Chapter #

THE EFFECT OF STORY IN MOBILE EDUCATIONAL GAME

Chris Lu[1], Maiga Chang[1], Kinshuk[1], Echo Huang[2], and Ching-Wen Chen[2]
[1]*School of Computing and Information Systems, Athabasca University, Canada*
[2]*Department of Information Management, National Kaohsiung First University, Taiwan*

1. INTRODUCTION

The trend of designing and developing mobile apps attracts many researchers' attention on using mobile devices to make users have feelings that they are living in the era or the place in which they can learn knowledge of particular domain, e.g. the users can learn rainforest plants and ecology in the Amazon River zone of a botanic garden [1,3,8,26]. Some other researchers further develop mobile games for educational purpose; these games not only make users do learning activities in authentic environments such as museums and historical sites, but also make them get motivated if compared with the abovementioned mobile learning systems [2,25].

A context-aware educational game-based mobile application can generate inquiry-based learning activities for the users according to their needs (under informal learning situation) and the courses they are taking (under formal learning situation). Such context-aware educational game allows users learning through role playing in a game world that integrates physical environment with the challenges and excitement of game play. The research team develops one, namely CAMEG [10,11], and its usability has been confirmed [13].

To make the generated learning activities more attractive to the users and make the mobile game become an immersive learning environment for the users, a new version of the game, namely CAMRPG, then is designed developed. In order to make the CAMRPG interesting and engaging to users,

the research team applies the story generation engine which is based on narrative theory to an educational mobile game for generating decorative stories of learning activities and for making students feel that they are living in the game world and role play an actor, explore the game world, complete the quests, and learn something.

The elements in narrative theory include storyline, character, and interaction have been analyzed and used in the design of game-based learning system [27]. Conle (2003) summarizes that a story should have temporal sequences, plots, characters, context, and the sense of an ending [4]. Some researchers have done the research in terms of finding the relationships between narrative elements and games [15]. They argue that some narrative features such as causality, temporality, and linearity, should be also considered so an interactive and engaging game can be well-designed and developed.

This research has two research questions needed to be examined for getting better idea of the effects that the stories in the mobile educational game have: (1) Do the stories have positive influence user acceptances toward the use of CAMRPG? (2) Do the stories make users feel the game is useful? (3) Is there any gender difference existed in terms of the perceived effectiveness and satisfaction toward CAMRPG? (4) Do gaming experience influence user acceptances toward the use of CAMRPG?

Two pilots have been conducted. In the pilots, a questionnaire is designed and used to gather learners' attitude (through a revised technology acceptance questions), perceived effectiveness, efficiency, and satisfaction toward the CAMRPG. The data have been collected and analyzed with quantitative analysis approach (e.g., independent t test) for assessing users' perceptions toward both games (i.e., CAMRPG and CAMEG). With the analysis results, this research can evaluate the effects that the generated stories in the mobile educational game has by seeing if there is any significant difference of user perceptions toward the two games.

2. CONTEXT-AWARE MOBILE LEARNING ACTIVITY AND STORY GENERATION

2.1 Knowledge Structures

In order to provide users' with personalized/customized learning services, first, we need to know what the users want to learn and what they already know. Quillian (1967) proposes a very first structure which is a kind of memory model [21]. After that, many different knowledge structured are

designed and proposed. Novak and colleagues propose Concept Maps which can be used for storing and presenting the concept relations that learning materials have [17,18]. Ogata and Yano propose a knowledge awareness map, which can visualize the relations between the sharing knowledge and the learner interactions [19]. Another well-known structure – semantic network – was proposed by Sowa. A semantic network is a systematic means for researchers to model an individual's mental schema of declarative knowledge [23].

Ontology in the computer science and artificial intelligence fields which is evolved from the philosophy domain has been applied in the text analysis area and has been used widely to analyze the semantic lexicon of words [16]. Researchers use ontology to define vocabulary that presents the knowledge of a particular domain in order to provide a platform for effective communication and knowledge sharing among users and systems.

Olawande and colleagues (2009) present an ontology-based architecture framework that constructs tourism-related web ontology language for tourism recommendation system development [20]. In their research, they define two ontologies – destination context ontology (DCO) and accommodation ontology (AO) – with respective social attributes (i.e., weather temperature, scenery, volume of traffic, crime rate, and city type). The tourism recommendation system first takes user preferences as input and retrieves and sorts the correlated destinations as initial recommendations. The system then uses DCO to filter and revise the initial recommendations based on the user's preferred social attributes. Finally, the system uses AO to filter and generate a list of accommodation suggestions.

Wu and colleagues (2008) propose an ubiquitous knowledge structure for museum learning and elementary-level botanic learning [24]. It has been proven to be a good way to store the knowledge that learning objects (in the real world) and materials (in the textbook) in one single knowledge structure. Its hierarchical structure is easy to understand and manage for general administrators (e.g., school teachers and system managers) and there is no specific rule for building a knowledge structure. In addition, a single structure can store knowledge associated with multiple domains/disciplines.

Three layers of the ubiquitous knowledge structure are adopted in this research to build the context-awareness knowledge structure of the authentic learning environment in which the mobile game takes place. Fig. 1 shows the altered context-awareness knowledge structure. The domain layer represents learning topics and domains that users are learning as well as the game themes that users can choose to play. The characteristic layer is a hierarchical structure in which the root nodes are associated with one or more nodes in the domain layer. The object layer stores all learning objects

in the real world (e.g., rooms, equipment, pine trees, etc.) and in the virtual world (e.g., payroll system, business policy, electronic forms, etc.).

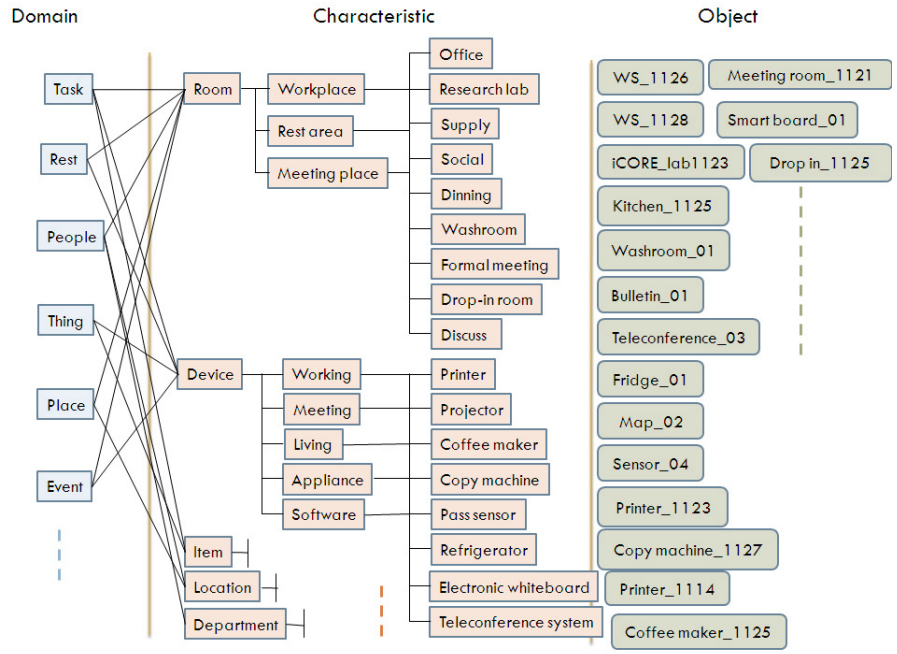

Figure #-1. Partial ubiquitous knowledge structure of an authentic learning environment.

In summary, a variety of knowledge structures have been designed and used by researchers. By analyzing and modifying the existing knowledge structures, this research chooses to adopt the ubiquitous knowledge structure as a solution to store and present the knowledge for the CAMRPG.

2.2 Learning Activity Generation

The use of location-based service can offer users more attractive and context-aware game-play experiences. However, the learning activities that games have usually are pre-defined and designed activities. This research designs a mechanism which can automatically generate learning activities according to user needs and the surrounding context to provide users personalized context-awareness learning activities.

Since the knowledge structure stores all learning objects and their attributes and embedded concepts, as well as the relationships among objects, an approach of retrieving relevant learning objects according to the user context, e.g., the chosen theme, location, learning experiences, is developed.

The learning objects retrieved via the approach can make users feel that the objects are what they want to see/know.

A learning activity may involve more than one learning object, so a user may need to spend more time to find all of the required learning objects that the learning activity asks for. Even if two learning activities have same amount of learning objects, some learning objects might not be so easy to find (or to access). Since the order of learning activities may be an important factor from both learning and playing viewpoints, the research team designs a mechanism to sort the learning activities by the amount of associated objects and their complexity. Users may solve their first learning activity with less difficulty and then, in the later stage, seek for multiple learning objects which some of them may not common to see. The activities associated with common learning objects can be seen as training quests and the activities associated with many or uncommon learning objects can be seen as challenges. Fig. 2 shows the learning activity generation flow. This flow has five steps.

Analysis: The first step is to list the learning domains and corresponding objects which can be used for learning by users in the authentic environment; then to identify all characteristics that the objects have and to figure the relationships among characteristics and objects out. The analysis results are stored into the ubiquitous knowledge structure. After that, roles and corresponding themes covering one or more learning domains in the game are designed for users choosing to play.

Role & theme: At this step, users can choose one of the roles that teachers and course authors designed at Step 1 and choose the theme s/he wants to play.

Learning activity chain generation: The game puts the chosen role and theme into the activity generation engine to generate activities. The activity generation engine retrieves suitable learning objects from the ubiquitous knowledge structure accordingly and then generates a list of learning activities which users may do in the authentic learning environment. At the end, the engine sorts the learning activities into a chain by comparing their complexity (as well as the rarity of required learning objects) and offers users learning activities in the chain one by one.

Learn by playing: Users can follow the instructions and look for the designated learning objects to solve the learning activities one by one, at meanwhile, s/he can get familiar with the environment and learn the associated knowledge.

Personal experience update: The learning objects and related knowledge users have seen and learnt will be recorded in the database, so the game is aware of users' learning progresses (e.g. what learning activities they have solved and what concepts they have learnt) and performances (e.g. how

well and how fast they did in solving the learning activities and how many learning activities they have done so far).

More details of the learning activity generation mechanism can be found in [13].

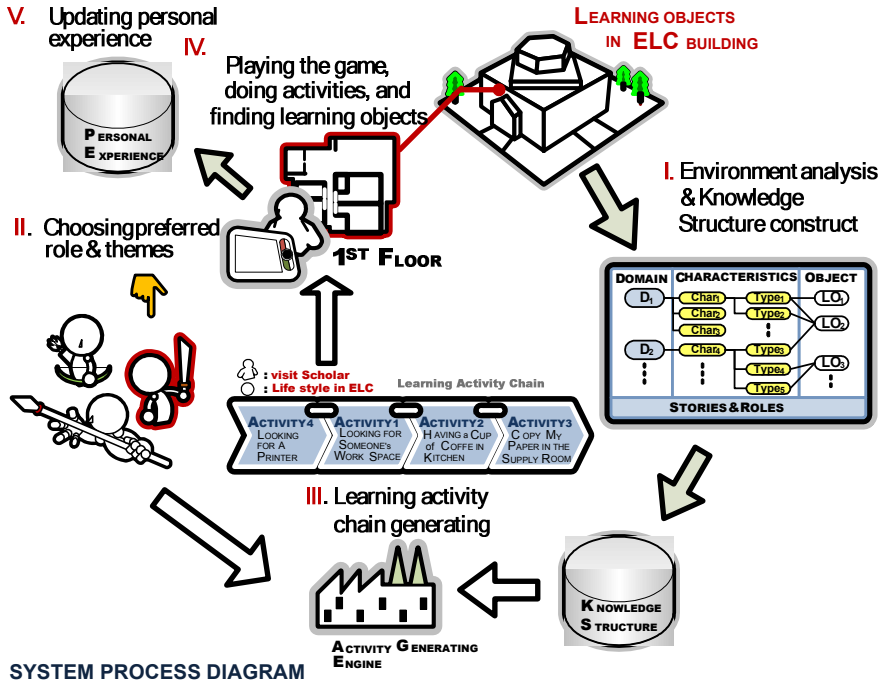

Figure #-2. Learning activity generation flow.

2.3 Transition Story Generation

Even the game can generate a series of learning activities for users, users may still be bored if they are just asked to do activities one by one. Few research talks about how to design the contents of mobile educational games and how to make users feel interested and want to play the game continuously. Story is important for designing an interesting and engaging game. Most of popular games have its background story no matter the story is a simple linear story (i.e., saving the princess) or a complex drama (i.e., the war happened between Alliance and Horde in World of Warcraft). Good story in the game design makes the game realistic and immersive as well as users involve constantly.

Therefore, it is important for designers to understand classic story structure. Generally, a story usually begins with a basic concept or an idea. The basic is to put one or more characters, in a kind of situations, in one of the settings in the game [22]. The research designs an educational role-playing game by applying narrative theory to decorate the generated learning activities, so the game can make users feel that they are living in the game world. Users play an actor, explore the game world, complete the quests, and learn something.

According to the literature review, the core narrative elements are identified and a structure is designed to store all necessary narrative element data for creating a story. A simple method is developed to pick up narrative data from the structure. The method is simple but it still maintains the consistency and sequence of story fragments among the learning activities of a chain, for instance, users won't see the car in the story of later activities if they sell it in the story of the activity they are solving at this moment.

By combining the idea of ubiquitous knowledge structure and the four narrative elements defined by other researchers, a four-layer narrative knowledge structure as Fig. 3 shows, is designed to help the game generate stories based on the chosen theme and generated learning activity chain's length.

In the narrative knowledge structure, each layer can have more than one level. The relations among elements are optional. The elements built in the narrative knowledge structure can be mixed of truth and fiction. Different schema is designed to store the properties of narrative elements. The schema of narrative elements can be seen as the settings of the storyline and used for generating story. Fig. 4 presents the schema of "Noon" element in time layer and "William" element in character layer.

The abovementioned narrative knowledge structure and narrative element schema are simple and clear, so teachers and course authors are capable of building their own for various learning domains and authentic learning environments. The story generation engine then can generate a series of stories (i.e., a storyline) to decorate the generated learning activities. More details of the story generation engine can be found in [14].

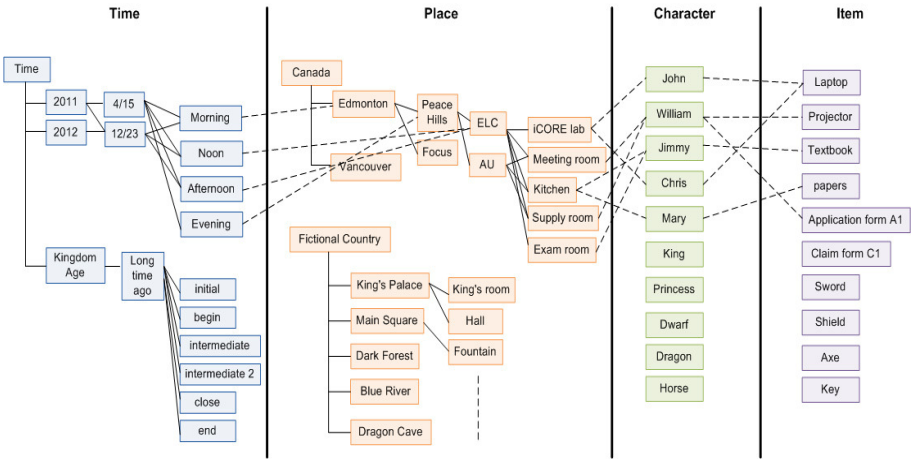

Figure #-3. Narrative knowledge structure.

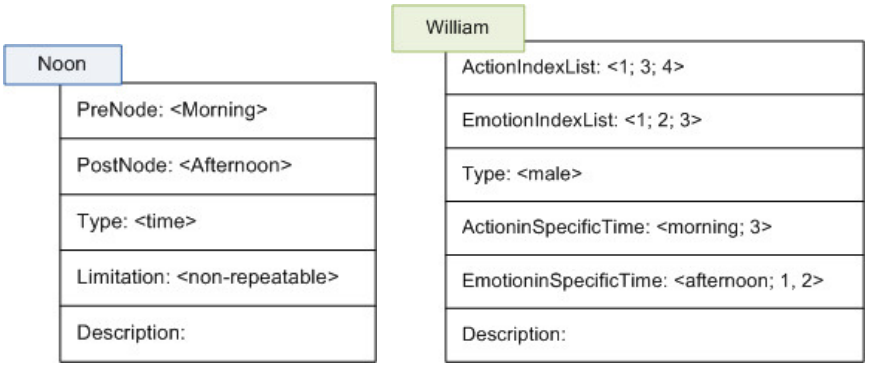

Figure #-4. Narrative element schema examples.

3. CONTEXT-AWARE MOBILE ROLE PLAYING GAME

To develop a lightweight, flexible, and scalable mobile educational game so the game can be played at any platform as well as additional components can be added to make the game better, this research takes multi-agent architecture into consideration for the game design. Multi-agent architecture not only allows different agents to have different responsibilities, but also provides an expandable way to develop further functions. For instance, new agents can be put into the game for special purpose and old agents can be

replaced with new and more functional ones. Fig. 5 shows the multi-agent architecture that this research uses in designing and developing the mobile educational game.

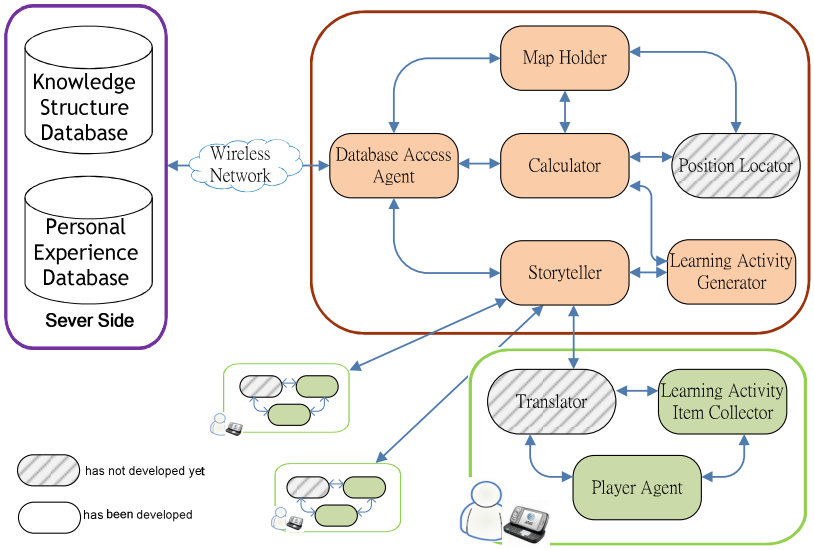

Figure #-5. Multi-Agent architecture of the proposed mobile educational game

Two groups of agents reside on the user's mobile phone: three agents, namely Player Agent, Translator, and Learning Activity Item Collector, form a group to serve and interact with the user; and six agents, namely Learning Activity Generator, Calculator, Map Holder, Database (DB) Access Agent, Storyteller, and Position Locator, form a group to work out context-awareness and the location-based learning activity chain. Each agent has its goal, task, demands, and communicated targets. More details for the responsibilities of each agent and the collaboration among agents can be found in [12].

During the game-play, Player Agent is the only agent that interacts with the user and enables data exchange between the user and other agents. The following subsections describe five phases of the game-play, during which a variety of agents participate in different phases to help, train, and challenge the user to complete the required activities.

3.1 Teleport Phase

In this phase, the user enters the game world. Player Agent, Map Holder, and DB Access Agent are awakened to handle the user's log in/register

request (Fig. 6). The teleport process is necessary in order to give the user a feeling that s/he is entering a virtual, imagined, and fantasy world.

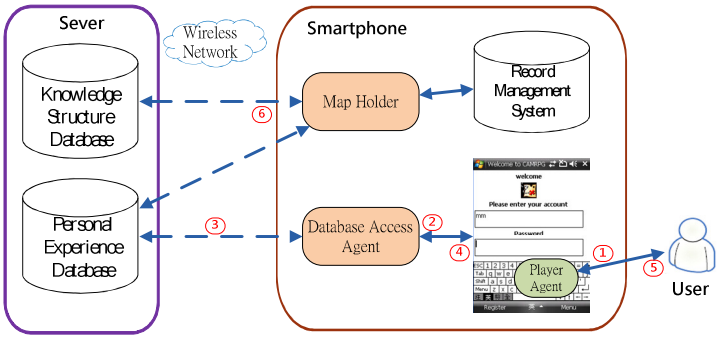

Figure #-6. Interactions among the user and agents in Teleport phase

3.2 Transfer Phase

In this phase, the user is asked to choose a role and the theme s/he wants to play. Player Agent and Learning Activity Generator are awakened to deal with the user's choices. The transfer phase is used to give the user an idea of the roles and the themes in the game. Correspondingly, the user can gain a better understanding of what the game offers via his/her chosen role and theme (Fig. 7).

3.3 Training Phase

In this phase, Player Agent displays a progress bar and asks the user to wait for a few seconds. In the background, Learning Activity Generator, Calculator, Storyteller, DB Access Agent, and Map Holder start collaborating to generate a series of story decorated quests for the user (Fig. 8). The training phase focuses on agent collaborations involving retrieving, weighting, and sorting the learning objects and learning activities based on the user's chosen theme, location, and learning objects nearby. Player Agent then receives several story decorated quests.

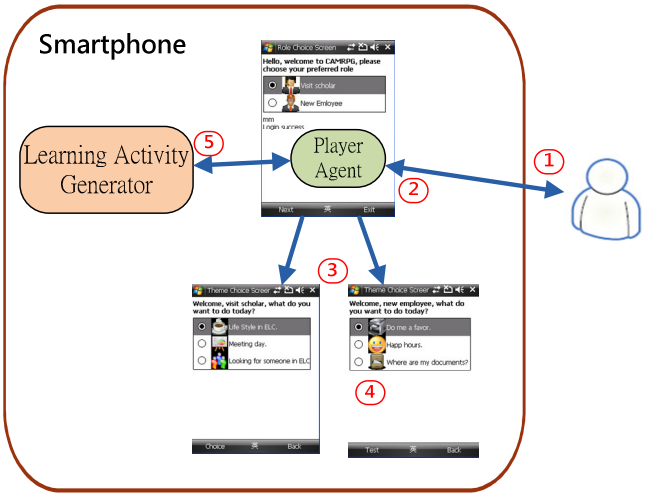

Figure #-7. Interactions among the user and agents in Transfer phase

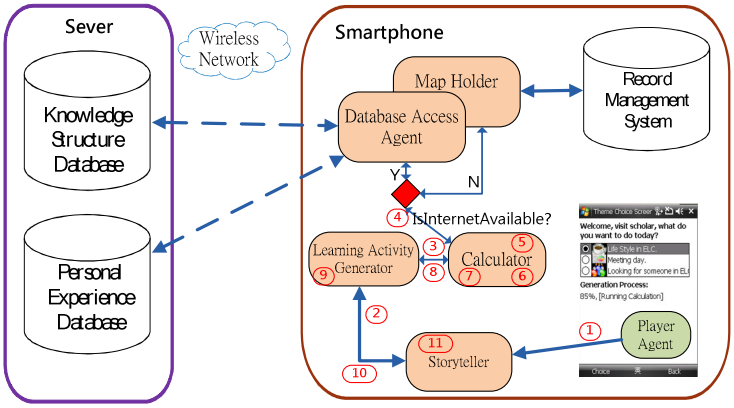

Figure #-8. Interactions among the user and agents in Training phase

3.4 Challenge Phase

In this phase, Player Agent receives a series of learning activities from Learning Activity Generator (Fig. 9). The challenge phase provides the user learning activities as quests in the game. The user is then asked to solve the quests one by one.

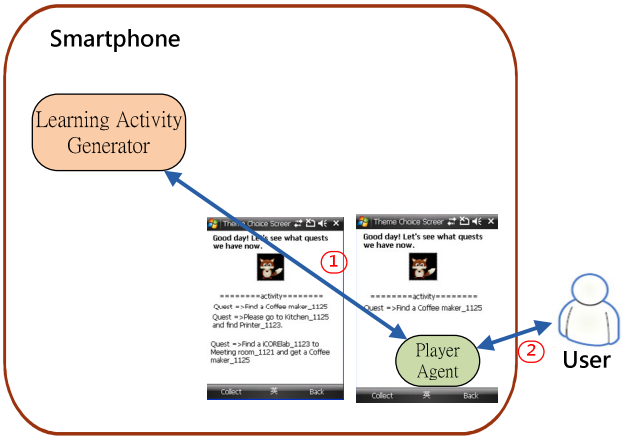

Figure #-9. Interactions among the user and agents in Challenge phase

3.5 Adventure Phase

In this phase, the user starts solving the activities one by one. S/he looks for the activity-relevant items (activity items for short), for example, the Decision Support System, "Oracle Decision Support Systems (DSS)," and the company, "Oracle". Player Agent, Learning Activity Item Collector, Map Holder, and DB Access Agent are awakened to support the user. The activity items are learning objects in the real environment and have two-dimensional barcodes attached. The user needs to explore the environment and look for the activity items required for his/her quest.

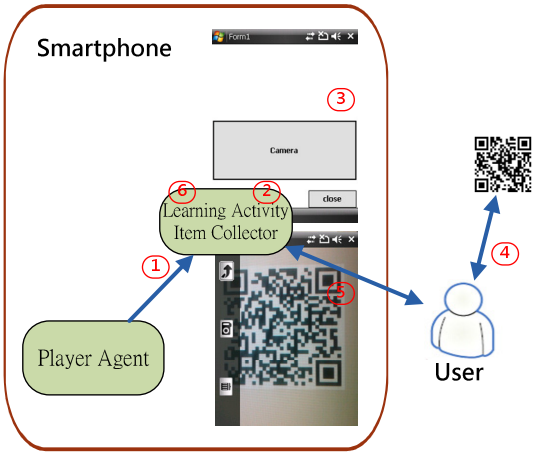

Figure #-10. Interactions among the user and agents in Adventure phase – item collecting

The adventure phase enables the user to walk around in the real world, look for specific activity items, take pictures on the two-dimensional barcodes, and receive the relevant instructions/tutorial for the learning objects (Fig. 10).

4. EVALUATION AND DISCUSSION

4.1 Hypotheses

This subsection describes the hypotheses we have in minds and want to verify, furthermore, this section also talks the pilot design and the data we are going to collect. As this research wants to know the effect of story in the mobile educational game, six hypotheses based on the four research questions are made:

H1: The generated stories in the game have a positive effect on user's acceptance towards using CAMRPG.

H2: The generated stories in the game have positive effect on user's perceived usability of CAMRPG.

H3: The generated stories in the game makes users more appreciate the game.

H4: There is gender difference on user's acceptance towards using CAMRPG.

H5: There is gender difference on user's perceived usability of CAMRPG.

H6: Gaming experience has positive effect on user's acceptance toward using the CAM-RPG.

To verify these hypotheses, a questionnaire consists of demographic questions, technology acceptance related questions, and usability related questions are needed. Usability is a general term used in human computer interaction (HCI) research and can be widely explained rather than the traditional term, "user friendliness". The Specifications of International Standard Organization for HCI and Usability, ISO 9241-11 document [7], is a guidance of usability. This standard provides developers the definition of usability and tells research how to identify the necessary items such as user's performance and satisfaction while evaluating system's usability. The definition of usability described in ISO 9241-11 is:

> Usability extents to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

A revised usability questionnaire has been made based on the usability analysis results we had for discovering the usability of the game without stories (i.e., CAMEG) [13]. The revised questionnaire contains eleven five-

point Likert-scale items (5 for "strongly agree" to 1 for "strongly disagree") which may affect a system's usability in the three dimensions described in ISO 9241-11, i.e., effectiveness, efficiency, and satisfaction. All items exist in the original questionnaire. The validity of these items was established by a review of three experts in educational technology field.

To gather CAMRPG users' acceptance and perceived usability toward CAMRPG, the researchers introduced CAMRPG to an undergraduate Management Information System (MIS) class of the department of Information Management (IM), National Kaohsiung First University of Science and Technology (NKFUST), Taiwan. The researchers explicitly told the students that the pilot is a voluntary activity and there is no compensation, reward, or recognition for anyone who participate the pilot and nothing will happen to the students who do not want to take place in the pilot. At the end, 55 undergraduate students (ages range 21-22 years old) were recruited, including 31 males and 24 females.

The experiment environment of the pilot took place in teaching building E of the university. The MIS course contents and concepts were taken into the game. The teaching building was considered as a virtual science park where many famous IT business and company reside in for participants learning MIS concepts while playing CAMRPG.

All participants had 20 minutes to play the game with the smartphones the researchers prepared at the authentic learning environment, as not all participants have smartphones and to avoid the influences that different devices may have in terms of affecting user's experiences in playing the game and perceptions toward the game. After they played the game, they were asked to fill up the questionnaire in order to gather necessary data for analyzing and verifying the proposed research questions.

The Cronbach's alpha value of the questionnaire is 0.840 with CAMEG's data set indicating that the questionnaire (and its items) can be seen as reliable due to its internal consistency is good enough (i.e., exceeds 0.75) [6]. In order to make sure that the questionnaire maintains good reliability for further quantitative data analysis, we also test its reliability with both CAMRPG's data set and the mixed-up of the two data sets (i.e., the data set of CAMEG and CAMRPG). The Cronbach's alpha values are 0.873 (for CAMRPG's data set) and 0.853 (for the mixed-up data set) showing that we can use the collected data to do follow-up analysis to find out the answers of the research questions.

4.2 Data Analysis

The demographic information includes CAMRPG user's gender information, experience in playing games, and time spent on playing games. Table 1 lists the descriptive statistics for 55 CAMRPG users.

Table #-1. Descriptive statistics of CAMRPG users

Gender	N	Playing Video Games	Playing Handheld Video Games	Playing Computer Games
Male	31	26 (83.9%)	26(83.9%)	30(96.8%)
Female	24	17 (70.8%)	19(79.2%)	22(91.7%)
Total	55	43(78.2%)	45(81.8%)	52(94.5%)

The results of Table 1 show that most of CAMRPG users had rich experiences in playing games, especially computer games. Video and computer games are both found to be major entertainment activities for them. Table 2 further summarizes how much time they usually spent (hours per week) on playing video games, handheld video games, and computer games. The data listed in Table 2 show that there is significant difference between male and female CAMRPG users in terms of playing computer games.

Table #-2. Comparison table of game playing time

Time for Playing	Gender	N	Mean (hours per week)	Standard Deviation	t value
Video Game	Male	31	4.5161	7.43806	-0.137
	Female	24	4.8542	10.90819	
Handheld Video Game	Male	31	4.2742	7.29365	1.087
	Female	24	2.4583	4.20123	
Computer Game	Male	31	21.7097	16.58954	2.314**
	Female	24	12.7500	10.40171	

**: $p < 0.01$

The groups were further observed and distinguished by comparing the time they spent on playing games. Students who were among top 25% in terms of the time spent playing computer games were defined as hard-core players. On the other hand, students who were among bottom 25% in terms of the time spent playing computer games were defined as casual players. The rest of students were defined as regular players.

It is possible that the students who spend a lot of time playing computer games may have higher expectation with the proposed game and may not recognize the proposed game as a good game. If this assumption is true, it would mean that the students in hard-core player and casual player groups will perceive the usability of CAMRPG and appreciate the stories in

CAMRPG significantly differently. Table 3 lists the new sample sizes of the comparable variables to be used for the quantitative analysis (i.e., independent t-test).

Table #-3. Sample sizes of different groups

Time for Playing	Gender	N	Mean
Gender	Male	31	-
	Female	24	-
Time spend on playing Computer Games	Hard-core player	14	40.21 (hrs/week)
	Regular player	26	17.19 (hrs/week)
	Casual player	15	3.67 (hrs/week)

Before we test if there is any difference of the user perceptions between hard-core and casual players, we can see, from Tables 4 and 5, that although both groups' mean values are quite high (i.e., positive perceptions) for the generated stories and the game, male users have relatively higher standard deviation but there is no gender difference between male and female users. This circumstance shows that male users may perceive extreme high or low responses for the stories and the game. Therefore, hypothesis H1 is **supported** but hypothesis H4 is **rejected**.

Table #-4. Descriptive statistics of CAMRPG users' perceptions toward the stories and acceptance toward the game

	N	Mean	Std. error	Std. Deviation
Perception towards the generated stories	55	4.0364	.07823	.58019
Acceptance toward using CAMRPG	55	4.1500	.08646	.64118

Table #-5. Independent t-test on gander difference

	Gender	N	Mean	Standard Deviation	t value
Perception towards the generated stories	Female	24	4.1458	.48295	1.237
	Male	31	3.9516	.64038	
Acceptance toward using CAMRPG	Female	24	4.2813	.37816	1.458
	Male	31	4.0484	.77840	

Table 6 lists the results of independent t-test on the two groups (hard-core and casual players) of CAMRPG users' acceptance toward the use of CAMRPG. The results show that there are significant differences between hard-core and casual players in terms of their acceptance toward CAMRPG ($p = 0.018$). Therefore, hypothesis H6 is **supported**.

Table #-6. Independent t-test on the time-spent groups

	Time-spent	N	Mean	Standard Deviation	t value
Acceptance toward using CAMRPG	Hardcore	14	4.3750	.35014	-1.994*
	Casual	15	3.9667	.68704	

*: $p < 0.05$

In order to verify the hypotheses H2 and H3, we need to test if there is perception difference between CAMEG users and CAMRPG users toward the usability of the games they played as CAMEG has no story. All data from 92 participants (include 37 CAMEG users and 55 CAMRPG users) are used for doing statistical analysis and independent t-test.

Table 7 lists the descriptive statistics of the perceived usability that the users have for the games they played. Apparently CAMRPG users have perceived the effectiveness of the game they played more positively as well as more satisfy with it than CAMEG users. Therefore, hypothesis H2 is **supported**.

Table #-7. Descriptive statistics of the perceived usability for CAMEG and CAMRPG group

	Group	N	Mean	S.D.	Std. Error Mean
Effectiveness	CAMEG	37	3.8784	.66044	.10858
	CAMRPG	55	**4.2364**	.56809	.07660
Efficiency	CAMEG	37	**4.2230**	.53289	.08761
	CAMRPG	55	4.0591	.53568	.07223
Satisfaction	CAMEG	37	3.8811	.61003	.10029
	CAMRPG	55	**3.9818**	.50077	.06752

We further use the independent t-test to check whether or not there is significantly difference on the perceived usability between CAMEG and CAMRPG users. The results listed in Table 8 show that there is significant difference found for the perceived effectiveness toward the games the users played, but no significant difference has found on the perceived efficiency and satisfaction factors. This finding further shows us that having stories in the mobile educational game not only make the users have higher satisfaction towards the game, but also increase their perceived effectiveness of the game. The results lead us to a positive answer for our research question - does having story in the mobile educational game make the game more appreciated by learners? Therefore, hypothesis H3 is **partially supported**.

Table #-8. Independent t-test to examine the different perceptions toward the two games

Usability Factors		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Effectiveness	Equal variances assumed	.944	.334	-2.775	90	.007**	-.35799
Efficiency	Equal variances assumed	.732	.394	1.442	90	.153	.16388
Satisfaction	Equal variances assumed	1.503	.223	-.866	90	.389	-.10074

**: $p < 0.01$

For verifying if there is any gender difference on the perceptions toward the usability of CAMRPG, we check the descriptive statistics and do an independent t-test on CAMRPG users' perceptions based on their genders. Table 9 lists the descriptive statistics, all CAMRPG users perceive positive usability of CAMRPG. It seems that the female users have perceived the effectiveness and the efficiency of the CAMRPG a little bit more positively than the male users.

Table #-9. Descriptive statistics of the perceived usability of CAMRPG for male and female students

CAMRPG	Gender	N	Mean	S.D.	Std. Error Mean
Effectiveness	Female	24	**4.4167**	.54507	.11126
	Male	31	4.0968	.55407	.09951
Efficiency	Female	24	**4.1042**	.53627	.10947
	Male	31	4.0242	.54143	.09724
Satisfaction	Female	24	3.9667	.43606	.08901
	Male	31	**3.9935**	.55253	.09924

Also, according the t-test results listed in Table 10, there is significantly different perceived effectiveness toward the CAMRPG between male and female participants. These results lead us to a partial positive answer for the research question - is there any gender difference existed in the perceived usability of CAMRPG? Therefore, hypothesis H5 is **supported**.

Table #-10. Independent t-test to examine the perceptions that different gender has toward CAMRPG

CAMRPG (using story in mobile educational game)	Levene's Test for Equality of Variances	t-test for Equality of Means

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Effectiveness	Equal variances assumed	.012	.913	2.138	53	.037*	.31989
Efficiency	Equal variances assumed	.115	.736	.546	53	.588	.07997
Satisfaction	Equal variances assumed	1.230	.273	-.196	53	.846	-.02688

*: $p < 0.05$

4.3 Findings and Discussions

Based on the collected data and the quantitative analysis, we then have answers for the proposed four research questions and get better idea of the effects of stories in the educational games, at least in the mobile education games.

(1) Do the stories have positive influence user acceptances toward the use of CAMRPG?

Yes, as the descriptive statistics of CAMRPG users' acceptance toward the game (listed in Table 4) and the results of independent t-test on the difference of acceptance among genders (listed in Table 5) show, CAMRPG users do have very positive responses toward the acceptance of the game and there is no gender difference found.

(2) Do the stories make users feel the game is useful?

Yes, except the perceived efficiency of the game may be dropping. The descriptive statistics listed in Table 7 shows that CAMRPG users perceive higher effectiveness and are more satisfying with the game than their counterpart – CAMEG users. The descriptive statistics also shows that the perceived efficiency of the game that CAMRPG users have is lower than CAMEG users. One possible reason for that is because CAMRPG does not allow users to start a learning activity until they read the story. In such case, the users are always encountering extra step (i.e., transition story) in-between two learning activities, which is, highly possible to make the users feel not so efficient in playing the game.

Fortunately, from the results of the correspondent independent t-test listed in Table 8, we can find that there is no significant difference on the perceived efficiency towards the games among the two groups, which means, the stories in the mobile educational game does not have too much negative

impact on the perceived efficiency that the users may have while playing the game.

(3) Is there any gender difference existed in terms of the perceived effectiveness and satisfaction toward CAMRPG?

First of all, the descriptive statistical data (i.e., Table 9) shows that the responses from both males and females were positive in terms of perceived effectiveness and satisfaction toward CAMRPG. In addition, responses of female participants to the perceived effectiveness are higher than those of male participants in the pilot. This finding align with other researchers' findings, which are males tend to feel educational games are boring but females have more positive perceptions toward educational games [5,9].

One interesting finding comes from the usability assessment of the proposed game. Female users have more positive perceived effectiveness and efficiency toward CAMRPG than male users. For the effectiveness factor, in particular, a significant difference exists between female and male users. Female users believe that they can learn object relevant knowledge effectively in the authentic learning environment.

One thing needs to be noted is, the results of independent t-test for examining the differences between male and female users who played CAMEG listed in Table 11 shows – the male and female CAMEG users have significant differences in terms of satisfying with the game they played. However, there is no significant difference on the perceived satisfaction towards the game among CAMRPG users. This finding implies that the usr of stories in the mobile game may make male users feel the game more like a real game and make them have higher satisfaction towards the game.

Table #-11. Independent t-test to examine the perceptions that different gender has toward CAMEG

CAMEG (mobile educational game without story)		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Effectiveness	Equal variances assumed	3.179	.830	2.185	35	.036*	.36889
Efficiency	Equal variances assumed	1.273	.267	1.470	35	.150	.27497
Satisfaction	Equal variances assumed	1.778	.191	2.339	35	.025*	.51143

*: $p < 0.05$

(4) Do gaming experience influence user acceptances toward the use of CAMRPG?

According to the demographic information of the participants listed in Table 3, the results show that hard-core game players spend average almost ten times of the hours on playing computer games than casual game players. Since hard-core game players play more games, it may lead us to have an assumption that they have a higher standard while evaluating the proposed game than casual game players. Surprisingly, hard-core game players, on the contrary, do have significantly more positive response in terms of the acceptance toward using the game than casual game players as the results show in Table 6. One possible reason that leads us to this finding – hard-core players like game and would like to give any game a shot. However, as the data is collected after the users played the game, such reason may imply that even hard-core players treat CAMRPG a real game instead of "learning application".

5. CONCLUSION

This chapter first reveals the design of a story generation engine for mobile educational role-playing game and the use of decorating mobile learning activities with the generated story fragments. An experiment has been done for assessing the effect of stories. The results show that the stories play an important role in terms of increasing student perceptions toward the mobile educational game's effectiveness and making students more satisfied with the game.

Many interesting and important findings have been found. For instance, male students perceived lower effectiveness of using a mobile educational game for learning and not satisfy with the game as their counterparts do when the game has no story. However, male students are more satisfied with the game when the game has stories to decorate its learning activities and become no significant different from female students. With such finding, mobile learning activity designer and mobile learning systems (apps) developers should consider the integration of stories into their designs and apps so both male and female students may perceive effectiveness and get more satisfy with the mobile learning systems/apps.

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