a similar shape as the bell curve.

6.3. Results from the interview data

To analyze the interview data, we employed the content analysis method [40] to study the interview data which is used to summarize the information of the interview data. A total of 18 (male = 8, female = 10) participants were interviewed in a face-to-face discussion.

When interviewed about the user experiences of using the Game-trip (Interactive map-bases physical exhibition and Quiz), almost eighty percent of the interviewees felt very fun and addictive during the gameplay (14/18, 77%). One of the interviewees said: *"The interactive map was so interactive and gave me an immersive experience on the big monitor. It was a very great idea to assign random small gifts to touching the building. It was also fun to search for answers of the quiz in the other exhibition."* and another interviewee said: *"The idea of putting quiz questions on the related exhibition was fun. I enjoyed hunting the answer for it"*.

When asked about the learning experience, half of the interviewees (9/18, 50%) reported a positive learning experience. For the Interactive map-based physical exhibition, interviewees felt that it allowed interactive learning but it was a very limited time to play due to the long queue. For the quiz questions, most of the respondents felt very positive about the learning experience during the search for the answers in other exhibitions of the event. One of the respondents commented *"The application was very interactive. I think that is be better compared to text only solutions which could be suitable for the Generation Z"*.

However, six interviewees gave neutral comments (6/18, 33%) they believe that the application has a great potential to improve the learning experience about tourism and culture heritage by creating joy during the gameplay but it doesn't necessarily enhance learning. Some interviewees played because of the small gifts from game. As one interviewee said *"It was a good idea for learning but it is not necessarily enhancing learning. I play because I want the small gifts from the game"* and three interviewees (3/18, 16%) responded with negative feedbacks about learning through the application and Quiz questions. As one interviewee noted *"I finished the game. I think it is fun but I feel I do not learn anything"*.

When asked about feeling the effect of the exhibition (15/18, 83%) more than eighty percent of the interviewees reported that the application help them get familiar with the exhibition and also forced them to explore the other exhibitions in the event.

Moreover, some interviewees reported that the application was engaging and that they wanted to come back to play again every day. As one interviewee said: *"The interactive map makes me engaged and get familiar with the exhibition. The quiz was fun; I tried to explore the exhibition to answer the question"* and another interested comment noted that*"The quiz makes me engaged, I talked with the booth attendant to find the answers and I feel competitive when I see myself standing on the leaderboard".*

When asked about application improvement and issues, more than fitty interviewees responded (9/18, 50%) that they require the function of a more enhanced visitor cooperation on the interactive map because visitors waited long queues to participate. In terms of the quiz question application, there were many cases of crashing for the android version. Five interviewees (5/18, 27%) were concerned about sometimes focusing on the questions in the phone exclusively, ignoring the exhibition environment and other people. As one participant noted: *"I do not care about the physical environment of the exhibition. I only focus on the question on the phone and the leaderboard."*

7. Discussions

This study revealed visitors' effect of using the gamification in the exhibition. Thus, we have designed and developed the application of Game-trip which consisted of two applications, an Interactive map-based physical exhibition and a Quiz. The experiments were tested at the Chiang Mai International Exhibition and Convention Centre for three days. The result of the survey questionnaire shows that visitors were satisfied with both applications in the perspective of fun and engagement and the applications also helped visitors get familiar with the exhibition. These results are consistent with [45] and [46] regarding implementing gamification application to exhibition and museum visits respectively.

In terms of learning, we found that some participants felt that the Interactive map-based physical exhibition did not really provide the visitors with learning information for the exhibition because there was a very limited time to play due to long queues. For the quiz question, the visitors were motivated to finish the quiz driven by the competition in the leaderboard and rewards. The quiz makes visitors curious to discover all the other exhibitions in order to search for the answers. Additionally, the quiz question provides a quest for

visitors to seek the information from other exhibitions. Moreover; the quiz leads the visitors to socialize with other visitors who also play the game which creates a small community to exchange the knowledge. However, the quiz cannot enhance any information of the physical exhibition. While previous research [47], [48], [49] asserted that Gamification can enhance students' learning experiences in school and university. These are inconsistent with our results that this may also be used in different contexts of exhibition in public space and museum settings.

Further analysis of the interview data showed positive effects of applied gamification in the exhibition, the interviewees reported that both applications in the Game-Trip are engaging and fun to use and make visitors get familiar with the exhibition. In fact, the small gift and the competition with other visitors were motivating to participate in the exhibition and discover all the information around the event. However, several interviewees reported neutral attitudes towards the application of enhanced learning and towards its capacity to improve the level of enjoyment for the physical exhibition.

To summarize the study, based on the knowledge and experience we can draw conclusions regarding two perspectives: for the physical interactive exhibition and the online digital exhibition. For the design of the gamification of physical interactive exhibitions, we suggest considering the selection of a device of visualization which is interactive and supports masses of visitors at the same time as much as possible in order to avoid long queues such as a projector or smart camera. In addition, the game element of reward such as real small gifts was worth to implement because it had an engaging effect and was impressive for visitors of the exhibition. For the online digital exhibition, we suggest designing a creative application or implement new technology such as location-based or augmented reality such as [45] which aims to convince the visitors to participate the exhibition as much as possible. In our case, the creativity of the question encouraged the visitors to seek the hidden answers in the exhibition which can promote the exhibition and can be engaging. However, we found that the game element of leaderboard may make the visitors feel too competitive which results in the participants not focusing on the information in the exhibition, which would be the main objective of the exhibition, but focusing on obtaining the score points. In these contexts, we suggest that the competitive elements of the game between participants such as leaderboards and leveling should be eliminated.

8. Conclusions

In this research, we proposed to study the effects of implementing the gamification concept to an exhibition event. To verify, we developed the Game-trip to investigate the user experience of physical interactive and online digital exhibitions in the perspective of engagement, learning and application design. We collected both qualitative and quantitative data from visitors who visited the Chiang Mai International Exhibition and Convention Centre in the event of Trip Northern.

Regarding our findings, visitors were satisfied with our purpose in the perspective of fun and engagement which also helped visitors get familiar with the exhibition. However, the visitors felt that the application cannot improve the learning of information in the exhibition well due to the very limited time to play and too competitive game elements, but the gamified exhibition can be used as a design to improve the overall visitor experience in exhibitions.

In the future, we aim to investigate the effects of gamification regarding the technology of augmented reality and virtual reality applications in terms of usage experience within a public exhibition.

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