ATHABASCA UNIVERSITY

PLATFORM INDEPENDENT GAME BASED EDUCATIONAL REWARD SYSTEM

BY

CHENG-LI CHEN

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULLFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE in INFORMATION SYSTEMS

FACULTY OF SCIENCE AND TECHNOLOGY

ATHABASCA, ALBERTA

SEPTEMBER, 2019

Approval of Thesis

The undersigned certify that they have read the thesis entitled

PLATFORM INDEPENDENT GAME BASED EDUCATIONAL REWARD SYSTEM

Submitted by

Cheng-Li Chen

In partial fulfillment of the requirements for the degree of

Master of Science in Information Systems

The thesis examination committee certifies that the thesis
and the oral examination is approved

Supervisor:
Dr. Maiga Chang
Athabasca University

Committee Members:
Dr. Hongxue (Harris) Wang
Athabasca University

Dr. Hung-Yi Chang
National Kaohsiung First University of Science and Technology

Dr. Rita Kuo
New Mexico Institute of Mining and Technology

External Examiner:
Dr. Zhou Long
Huaihua University

February 5, 2019

Abstract

Reward has become an important role to increase students' motivation in traditional classroom learning. This research designed an In-game Card as Education Reward (ICER) web-based system which helps teachers give students reward while students have good performance in learning activities such as assignment, presentation, and exam. Whenever students complete a learning activity, their teacher can choose different type and rarity in-game cards and deliver the cards to the students by using ICER web-based management system. Students can redeem the reward on ICER website and receive in-game cards in the game. When students have better performance in terms of doing learning activities, they will receive more powerful in-game items from ICER. With these powerful in-game cards' help, students can have more fun in the game-play and may put more efforts on doing their homework and may be actively participated in the discussions in the class for getting better rewards.

Keywords: In-game card, Learning Performance, Trading Card Game, Educational Reward

Table of Contents

List of Figures

List of Tables

Chapter 1. Introduction

This chapter mainly describes the motivation of doing this research. I will also introduce the proposed goals and possible contributions for this research. At the end of this chapter, I will briefly describe the structure of this research.

1.1 Motivation

Traditionally, teachers give students rewards according to the performance that students have shown in different learning activities. Eric, a science teacher, wants to encourage students to learn. He may give pencils as rewards to the top three students who receive highest marks for the mid-term exam. He expects to see that students will have better performance for the next learning activities (e.g., final exam) if they receive rewards from this one.

In the context of distance education and online learning, for instance, students at Athabasca University are learning online in different time zones across Canada and worldwide, giving students real items as rewards is impractical and unrealistic. In order to make teachers still capable of rewarding students just like how they did in traditional learning settings, a system works with educational reward mechanism needs to be designed and developed.

1.2 Goal and Contribution

This research plans to design a platform independent game-based educational reward mechanism – ICER web-based system. The system includes educational reward setup modules and reward distribution module for the trading card game. Besides, there is a robust authorization and data communication framework among the system, which can be easily integrated into web and the game. Teachers can use similar way to give students “in-game” card as rewards like what they always do in

classrooms. With the system's help, students' academic achievement may be improved. Moreover, teachers can use the rewards to engage students to participate in online learning activities, particularly in online discussions. In summarize, this research will develop a system which can achieve the following goals:

1. Students' learning performance will be improved.
2. To help teacher enhance students' participation in online learning activities.
3. Academic administrators or teachers can easily adopt ICER web-based system in any courses without compromising student's privacy.

1.3 Thesis Organization

In Chapter 2, I will discuss some relevant works. First of all, Learning Management System will be discussed to understand why Moodle can be one of the most popular Learning Management System. Then discuss the effectiveness of Web 2.0 applications, why Web 2.0 applications have become effective learning environment. In section 2.3, I will discuss why rewards can motivate students in learning. Moreover, Game-Based Learning will be also discussed in section 2.4 to understand how learning motivation affects learning effectiveness. I will also take Trading Card Game as an example to discuss how students are stimulated in learning.

In Chapter 3, I will discuss the development of Educational Resource Information Communication Application Programming Interface (i.e., ERIC API) as well as the architecture and workflow of the API. Then I will also use the integration of Moodle and Online Test System with ERIC API to show the implementation. Chapter 4 describes two different applications for in-game card as educational reward (ICER) - ICER Moodle plug-in, and ICER web-based system. Both the two application will also adopt ERIC API to do the integration.

In Chapter 5, I will conduct the pilot of the research. Research model and

some hypothesis will be proposed. Experiment design such as experiment flow and designed questionnaires also can be found in Chapter 5.2. Then, follow up chapter will show the reliability and validity for the designed questionnaire, quantitative analysis will also be shown at the end of the chapter. In Chapter 5.4, I will discuss the expected findings and unexpected findings for the hypothesis.

Chapter 6 will summarize the conclusion and the next step of this research for the further improvement.

Chapter 2. Relevant Research

The concept of In-game card as Educational Reward (ICER) has been adopted in two different scenarios so far – for Learning Management System (i.e., ICER Moodle plug-in) and for Web (i.e., ICER web-based System). These two scenarios are getting involved with the development of Learning Management System and Web 2.0.

In order to see whether or not students can be affected or motived by the proposed ICER web-based system I also do some survey by reading some educational reward and game-based learning literatures that can be found in section 2.3 and section 2.4. In section 2.5 I use concrete instance to show that Chen's designed game and reward can indeed affect students learning motivation.

These powerful literatures provided critical information can be used to theoretically support my research. At the end of this chapter, I will summarize some objectives and research issues for achieving the research goals.

2.1 Learning Management System (LMS) and Moodle

In online learning environment, Learning Management System plays an important role which can help teachers to monitor students learning outcomes such as students' academic achievement. Students can use learning management system to access learning materials through web browsers while using desktop, laptop or any other mobile devices. In addition, students can interact with tutor or each other by sharing knowledge, taking online exams and uploading assignments (Jurubescu, 2008).

According to Lwoga's research (2014), a successful learning management system must have positive user's perception of usefulness and satisfaction toward the system. If users feel the system is useful, they could be satisfied and be pleasure to

adopt it continually. Therefore, to increase the usage of learning management system such as improve usability can make the system success (Mtebe, 2015). Moodle now has become a successful learning management system since it is flexible, scalable, sustainable, and ease of use (Thuseethan & colleagues, 2015). The most important thing is Moodle is a cost-effective open source learning management system.

Al-Ajlan (2012) choose ten learning management systems (i.e. LON-CAPA, Desire2Learn, ANGEL Learning, TeleTOP, Blackboard, Sakai, dotLRN/OpenACS, ATutor and Moodle) which meet the requirement of Qassim University. He compared the chosen learning management systems according to predefined criteria – the functionalities (e.g., discussion forums, video services, etc.) the systems have (Al-Ajlan, et al., 2008). He found that Moodle has the most available features. Furthermore, Cavus and Zabadi (2014) compared another six popular learning management systems (i.e., ATutor, Claroline, Dokeos, Ilias, Moodle, and Sakai) by summarizing their functionalities. They found that Moodle has the most completed communication tools (e.g., real-time chat and discussion forum), which has served over seventy millions users. Apparently, Moodle has become the most popular learning management system for online learning.

Moodle was developed by Martin Dougiamas which has various modules for students to learn (Dougiamas and Taylor, 2003). As Figure 1 shows, Moodle can be developed by open source software such as PHP and MySQL. Besides, it can be implemented on any difference operations such as Windows and Linus. Students or teachers can use any kind of browsers (e.g., IE and Chrome) to login Moodle. The most common modules that Moodle has are forum, testing, assignment, voting, Wiki, chat room, questionnaire and expansion module (Jin, 2012). This research will develop expansion modules (e.g., criteria setup module and in-game item deliver module) for the reward mechanism purpose.

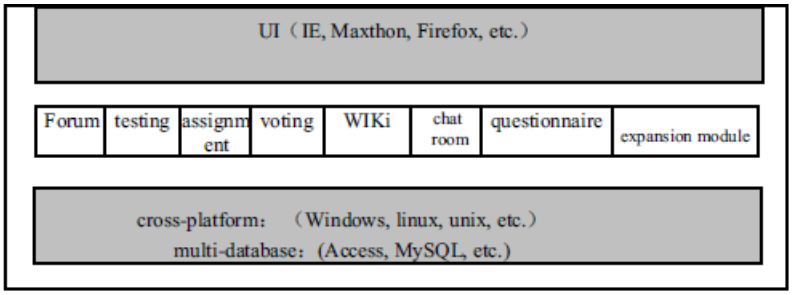

Figure 1. Architecture of Moodle (according to Jin, 2012).

2.2 Web 2.0 Applications

The earliest Web 2.0 concept was proposed by O'Reilly (2007) who though the strong Web 2.0 can harness collective intelligence. For example, Wikipedia allows users to add or edit information to be more exactly. Web 2.0 applications will be more portable and can be implemented on different platforms or devices. In online learning, Web 2.0 applications also can be imported into it such as E-learning 2.0 (Pattnayak and Pattnaik, 2016). Unlike E-learning 1.0, students can use social software such as wikis to obtain knowledge by interact with each other.

In recent years, many useful Web 2.0 applications/systems (Bosch, 2009) such as Facebook, AU landing, blogs and wikis are proposed and allow teachers to create effective learning activities in online learning environment. In order to compare students' discussion abilities in different learning environments (i.e., traditional learning and Facebook), Orawiwatnakul and Wichadee (2016) conducted a pilot in a course – "English for Expression Ideas". They let students to do the group discussions in traditional classroom and followed by a test (i.e., test #1) at the first stage. At the second stage, students just needed to discuss with each other on Facebook and also followed a test – test #2. They found that students' scores of test #2 are significantly higher than their scores of test #1. Besides, students had satisfied perceptions toward the discussion activity on Facebook.

2.3 Educational Reward

In traditional classroom learning, Winefield and Barnett (1984) argued that rewards positively affect students' learning performance. However, Marinak (2007) pointed out that if rewards are not attractive to students, students' learning motivation will not be affected. Another researcher, McNinch (1996), considered that cash can be used as reward to encourage students learning. Although this method is attractive for students, it is still criticized by others as giving cash to students that looks like a kind of suborning (Kohn, 1999). According to the above studies, we can find out that only when students think the rewards they received are valuable or meaningful, the reward mechanism can be effective in terms of engaging students in learning.

2.4 Game-Based Learning

Jong and colleagues (2013) developed a game to integrate into an unpopular course “Operation System” in department of information management. They found that students’ performance such as test scores are significantly increased. Besides, students were more likely to put efforts in learning. Lin and colleagues (2014) designed an experiment to compare students’ learning motivation in game-based learning environment. They found that no matter what kind of platforms the game took place such as mobile devices, or desktop/laptop computers, students’ learning motivation can be significantly improved. In conclusion, game-based learning can stimulate students’ learning motivation even if they don’t like the course.

2.5 Trading Card Game

To make rewards more attractive for students, Chen (2009) used cards in the Trading Card Game (TCG) he developed as educational rewards. Teachers can give students higher-level cards if students did exercises well. Once students receive

higher-level cards, they have higher chance to win in the game-play. On the other hand, when students are not doing exercise well, they probably will not receive cards as rewards or only receive lower-level cards for what they have done.

Chen’s research also conducted an experiment to find out whether or not the use of the trading cards as educational rewards affects students' motivations and academic achievements. There were 172 fifth-grade students, 80 boys and 92 girls, participated in the experiment and were separated into two groups. The 68 control group students only used a vocabulary system for practicing their English vocabularies, and the 104 experiment group students used the vocabulary system and received cards as rewards automatically every time after they practiced vocabularies with the system.

Chen’s research result showed that students who played the TCG more, they practice in the vocabulary system more often. The result suggested that students were study harder in order to receive higher-level cards. However, the research only has one learning activity which is vocabulary learning. Moreover, Chen's study only investigated elementary school students' attitudes toward the TCG. It is very important to know whether or not the same effect can be found at secondary and post-secondary level.

Having Web 2.0 applications included in courses in a technology-enhanced learning environment like Moodle may require teachers doing a lot of efforts from the course/activity design stage to the students learning stage (Oproiu, 2014). On the other hand, when a university like AU wants to integrate any application/system into the learning management system, a heavy loading for developers and a lot of manpower hours and testing are required. Similar to the difficulty of integrating Web 2.0 applications into a learning management system, in order to develop the reward mechanism a game also needs to be integrated into Moodle that allows teachers to

give in-game items for students as rewards.

2.6 Objectives and Research Issues

In order to reach the research goals this research has following two objectives:

Objective #1: To have a secure robust authorization and data exchange protocol and mechanism between the ICER web-based system and Trading Card Game while student's privacy and anonymity is maintained.

ICER web-based system and TCG are two systems. Student's private data like student ID should never be known by the game and student's identity should remain unknown from other players in the game. As the rewards that students received need to be sent to the game from the ICER web-based system, it is important to have a secure and robust authorization and data exchange mechanism so students can receive the rewards they deserved to have while keeping students to receive unauthorized rewards.

Issue #1-1: How does the "reward distribution module" deliver students cards to the game without compromise of students' privacy, such as their name and student ID?

The game, the proposed TCG, is an independent system allowing students from different schools around the world to play and compete with others. Each school may have its own students' private data (e.g., student ID, gender, and academic scores) stored. When integrating the educational reward modules into ICER web-based system, the private data should not be sent to the game. On the other hand, the game does need to know a unique ID which is associated to a particular student and won't never change so it can dispatch correct cards to correct player.

There are two ways I can fulfill the game's need and protect student's privacy. The first one is to add a table which stores the mapping of student ID and player ID in

the database on the server runs ICER web-based system. In such case, the “reward distribution module” can tell the game a specific player ID when it wants to deliver cards for particular student. The other solution is to add a conversion mechanism that covert student ID into a unique code. With this conversion, the distribution module and the game can use the unique code as key to associate to a particular player ID and deliver cards as rewards for the student without compromising her or his student ID.

Issue #1-2: How to avoid unauthorized card delivery request?

When the distribution module sends requests to the game for delivering cards to a specific player, the communications between the two systems may be intercepted by hackers. Using the intercepted information, hackers might alter packages sending from the distribution module and make themselves (or help others) receive cards that are not belonging to them. In order to prevent fake or unauthorized card delivery request happens two solutions can be considered.

The first solution is to add a program which establishes, with the game, a set of keys to provide to the distribution module. The module will encrypt its communications with the keys. When the game receives the card delivery request, it can judge the accuracy of the request. The other solution is to add a timestamp program which records the timestamp of the distribution module sends the request. When the game receives the request, it can determine whether or not the request’s sending timestamp is correct.

Objective #2: Improve students' performance on learning activities

To prove the ICER web-based system is useful, it is important to have an experiment designed and conducted to verify the following two issues:

a. Students' performance of the follow-up learning activities will be improved if they receive in-game cards for their current activities.

b. Students will actively participate in learning activities when the ICER web-based system and TCG are integrated with ERIC API.

Issue #2-1: What is learning performance?

In order to find out whether or not the ICER web-based system can affect students' learning performance, we need to define what learning performance is.

The possible way to recognize the learning performance is depending on what the learning activity is. For example, if students take traditional math course, their improvement from midterm to final exam could be their learning performance. The other way is to find out what else learning activities can be used to collect learning performance through literature review.

Issue #2-2: What is the effectiveness of using cards as educational rewards?

After defining the types of collectable learning performances, this research will evaluate the effectiveness of using in-game cards as educational rewards for students and teachers. This study considers the use of two ways to evaluate the effectiveness. The first way is designing a questionnaire to collect students' perceptions toward the ICER web-based system, rewards (i.e., the cards), and the game. The second way is to interview with teachers to understand their perceptions and experiences of using the ICER web-based management system. For example, we can also ask the teacher how she or he feel about students' participation changes in learning activities after she or he adopts the reward mechanism.

Chapter 3. Educational Resource Information Communication (ERIC API)

Educational Resource Information Communication (ERIC) API has been developed which enables the integration of two separate system and enhance their interoperability while keeping both systems working independently like they were. ERIC API can be easily inserted or attached to any system through making no or very little modifications to the system. With ERIC API's help, educational technology researchers can make their research (i.e., educational games) available and accessible for the potential users as the stakeholders don't need to put many efforts in terms of integrating their systems into the platform the stakeholders like schools are currently using. This Chapter mainly focuses on the workflow of the developed ERIC API and talks the case of integrating Moodle and Online Tests System (OTS) so students can grant Moodle permission to access the information of the tests they are supposed to take, whether or not they have completed particular tests, and how they performed in the tests.

3.1 Workflow of ERIC API

When a student logs in Moodle, the Moodle authenticator has to check whether or not his or her credential such as username and password is correct. To enable the interoperability of Moodle so it can work with other independent system like OTS – an online test system, it needs to store the student's username into session after his or her identity has been verified. Figure 2 shows how ERIC API works in the integration of Moodle and OTS.

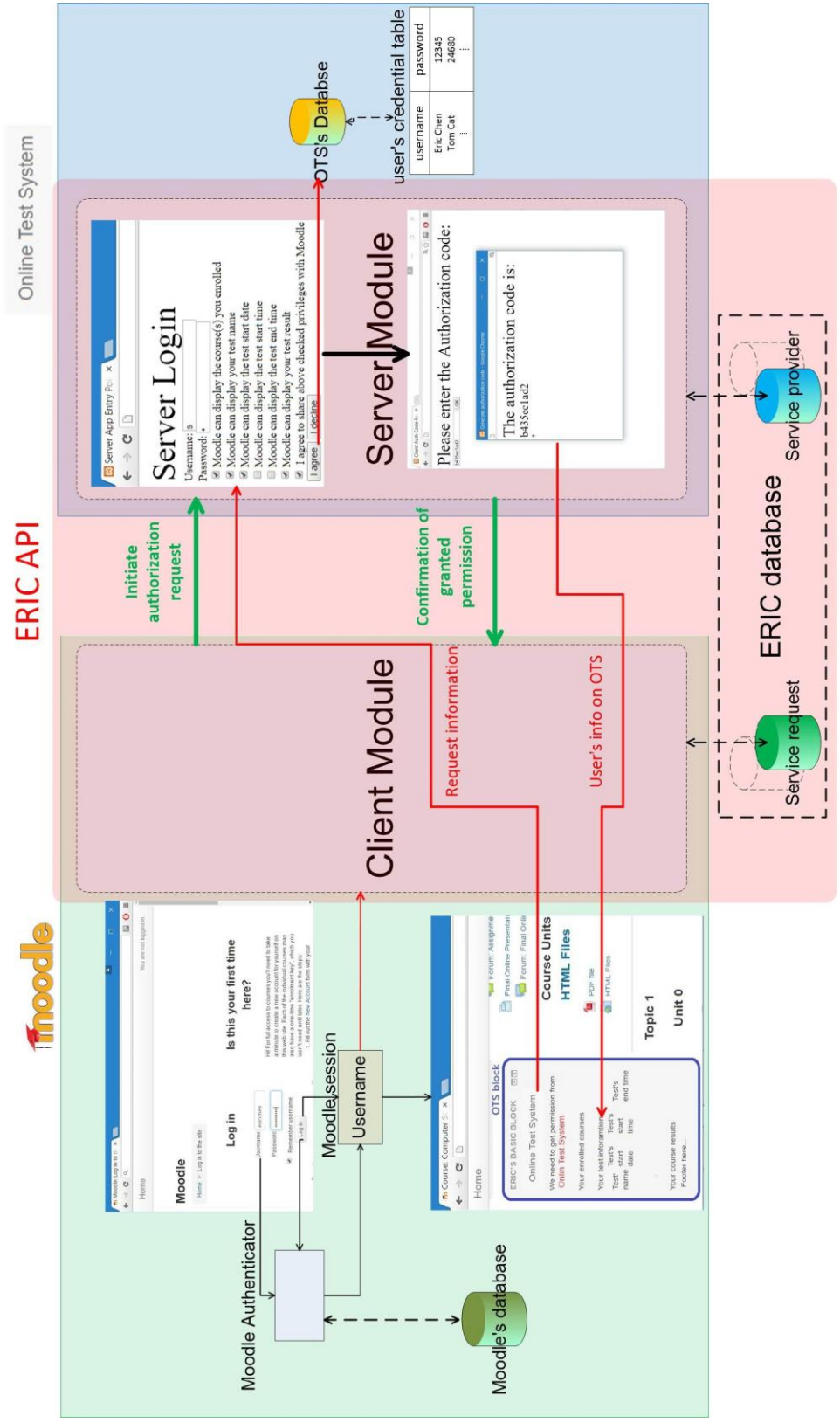

Figure 2. Prototype of ERIC API.

Before a Moodle block (as shown at bottom left of Figure 2) can ask for the student's test relevant information from OTS and show on the block, Moodle has to

get permission from the student so OTS can respond its information access request. To get the student's permission, the client module of ERIC API at Moodle site (i.e., we call service requestor) first retrieves the username from the session and converts it to a specific Universally Unique Identifier (UUID). The client module then redirects the student to the permission granting page of the server module of ERIC API at OTS site (i.e., we call service provider). On the permission granting page, the student has to enter his or her OTS's username, password and select at least one privilege (e.g., allows Moodle to show the tests he or she is supposed to take) that he or she wants to grant for Moodle to access. The server module randomly generates an authorization code and redirects the student back to the service requestor with the confirmation of granted permissions after it verifies the student's identity from OTS' database. As soon as the student confirms his or her authorization via entering the correct authorization code, OTS block on Moodle will be able to send information requests of the granted permissions to OTS and get the data its needs to show on the webpage.

3.2 Case of the Moodle and OTS Integration

In this section, I use a case to explain how a student grants Moodle to access and show the information that he or she has on OTS when the ERIC API is plugged into Moodle. As Figure 3 shows, when a student logs in Moodle, he or she can see a block on the left side on Moodle.

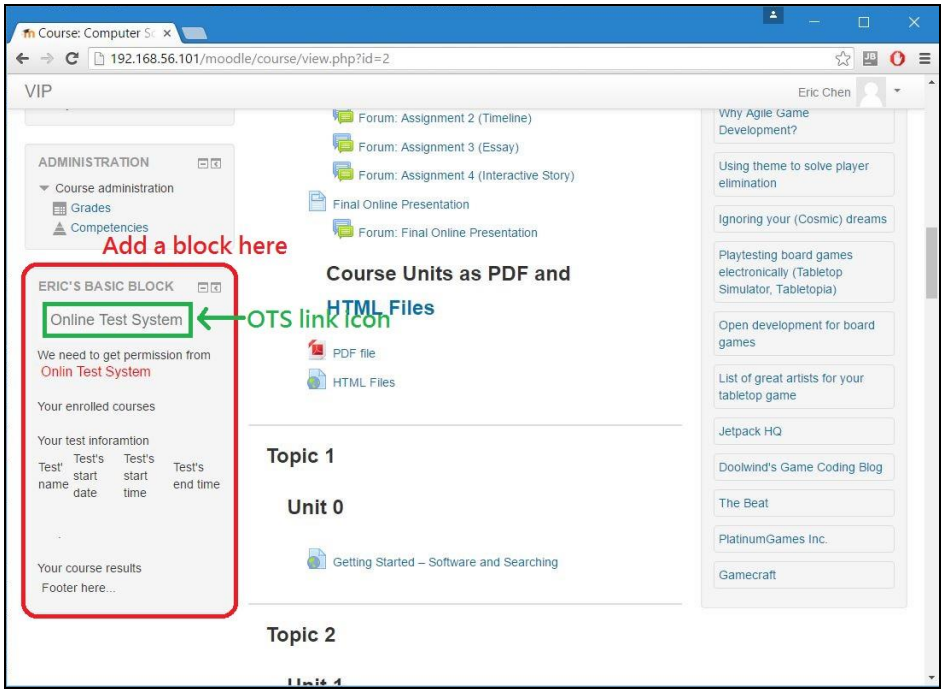

Figure 3. A Moodle block.

The student can click the "Online Test System" link to setup which permissions he or she wants to grant for Moodle to access. Figure 4 shows he or she allows Moodle to access and show the courses he or she enrolled, the test names and their start dates he or she needs to take, and the performances he or she got.

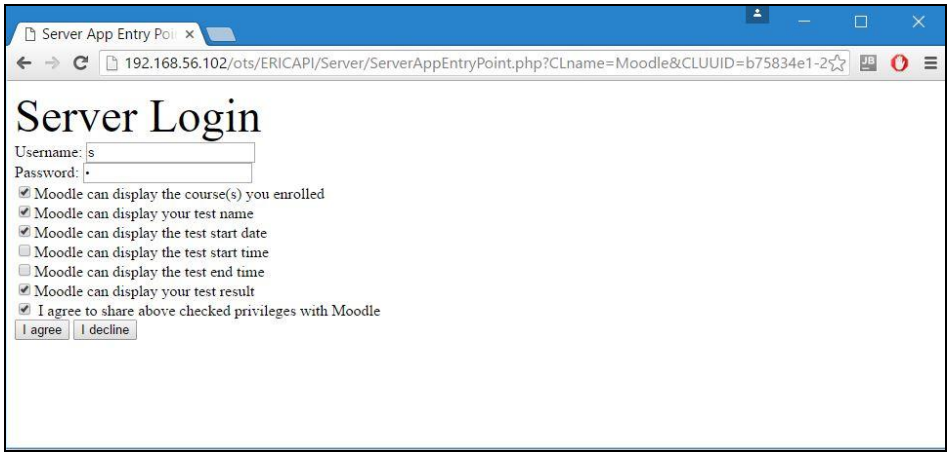

Figure 4. Permission granting page at service provider side.

Figure 5 shows that the Moodle block now can show the information on OTS that the student authorized it to access via sending requests to OTS with client module of ERIC API.

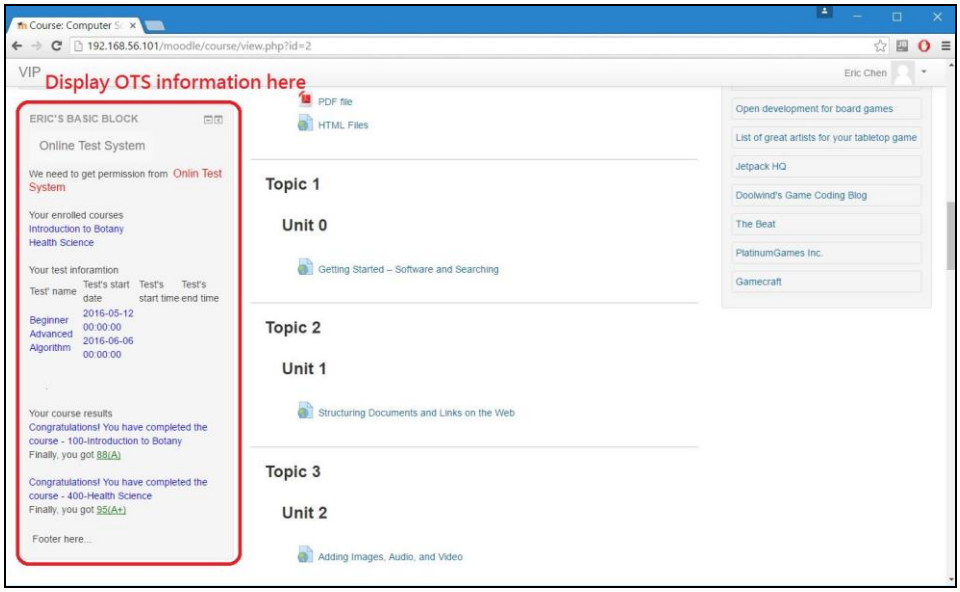

Figure 5. The Moodle block with built-in ERIC API can now access the student's information on OTS.

Chapter 4. In-game Card as Educational Reward (ICER)

This Chapter mainly describes the integration of Moodle and TCG with ERIC API – ICER Moodle plug-in. In section 4.1, I would like to introduce the architecture of ICER Moodle plug-in. The implementation of ICER Moodle plug-in can be found in section 4.2. For section 4.3, I applied ICER to a web-based system with the trading card game (TCG) for delivering in-game cards to students as educational rewards. The implementation of ICER web-based system can be seen in section 4.4.

4.1 ICER Moodle Plug-in

I designed Educational Reward plug-in for Moodle to deliver cards of the TCG that Chen and colleagues developed (Chen, 2009). The plug-in needs to support teachers awarding their students by giving particular cards according to students' performances on different learning activities. With the help of Educational Resource Information Communication API (i.e., ERIC API), students' identities won't never be revealed to the game while the Moodle plug-in delivers in-game items as rewards according to the pre-defined award criteria.

Learning Management System like Moodle and the TCG are two systems that this research aims to integrate together so teachers can set some award criteria up for giving students in-game items as rewards according to their performances of particular learning activities. The plug-in at Moodle platform side needs to get student's permission in sending in-game items as rewards to the game side. By integrating ERIC API into the design of the plug-in, Moodle can work with the game and reach the goal and keep student's private data like student ID and identity remaining unknown for both of the game and its players.

In order to reach the goal, the plug-in should have three modules: criteria setup module, evaluation module and reward distribution module. Using an example to

explain the architecture and workflow of the Moodle plug-in and the relationship between the plug-in and the TCG. A science teacher, John, who teaches Math and he creates a 10-question quiz for students to practice as step 1 in Figure 6 shows. The criteria setup module will get the quiz activity from Moodle's database (i.e., step 2 in Figure 6) for him to setting up the awarding criteria (e.g., for students who get more than 90 marks will be awarded one level 3 avatar card; for whom gets marks higher than 80 will be awarded one level 2 avatar card; and, for whom gets marks higher than 70 will be awarded one level 1 avatar card) for the quiz as step 3 in Figure 6 shows. The module will save all teacher predefined criteria to a Reward database as step 4 in Figure 6 shows. The second module, evaluation module, then will assess whether or not a student can be awarded against the predefined criteria as Step 5 shows.

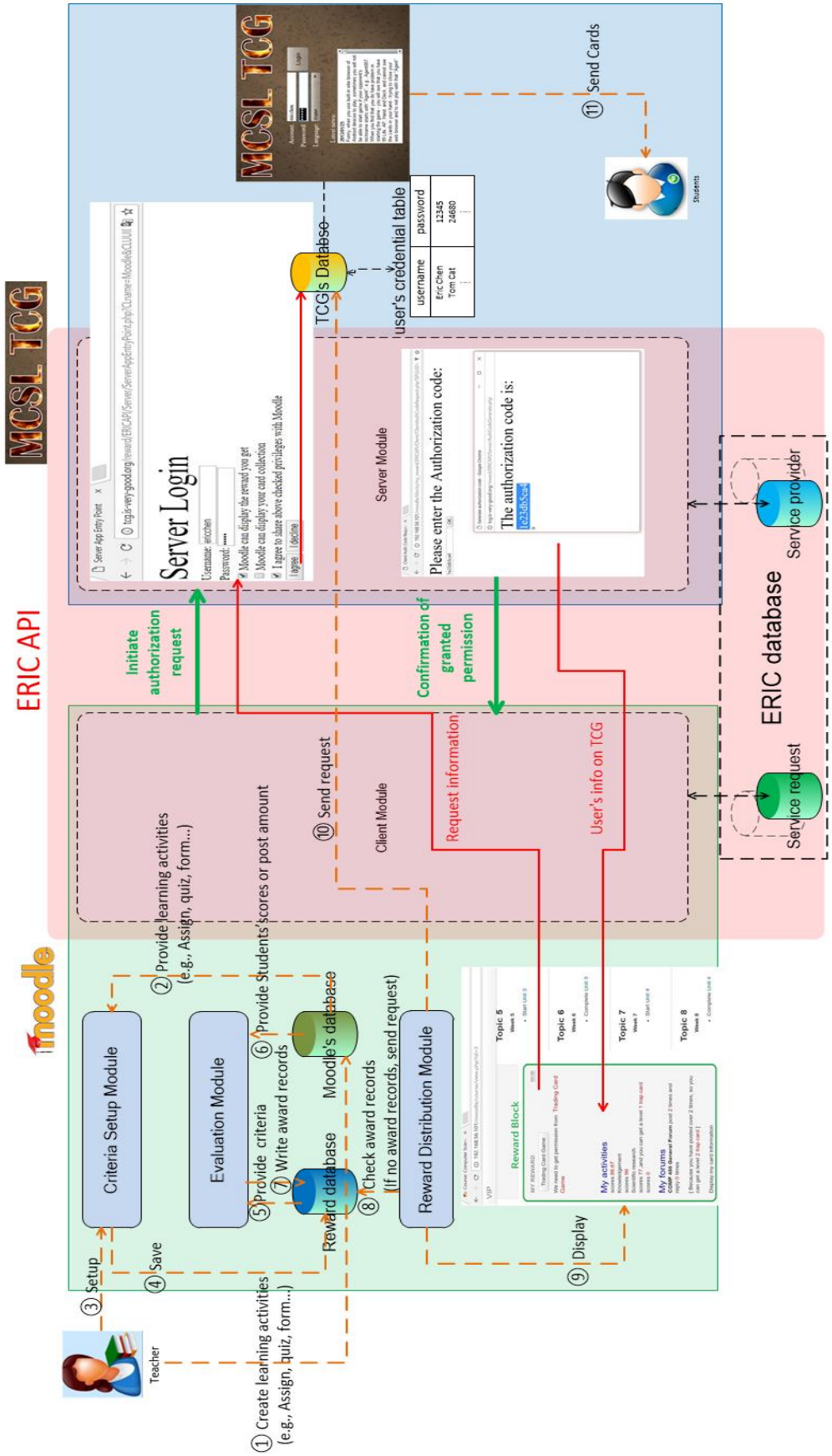

Figure 6. Reward Moodle plug-in's architecture and workflow.

Assuming a student, Eric, gets 90% marks for the quiz, the evaluation module will assess his performance (i.e., step 6) and write the award record to Reward database every time when the main page of the course is loaded or refreshed (i.e., step 7).The reward distribution module will check the award record(s) for the student and make a card delivery request to the TCG every time when the main page of the course is loaded or refreshed as step 8 in Figure 6 shows. Moreover, the reward distribution module will not only show the student what reward he or she received due to what reason (as step 9 shows), but also make a card delivery request through ERIC API as step 10 shows. ERIC API works as the bridge of the Moodle plug-in and the TCG. After receiving and confirming the authenticity of the request, the TCG will randomly choose an avatar card at requested level and assign it to Eric's account in the TCG as step 11 in Figure 6 shows.

4.2 The Implementation of ICER Moodle Plug-in

Teachers usually have different criteria for awarding students according to their performance on different learning activities. The criteria setup module needs to allow teachers to set their own awarding criteria for individual learning activity so the evaluation module can check whether or not a student should be awarded and the reward distribution module can deliver students proper items as rewards accordingly.

When a teacher signs in Moodle, he or she can see the "Reward Module Block" on the left-hand side of course's main page as Figure 7 shows. The criteria setup module can retrieve all of the learning activities (i.e., Assignment, Assign, Quiz etc.) that the course has from Moodle's database. The teacher can choose any of the learning activities that he or she wants to give students rewards based on their performance.

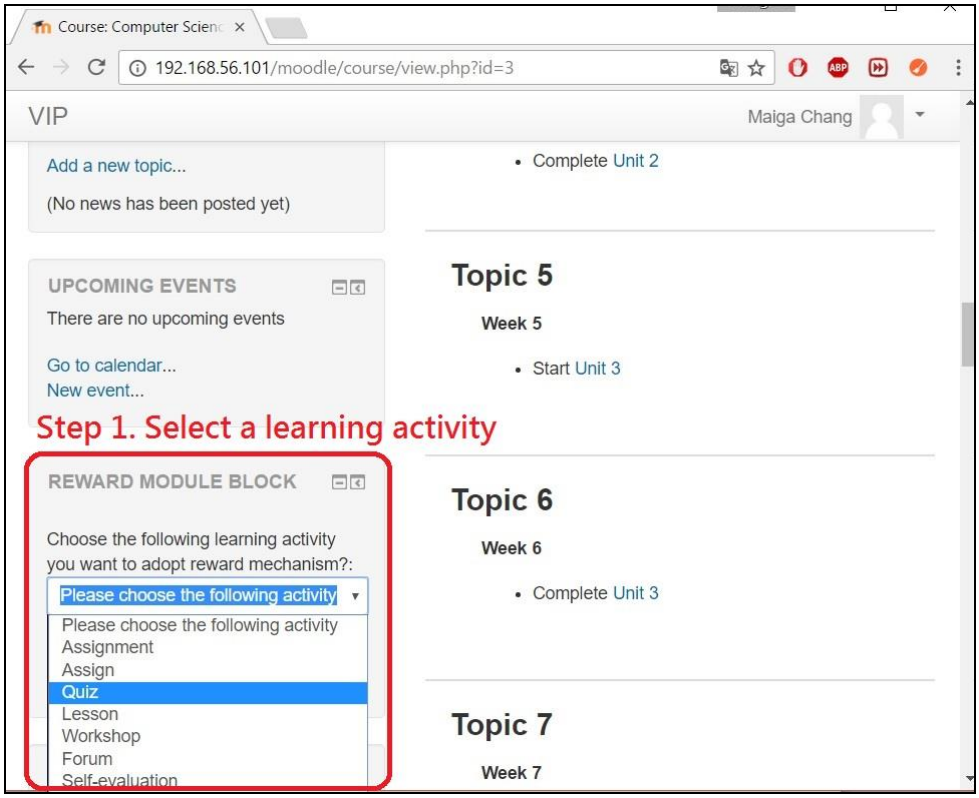

Figure 7. Reward Module block for teachers to setup awarding criteria.

After the teacher selects a learning activity, the criteria setup module will provide him or her a default awarding criteria. He or she can also freely edit the criteria based on his or her preference and plan. As Figure 8 shows, the teacher sets that students can get a level 3 avatar card if they receive marks between 91 to 100; a level 3 trap card for the marks between 81 to 90; and, a level 1 magic card for marks between 76 to 80 for the chosen learning activity “Math” which is one of the quizzes the course has. When the teacher completes the criteria setup for the learning activity, he or she can click “save” button and a “Successful saved!” message will be showing up at the bottom of the block.

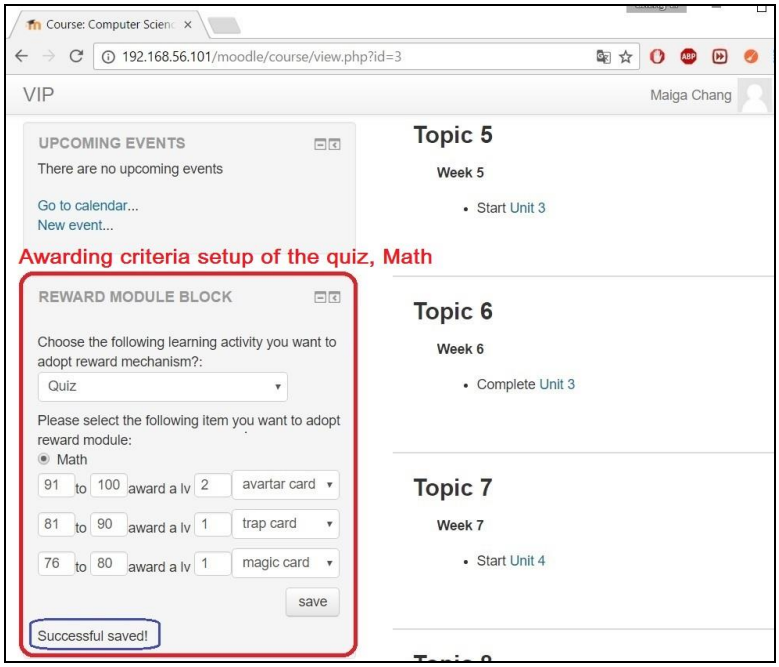

Figure 8. Setting awarding criteria for the "Math" quiz.

Before the Moodle plug-in can deliver a student the card of the TCG as his or her reward, Moodle needs to have permission to access the student's TCG account while his or her identity in both of Moodle and the TCG should remain anonymous for both systems. Here we use a student case to explain how a student grants Moodle to access and show the card collection information that he or she has in the TCG via ERIC API. As Figure 9 shows, when a student sign in Moodle, he or she can see "My Reward" block on the left-hand side of course's main page. The student can see his or her performance for the Math quiz and can know whether or not he or she can be awarded for that performance. In this case, Student A has completed the quiz and gets marks 90. The evaluation module assesses that his or her performance makes him or her get a level 3 trap card according to the criteria set by the teacher.

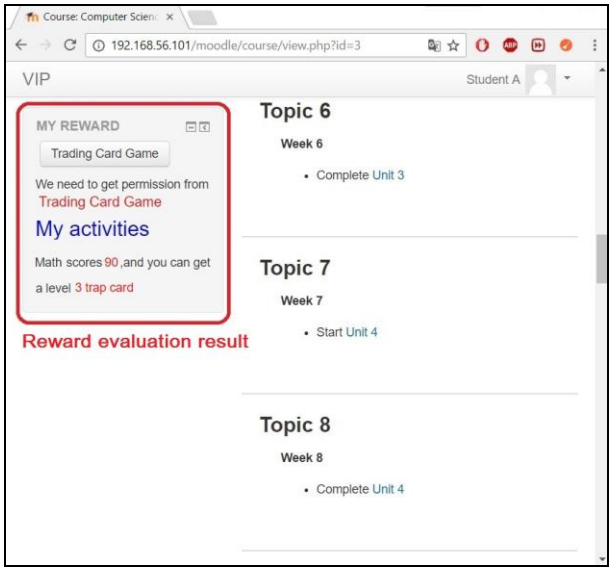

Figure 9. My Reward *block* for students seeing the in-game cards they are awarded.

Whenever the course's main page is refreshed or the student signs in Moodle again, the block reward distribution module shows that he or she has been awarded by the evaluation module as Figure 10 shows. Before the student grants Moodle permission to access his or her TCG account, any reward record will be stored into the Reward database so the reward distribution module can make reward delivery request to the TCG later.

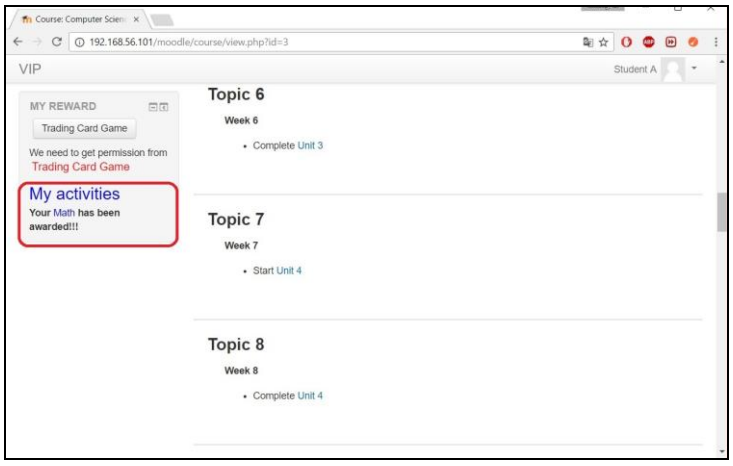

Figure 10. The *student* has been awarded for his or her performance on the Math quiz.

When the student clicks the "Trading Card Game" button, he or she can choose which permission(s) he or she want to grant Moodle to access. Figure 11

shows the student only allows Moodle to send the reward he or she gets to his or her TCG account.

Figure 11. Permission granting page at the TCG.

Since the student only needs to enter his or her TCG username and password at the TCG server, Moodle never has his or her credentials of the TCG. On the other hand, since the permission granting request made by Moodle only sent a 128-bit Universally Unique Identifier (UUID) to represent the student in Moodle, the TCG never knows which student the TCG username is. The TCG will randomly generate an authorization code as Figure 12 shows for the student entering back on Moodle within 30 seconds to make the permission granting request valid. Figure 13 shows that the block now can show the reward the student received on the TCG when the reward distribution module sends card delivery request to the TCG via ERIC API. In this case, Student A has already got a level 3 trap card.

Figure 12. Authorization code generated by the TCG and the student needs to enter the code on Moodle.

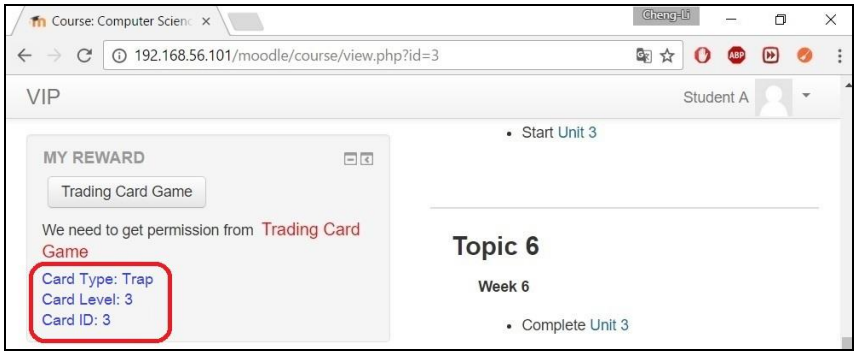

Figure 13. The *reward* distribution module can now deliver cards as rewards to the student's TCG account.

After the student receives the reward from the plug-in, he or she can sign into the game to check whether or not he or she received the card. As Figure 14 shows, the student has received a trap card, Graft. His or her card has been updated as the screenshot on the top-left corner in Figure 14 shows that he or she doesn't have the card before the reward is delivered and the screenshot on the bottom-right corner shows he or she has the card.

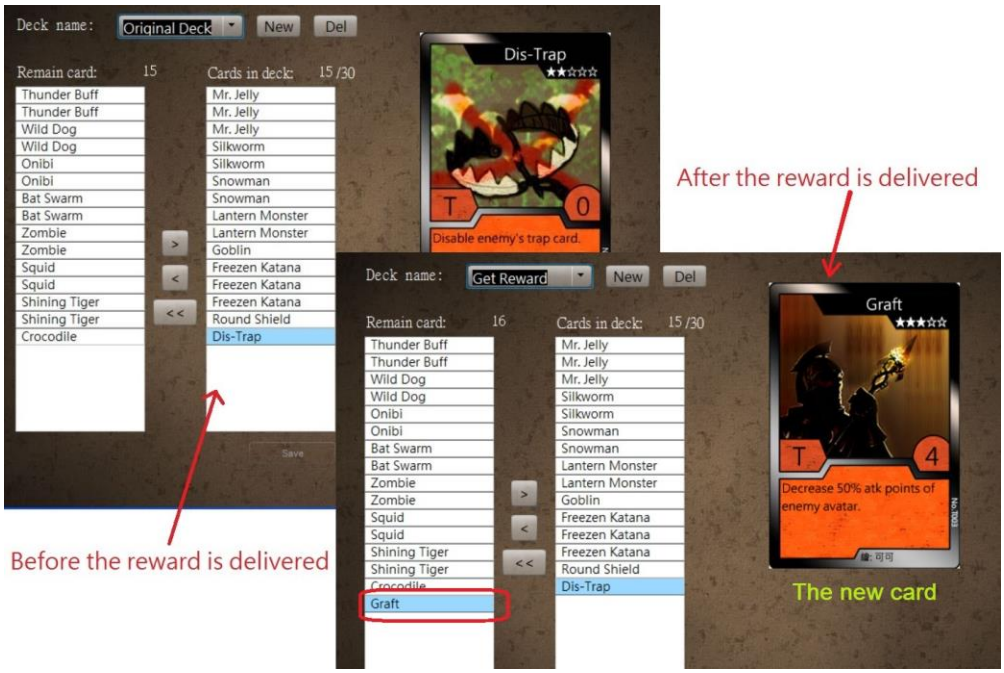

Figure 14. The *student* has received a level 3 trap card, "Graft", as reward.

4.3 The Integration of ICER Web-based System and TCG

ICER web-based system and the TCG are two systems that this research aims to integrate together so teachers can choose in-game cards as rewards for the students to redeem according to students' performances of particular learning activities. Whenever a teacher wants to give a student reward, he or she just need to sign on the system and choose type and level of the in-game card. The system will generate an URL for the teacher so that he or she can give out the URL for the student to redeem the reward. Once the student has the URL, he or she needs to authorize ICER web-based system (for once) to access his or her TCG account by entering their credentials at TCG if it is the first time he or she redeem for the reward on TCG.

ICER web-based system has two modules: reward setup module and reward distribution module. Using an example to explain the architecture and workflow of relationship between the ICER system and the TCG. A science teacher, Eric, who teaches Math and he wants to give out his students a three-star avatar card when the student gets A+ for the midterm exam. He needs to setup the reward as the Step 1 in Figure 15 shows. The reward setup module will check reward database (i.e., Step 2 in Figure 15) to remind him if the student has been awarded before (i.e., Step 3 in Figure 15). The reward distribution module will generate an URL and write a record into the reward database as Steps 4 and 5 in Figure 15 show. Eric then will send the specific URL to the students as Step 6 shows.

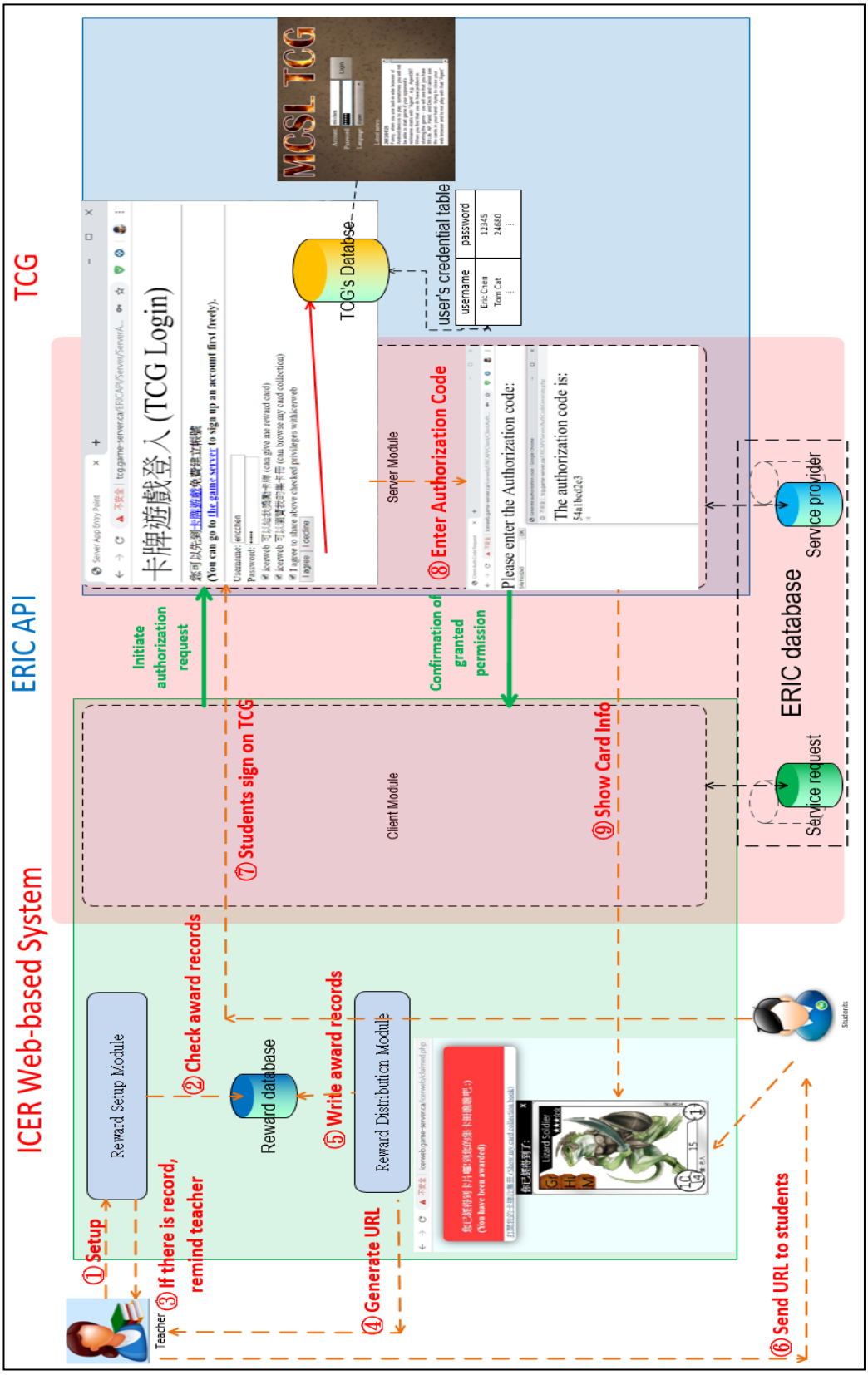

Figure. 15. Architecture of integrating ICER web-based system and TCG with ERIC API.

Assuming a student – Chris who has received the URL, he can copy and paste

it into any browser like Chrome, Firefox, Safari or IE to redeem the reward. ERIC API will redirect him to the TCG and ask him to sign on the TCG to grant the permission(s) for ICER web-based system to deliver card to the TCG as Step 7 shows. Chris then will be asked to enter the correct authorization code to make sure that communication has not been hacked (i.e., Step 8 in Figure 15). After entering the authorization code, Chris can see what kind of cards has been delivered to his account in the TCG as Step 9 in Figure 15 shows.

4.4 The implementation of ICER Web-Based System

4.4.1 ICER Web-based System for teachers. When a teacher signs in ICER web-based system, he or she can see the "Give card as educational reward" and "Manage all given rewards" hyperlink on the main page as Figure 16 shows.

Figure.16. Architecture of integrating ICER web-based system and TCG with ERIC API.

After the teacher clicks "Give card as educational rewards", he or she can enter any unique ID for the student, select the drop-down card type and level. As Figure 17 shows, the teacher wants to award Chris a three-star avatar card he or she can just create an ID "TodaysOnly" for him. As Figure 18 shows once the teacher

clicks “Give and Generate URL”, he or she can see a URL generated for student to redeem the reward in the TCG. She or he can then send the URL to Chris by any means.

Figure 17 . *Reward* setup module.

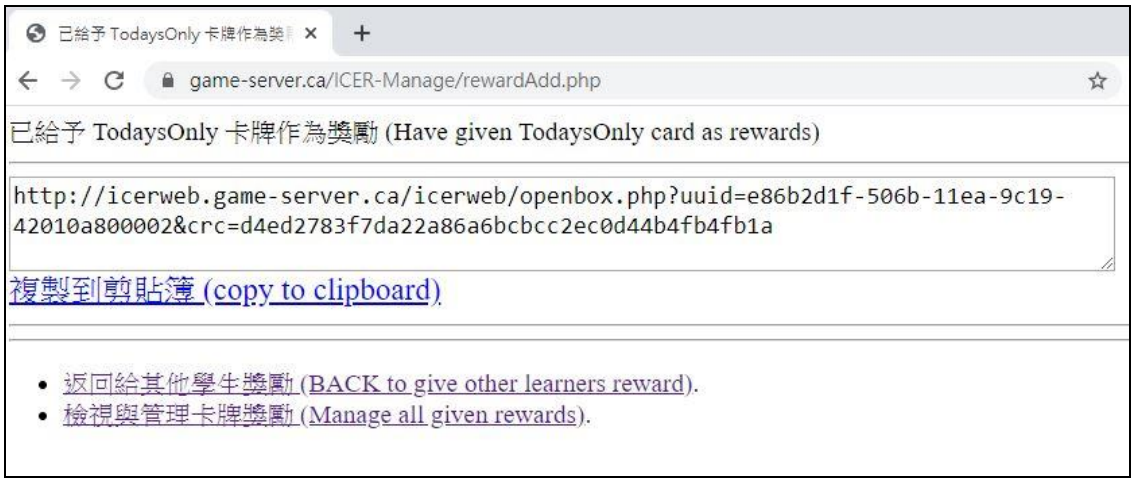

Figure 18. URL generated for student to redeem the reward on the TCG.

By clicking the link of “Manage all given rewards” shown on the main page, the teacher can also see all of the rewards that he or she has given as well as knows

who have redeemed the given rewards and who haven't as Figure 19 shows. If Chris loses the given URL, the teacher can also retrieve the link here from this page.

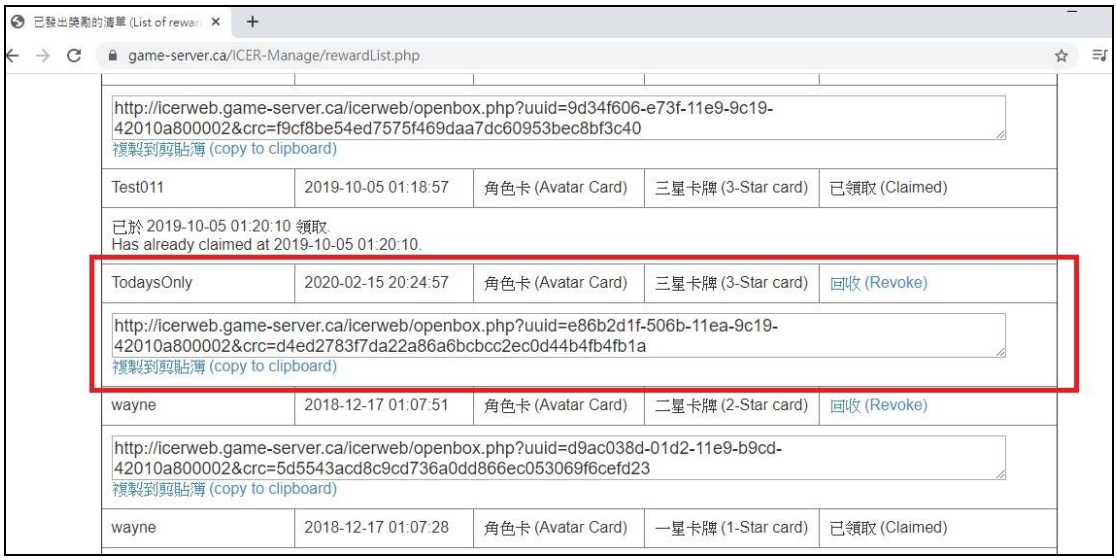

Figure 19. List of *rewards* that have been given.

4.4.2 ICER Web-based System for students. When a student receives the URL from the teacher, he or she can copy and paste the URL into any browser to start his or her reward redemption. Take Chris as example again. As soon as Chris starts the redemption process as Figure 20 shows, he needs to enter the given unique ID – "TodaysOnly" and click "Open Now!" button to redeem the reward.

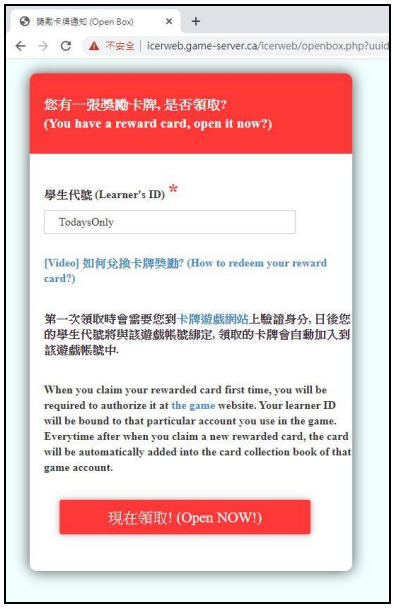

Figure 20. Reward redemption page.

After Chris clicks “Open Now!” button, he will be redirected to the TCG Login page as Figure 21 shows. Since he is on the TCG’s website, he would be feel comfortable to grant the permission(s) that allow the ICER web-based system to deliver the reward card to the TCG as well as retrieve his card collection information from the TCG by entering his credentials of TCG.

Figure 21. Permission granting page at TCG.

Figure 22 shows that ICER web-based system delivered the reward card to the TCG via sending requests to the TCG with client side of ERIC API.

Figure 22. ICER *web*-based system has delivered an in-game card as reward.

Chapter 5. Experiment and Discussion

This Chapter will describe how the experiment is design, what data is collected, and the analysis results and findings. Some hypotheses are also proposed in order to prove users' attitude or perception toward the computer game, innovated technology and the use of ICER web-based system. Section 5.2 will mainly describe the experiment design which includes participants and experiment procedure. The collected data will be discussed and analyzed in Section 5.3. Some potential findings such as important findings and unexpected finding will be summarized in Section 5.4.

5.1 Research Model and Hypotheses

This section will discuss some research questions for testing and verifying purpose based on the similar research in the past. The research questions include users' attitude toward computer games, acceptance of innovated technology, and the usability of ICER web-based system. I took a key moderator – disciplines (i.e., information relevant discipline students and education relevant discipline classes students) into consideration for designing the research model and hypotheses. In the experiment section, I would like to know whether or not the proposed ICER web-based system can attract students to use and improve students' learning performance.

5.1.1 Research Model and Questions. In this section, I propose three directions may affect students' perceptions toward ICER web-based system – students' attitude toward playing computer game, students' past experience on using innovated system, and students' perceptions toward using the proposed ICER web-based system. I adopted Computer Game Attitude Scale (CGAS), Diffusion of Innovation (DoI) questionnaire, and System Usability Scale (SUS) accordingly to see

how they think or feel about ICER web-based system. I list the following research questions based on the research model:

H1: Does students' computer game attitude affect system usability?

H2: Does students' computer game attitude affect their preference of playing TCG?

H3: Does students' computer game attitude affect their improvement from midterm to final exam?

H4: Does students' Diffusion of Innovation affect their preference of playing TCG?

H5: Does students' Diffusion of Innovation affect system usability?

H6: Does system's usability affect students' improvement from midterm to final exam?

H7: Does system's usability affect students' preference of playing TCG?

H8: Does system's usability affect students' reward times?

H9: Does students' preference of playing TCG affect their improvement from midterm to final exam?

H10: Does students' reward times affect their improvement from midterm to final exam?

H11: Is there any discipline difference in computer game attitude?

H12: Is there any discipline difference in Diffusion of Innovation?

H13: Is there any discipline difference in preference of playing TCG?

H14: Is there any discipline difference in system usability?

According to the abovementioned research questions, I propose several hypotheses on both macro view and micro view contains the three directions detail that will be computer game attitude, system's usability, and Diffusion of Innovation.

ICER WEB-BASED SYSTEM

Figures 23 and Figure 24 show the macro view and micro view of the proposed research model respectively. Each directed-label arrow indicates the relationship between dimensions. For example, H1 arrow indicates the first hypothesis – "Students' attitude toward playing computer game will positively affect their preference of playing TCG."

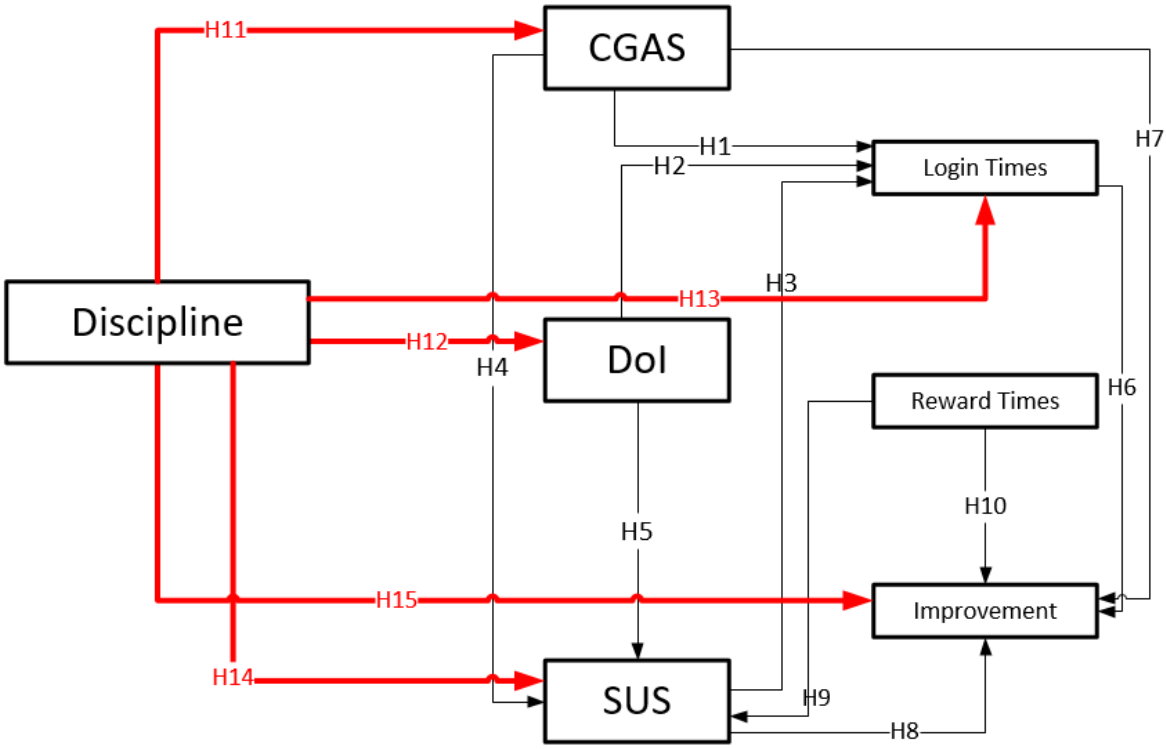

Figure 23. Macro view of research model.

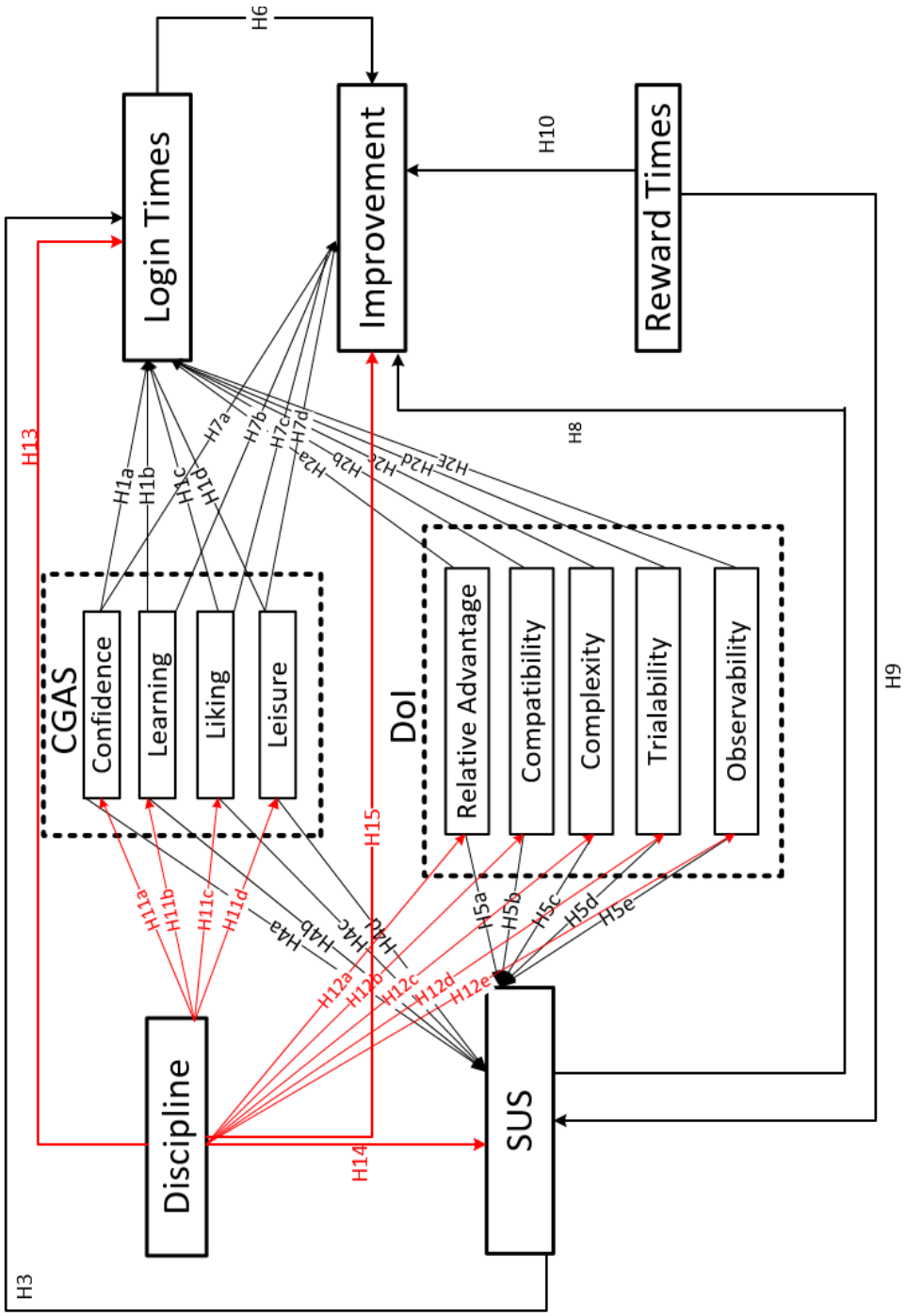

Figure 24. Micro view of research model.

5.1.2 Hypotheses. In this section, some hypotheses are proposed and discussed to verified the research model. I use the constructs described in Figure 24 to make hypotheses as follows to test them via the analysis of collected data:

H1a. Students' confidence toward playing computer game will positively affect their preference of playing TCG.

H1b. Students' learning toward playing computer game will positively affect their preference of playing TCG.

H1c. Students' liking toward playing computer game will positively affect their preference of playing TCG.

H1d: Students' leisure toward playing computer game will positively affect their preference of playing TCG.

H2a. The perceived relative advantage will positively affect students' preference of playing TCG.

H2b. The perceived compatibility will positively affect students' preference of playing TCG.

H2c. The perceived complexity will positively affect students' preference of playing TCG.

H2d. The perceived trialability will positively affect students' preference of playing TCG.

H2e. The perceived observability will positively affect students' preference of playing TCG.

H3: Students' system usability score will positively affect their preference of playing TCG.

H4a: Students' confidence toward playing computer game will positively affect their System Usability Scale scores.

H4b: Students' learning toward playing computer game will positively affect their System Usability Scale scores

H4c: Students' liking toward playing computer game will positively affect their System Usability Scale scores

H4d: Students' leisure toward playing computer game will positively affect

their System Usability Scale scores

H5a: The perceived relative advantage will positively affect students' system usability score.

H5b: The perceived compatibility will positively affect students' system usability score.

H5c: The perceived complexity will positively affect students' system usability score.

H5d: The perceived trialability will positively affect students' system usability score.

H5e: The perceived observability will positively affect students' system usability score.

H6: Students' preference of playing TCG will positively affect their improvement from midterm to final exam.

H7a: Students' confidence toward playing computer game will positively affect improvement from midterm to final exam.

H7b: Students' learning toward playing computer game will positively affect improvement from midterm to final exam.

H7c: Students' liking toward playing computer game will positively affect improvement from midterm to final exam.

H7d: Students' leisure toward playing computer game will positively affect improvement from midterm to final exam.

H8: Students' System Usability Scale Score will positively affect their improvement from midterm to final exam.

H9: Students have been given reward whose System Usability Scale Score are higher than those who don't have.

H10: Students have been given reward whose improvement from midterm to

final exam are higher than those who don't have.

H11a: Information relevant discipline students' confidence toward playing computer is higher than education relevant discipline students'.

H11b: Information relevant discipline students' learning toward playing computer is higher than education relevant discipline students'.

H11c: Information relevant discipline students' liking toward playing computer is higher than education relevant discipline students'.

H11d: Information relevant discipline students' leisure toward playing computer is higher than education relevant discipline students'.

H12a: Information relevant discipline students' perceived relative advantage of using new technology is higher than education relevant discipline students'.

H12b: Information relevant discipline students' perceived compatibility of using new technology is higher than education relevant discipline students'.

H12c: Information relevant discipline students' perceived complexity of using new technology is higher than education relevant discipline students'.

H12d: Information relevant discipline students' perceived trialability of using new technology is higher than education relevant discipline students'.

H12e: Information relevant discipline students' perceived observability of using new technology is higher than education relevant discipline students'.

H13: Education relevant discipline students play TCG more often than information relevant discipline students.

H14: Education relevant discipline students give higher System Usability Scale scores than information relevant discipline students.

H15: Education relevant discipline students' improvement from midterm to final exam is higher than information relevant discipline students'.

5.2 Experiment Design

5.2.1 Participants and Experiment Flow. To understand whether or not the ICER web-based system can help students improve their learning performance, I had recruited two classes from different departments, Department of Information Management (DIM) and Graduate School of Education (GSE), at Chung Yuan Christian University, Taiwan after midterm exam. There were twenty-five students in the DIM class and sixteen students in the GSE class.

Figure 25 shows the experiment flow of the experiment which can be divided into three stages as the time past. At first stage, both classes of students were asked to fill out a pre-survey questionnaire that includes Computer Game Attitude Scale (CGAS) and Diffusion of Innovation (DoI) parts. I also introduced them TCG and ICER web-based system, then left some time to invite them to play with me as the trial bases.

At second stage, students started to play TCG with each other in-and-after the class for three weeks. As a control group, DIM students were not given any in-game card as reward since I didn't arrange any learning activity for them to complete. On the other hand, the teacher arranged final presentation for GSE students as their learning activity. The student who has done the oral presentation very well were given in-game cards as rewards after. At the last stage, after the two classes of students completed their final exams, they were also asked to complete the post-survey questionnaire regarding their perceptions toward the usability of the ICER web-based system.

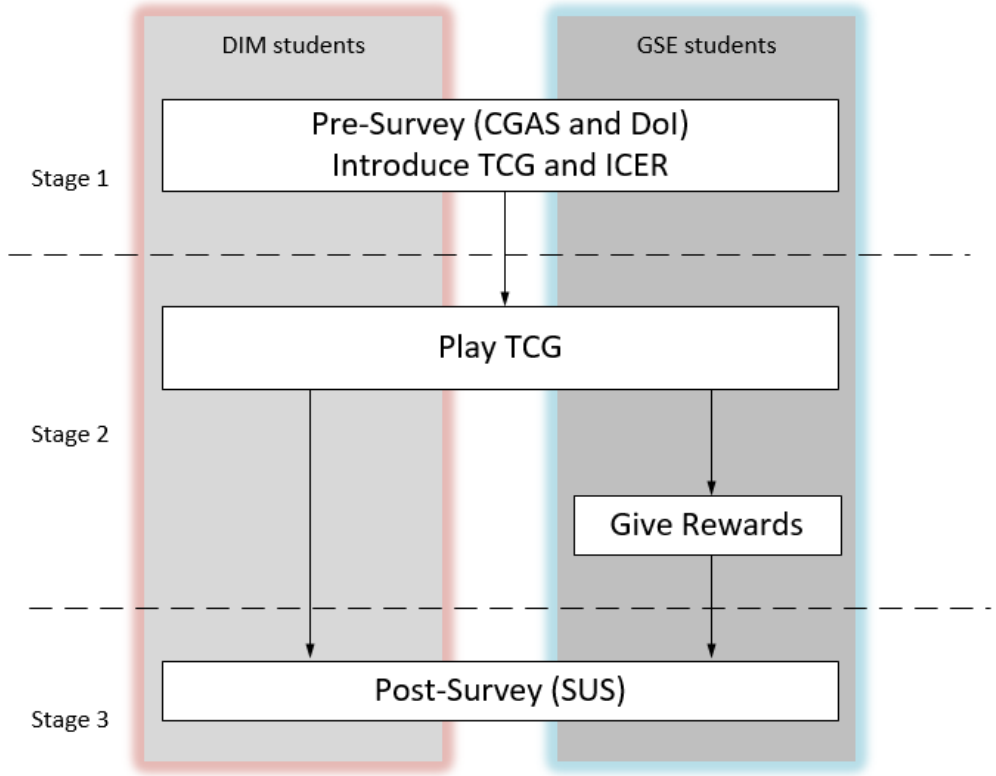

Figure 25. Experiment Flow.

5.2.2 Questionnaire Design.

Computer Game Attitude Scale (CGAS). Computer Game Attitude Scale is used to measure player's attitude towards playing computer games. The original CGAS was proposed in 1997 (Chappell & Taylor, 1997), Chen also developed anther version of CGAS for Taiwanese students (Chen, 2006). In 2013, Lui and colleagues (2013) added some items as a new version of CGAS (NCGAS) by adopting items from Chappell and Taylor's.

In this experiment, I used the revised NCGAS proposed by Chang (2014). NCGAS 2014 has 17 five-point Likert-scale items (5 for "strongly agree" to 1 for "strongly disagree"), and these 17 items are composed of four factors: confidence, learning, liking, and leisure. The detail of the CGAS can be found in Appendix A.

Table 1.

Computer Game Attitude Scale

Factor	Items	Source Studies
Confidence	1. I am good at playing computer games.	(Chang et. al., 2014)
	2. Playing computer games is easy for me.	(Chang et. al., 2014)
	3. I understand and play computer games well..	(Chang et. al., 2014)
	4. I am skilled at playing computer games	(Chang et. al., 2014)
Learning	5. I like taking courses that use computers.	(Chang et. al., 2014)
	6. Using computer games in school is a good way to learn..	(Chang et. al., 2014)
	7. Playing computer games improves my eye and hand coordination..	(Chang et. al., 2014)
	8. Playing computer games enhances my imagination.	(Chang et. al., 2014)
Liking	9. I like it when people talk about computer games.	(Chang et. al., 2014)
	10. I feel comfortable while playing computer games.	(Chang et. al., 2014)
	11. I am very interested in solving quests/questions/missions in computer games.	(Chang et. al., 2014)
	12. I always try to solve the current quest/question/mission in the computer game.	(Chang et. al., 2014)
Leisure	13. Playing computer games makes me happy.	(Chang et. al., 2014)
	14. Playing computer games is part of my life.	(Chang et. al., 2014)
	15. When I have free time, I play computer games.	(Chang et. al., 2014)
	16. I talk about computer games with my friends.	(Chang et. al., 2014)
	17. I am not alone in a computer game as I can make friends there.	(Chang et. al., 2014)

Diffusion of Innovation Questionnaire. Diffusion of Innovation (DoI) is used

to measure user's acceptance when an innovation comes out. For example, when a new generation of smartphone publishes, I will try it out or could buy it at the store immediately, my feedback for DoI could be strongly agree.

The original DoI was published by Rogers (2003) who uses five categories to describe the difference acceptance levels – innovators, early adopters, early majority, late majority, and laggards. Park and Chen (2007) also applied Diffusion of Innovation to understand participants' acceptance toward using smartphone. Quadir et al. (2017) revised items for three factors (i.e., Relative Advantage, Complexity and Trialability) to measure users' perceived innovation game attribute. However, there are only two items in the factor "Trialability" that Quadir proposed. Chang (2019) designed a robust DoI questionnaire to measure users' innovation acceptance by merging Park and Chen's items into Quadir's. In this experiment, I used her proposed new DoI as a part of my pre-survey questionnaire as Table 2 shows. The detail of questionnaire also can be found in Appendix A.

Table 2.
Diffusion of Innovation questionnaire

Factor	Items	Source Studies
Relative Advantage	1. When a course has reward mechanism, I will accomplish its learning activities quickly.	(Quadir et. al., 2017)
	2. When a course has reward mechanism, I will improve the quality of learning activities while doing them.	(Quadir et. al., 2017)
	3. When a course has reward mechanism, I will more likely to be concentrate and participate in it..	(Quadir et. al., 2017)
	4. When a learning activity like assignment or exam has reward mechanism, I receive better marks.	(Quadir et. al., 2017)
	5. When a learning activity like assignment or exam has reward mechanism, I would more like to start doing it.	(Quadir et. al., 2017)
Compatibility	6. A course should have reward mechanism.	(Quadir et. al., 2017)
	7. For making me learn better, a course needs to have reward mechanism	(Quadir et. al., 2017)

	8. Adopting reward mechanism in a course fits well with the way I like to learn.	(Quadir et. al., 2017)
	9. My learning style needs to have rewards for doing learning activities in a course.	(Park & Chen, 2007)
Complexity	10. Playing a trading card game like “Yu-Gi-Oh!”, “Pokemon” or“Hearthstone” is easy for me.	(Quadir et. al., 2017)
	11. I understand the game mechanics of a trading card game.	(Quadir et. al., 2017)
	12. Learning how to play a trading card game is easy for me.	(Quadir et. al., 2017)
	13. It is easy to learn when a course has reward mechanism.	(Quadir et. al., 2017)
	14. It is easy to know how I can get the reward when a course has reward mechanism.	Self-developed
Trialability	15. I’ve had great deal of opportunities to try how to play a trading card game.	(Quadir et. al., 2017)
	16. I can satisfactorily try out various trading card games.	(Quadir et. al., 2017)
	17. Before deciding whether or not to play the trading card game, I would need to get familiar with it on a trial basis.	(Park & Chen, 2007)
	18. Before deciding whether or not to play the trading card game, I would need to properly understand the game mechanics.	(Park & Chen, 2007)
	19. I know where I can go to satisfactorily try out various trading card game	(Park & Chen, 2007)
Observability	20. It is easy for me to see others’ game-play of a trading card game.	(Park & Chen, 2007)
	21. I have had a lot of opportunity to see the trading card game being played.	(Park & Chen, 2007)
	22. I can see my friends like to play a trading card game.	(Chang, 2019)
	23. I can see my friends like to use their powerful cards to beat their opponents.	(Chang, 2019)
	24. I will play the trading card game after seeing my friends duel with each other in a trading card game.	(Chang, 2019)
	25. I have my own game-play strategy after seeing my friends duel with each other in the trading card game.	(Chang, 2019)

System Usability Scale (SUS). After students used ICER web-based system, I

asked them to fill out the usability questionnaire. The questionnaire has 25 five-point Likert-scale items (5 for "strongly agree" to 1 for "strongly disagree") including System Usability Scale (SUS) designed by Brooke (1996) and three construct of usability proposed by Lu (2011) as Table 3 shows. In this research, I extracted 10 SUS items and calculated SUS scores to measure students' perceptions toward using the ICER web-based system. Appendix A shows the usability questionnaire for this experiment.

Table 3.
Usability Questionnaire

	Items	Source Studies
1.	It is easy to redeem a reward given by the teacher.	(Brooke, 1996)
2.	I think that I would need the support of a technical person to help me redeem rewards given by the teacher.	(Brooke, 1996)
3.	It is easy to use In-game Card as Educational Reward (ICER) web-based system.	(Brooke, 1996)
4.	It is simple to see my card collection in the final step of the redemption.	Self-developed
5.	ICER web-based system is unnecessarily complex.	(Brooke, 1996)
6.	I can easily know how to see my card collection from the ICER web-based system.	Self-developed
7.	I can see the information of my card collection after I grant ICER web-based system permission to access my card collection in the TCG.	Self-developed
8.	I know how to use my TCG credentials to authorize ICER web-based system to access my card collection in the TCG.	(Lu, 2011)
9.	The ways of getting cards from different learning activities are similar.	(Brooke, 1996)
10.	I would imagine that most people would authorize ICER web-based system to access their card collection in the TCG very quickly.	(Brooke, 1996)
11.	I can quickly become skillful with authorizing ICER web-based system to access my card collection information in the TCG.	Self-developed
12.	I still remember how to authorize ICER web-based system to access my card collection information in the TCG.	Self-developed
13.	I felt very confident in authorizing ICER web-based system to access my card collection information in the TCG.	(Brooke, 1996)
14.	I try to complete learning activities quickly when my teacher has reward linked to learning activities like assignments, quizzes, and exams.	(Lu, 2011)
15.	It is practical to adopt reward mechanism for any learning activities.	Self-developed

16.	I can use the cards awarded in the course to play with my classmates in the TCG.	Self-developed
17.	Granting ICER web-based system permission to access my card collection in the TCG is good.	(Lu, 2011)
18.	I need to learn a lot of things before I am capable of authorizing ICER web-based system to access my card collection in the TCG.	(Brooke, 1996)
19.	Once my performance of a learning activity meet the criteria, I can get cards for the TCG	Self-developed
20.	I can use any of my awarded cards to play with my classmates in the TCG.	(Brooke, 1996)
21.	I will recommend other teachers to also adopt reward mechanism in their courses.	(Lu, 2011)
22.	After my teacher adopts reward mechanism for his/her course, I am more likely to participate in.	Self-developed
23.	After seeing the update of cards awarded for my good performance on learning activities, I put more efforts on doing the learning activities	(Brooke, 1996)
24.	After my teacher adopts reward mechanism for his/her course, I put more efforts on doing the learning activities.	Self-developed
25.	I hope my teacher can adopt reward mechanism for all kinds of learning activity in his/her class.	Self-developed

5.2.3 Data Collection. Despite of the students' computer game attitude, diffusion of innovation and system usability can be collected by the questionnaire, I also collected both classes' TCG login times from database as their preferences of playing the game. In order to give GSE's students reward, I observed their performance from time to time by attending the course every week. The course tutor arranged presentations for the students every week. As an audience, I have to see students' made slides and their presentation skills such as the fluency of the speech. If the student has clear presentation slides and has silver tongue, he or she can get a three-star avatar card.

At the end of the semester nine students have been given rewards, whereas the other seven are not. The two classes course tutors provided students' difference from midterm to final exam will be the improvements for comparison in the next section.

5.3 Validity and Reliability Analysis

CGAS and DOI questionnaire was adopted from previous research and its validity and reliability had been proven by other researchers. In this research, I analyzed it further before using the collected data to examine or verify my proposed hypotheses. I used SPSS Statistics 20 to analyze the responses and to verify the reliability and validity. After the validation, I removed the low reliability items to make sure the overall Cronbach's alpha of questionnaire is still high. All of the remaining items will be used for the further analysis.

5.3.1 Reliability and Validity Analysis for CGAS Questionnaires

***Graduate School of Education*.** The overall Cronbach's alpha is 0.950 for the original 17 items CGAS, which indicates that the questionnaire and its items can be seen as reliable because the internal consistency is good enough (i.e., exceeds 0.70)(Hair, Anderson, Tatham, & Black, 1998). However, there are two items of Learning and Leisure (i.e.,Q6 and Q13) should be removed in the first run since the Cronbach's alpha value will increase if the item has been deleted.

After remove Q6 and Q13, the overall DoI's Cronbach's alpha remains in good level (i.e., 0.948). Each factors' Cronbach's alpha value still stays at the good level as Table 4 shows. These fifteen items will be used for the further analysis.

Table 4.

2nd run of Reliability Analysis for CGAS questionnaire for GSE

CGAS factors	Items	Cronbach's alpha if item deleted	Cronbach's alpha
Confidence	CON_Q1 CON_Q2 CON_Q3 CON_Q4	0.972 0.966 0.960 0.960	0.973
Learning	LRN_Q5 LRN_Q7	0.341 0.706	0.743

	LRN_Q8	0.847	
Liking	LIKE_Q9 LIKE_Q10 LIKE_Q11 LIKE_Q12	0.847 0.802 0.770 0.833	0.854
Leisure	LEI_Q14 LEI_Q15 LEI_Q16 LEI_Q17	0.869 0.794 0.857 0.839	0.876

The items' internal commonality for each construct in the research model was examined by using principal component analysis. Table 5 shows all constructs' results in principle component analysis after the items with lower factor loading were removed. Each item's factor loading was higher than 0.65 which means these fifteen items can be considered as a valid CGAS questionnaire.

Table 5.

2nd run validity analysis of the CGAS questionnaire for GSE

		Component
CON_Q3	I understand and play computer games well.	0.972
CON_Q4	I am skilled at playing computer games	0.972
CON_Q2	Playing computer games is easy for me.	0.960
CON_Q1	I am good at playing computer games	0.945
Eigenvalue		3.705
% of variance		92.603
LRN_Q5	I like taking courses that use computers.	0.949
LRN_Q7	Playing computer games improves my eye and hand coordination.	0.818
LRN_Q8	Playing computer games enhances my imagination.	0.672
Eigenvalue		2.022

% of variance		67.389
LIKE_Q11	I am very interested in solving quests/questions/missions in computer games.	0.896
LIKE_Q10	I feel comfortable while playing computer games.	0.863
LIKE_Q12	I always try to solve the current quest/question/mission in the computer game.	0.811
LIKE_Q9	I like it when people talk about computer games.	0.769
Eigenvalue		2.797
% of variance		69.916
LEI_Q15	When I have free time, I play computer games.	0.930
LEI_Q17	I am not alone in a computer game as I can make friends there.	0.873
LEI_Q16	I talk about computer games with my friends.	0.833
LEI_Q14	Playing computer games is part of my life.	0.793
Eigenvalue		2.949
% of variance		73.729

Extraction Method: Principal Component Analysis.

Department of Information Management. In the first run, the overall questionnaire is reliable (Cronbach's alpha is 0.932). I then found that Q13 of Leisure should be removed so that the Cronbach's alpha value increase. After remove Q13, the overall CGAS's Cronbach's alpha remains in good level (i.e., 0.932). Each factors' Cronbach's alpha value still stays at the good level as Table 6 shows.

Table 6.

2nd run of Reliability Analysis of CGAS questionnaire for DIM

CGAS factor	Items	Cronbach's alpha if item deleted	Cronbach's alpha
Confidence	CON_Q1	0.913	0.947
	CON_Q2	0.966	
	CON_Q3	0.926	
	CON_Q4	0.917	
Learning	LRN_Q5	0.881	0.869
	LRN_Q6	0.854	
	LRN_Q7	0.761	
	LRN_Q8	0.812	
Liking	LIKE_Q9	0.827	0.832
	LIKE_Q10	0.747	
	LIKE_Q11	0.831	
	LIKE_Q12	0.746	
Leisure	LEI_Q14	0.884	0.907
	LEI_Q15	0.850	
	LEI_Q16	0.850	
	LEI_Q17	0.927	

Table 7 shows all constructs' results in principle component analysis after the items with lower factor loading were removed. Each item’s factor loading was higher than 0.65 which means these sixteen items can be considered as a valid CGAS questionnaire.

Table 7.

2nd run validity analysis of the CGAS questionnaire for DIM

		Component
CON_Q1	I am good at playing computer games.	0.965
CON_Q4	I am skilled at playing computer games.	0.963
CON_Q3	I understand and play computer games well.	0.943
CON_Q2	Playing computer games is easy for me.	0.870
Eigenvalue		3.506
% of variance		87.642
LRN_Q7	Playing computer games improves my eye and hand coordination.	0.940

LRN_Q8	Playing computer games enhances my imagination.	0.880
LRN_Q6	Using computer games in school is a good way to learn.	0.813
LRN_Q5	I like taking courses that use computers.	0.751
Eigenvalue		2.883
% of variance		72.060
LIKE_Q10	I feel comfortable while playing computer games.	0.892
LIKE_Q12	I always try to solve the current quest/question/mission in the computer game.	0.867
LIKE_9	I like it when people talk about computer games.	0.769
LIKE_11	I am very interested in solving quests/questions/missions in computer games.	0.769
Eigenvalue		2.731
% of variance		68.281
LEI_Q16	I talk about computer games with my friends.	0.937
LEI_Q15	When I have free time, I play computer games.	0.936
LEI_Q14	Playing computer games is part of my life.	0.879
LEI_Q17	I am not alone in a computer game as I can make friends there.	0.782
Eigenvalue		3.138
% of variance		78.447

Extraction Method: Principal Component Analysis.

In order to compare with GSE students' attitude toward playing computer games, I additionally removed Q6 to see if the questionnaire is still reliable and valid.

The overall of the Cronbach's alpha value is 0.948. Each factor's Cronbach's alpha value still remained at the good level as Table 8 shows.

Table 8.

Revised Reliability Analysis of the CGAS questionnaire for DIM

CGAS factors	Items	Cronbach's alpha if item deleted	Cronbach's alpha
Confidence	CON_Q1	0.972	0.973
	CON_Q2	0.966	
	CON_Q3	0.960	
	CON_Q4	0.960	
Learning	LRN_Q5	0.341	0.743
	LRN_Q7	0.706	
	LRN_Q8	0.847	
Liking	LIKE_Q9	0.847	0.854
	LIKE_Q10	0.802	
	LIKE_Q11	0.770	
	LIKE_Q12	0.833	
Leisure	LEI_Q14	0.869	0.876
	LEI_Q15	0.794	
	LEI_Q16	0.857	
	LEI_Q17	0.839	

Next, the items' internal commonality for each construct in the research model was examined using principal component analysis, and the items with lower factor loading were removed. Table 9 shows the principal component analysis result for each factor, each item has exceeded 0.65 factor loading which means it is a valid questionnaire.

Table 9.

Revised validity analysis of the CGAS questionnaire for DIM

		Component
CON_Q1	I am good at playing computer games.	0.965
CON_Q4	I am skilled at playing computer games.	0.963
CON_Q3	I understand and play computer games well.	0.943
CON_Q2	Playing computer games is easy for me.	0.870

Eigenvalue		3.506
% of variance		87.642
LRN_Q7	Playing computer games improves my eye and hand coordination.	0.961
LRN_Q8	Playing computer games enhances my imagination.	0.929
LRN_Q5	I like taking courses that use computers	0.733
Eigenvalue		2.324
% of variance		77.481
LIKE_Q10	I feel comfortable while playing computer games.	0.892
LIKE_Q12	I always try to solve the current quest/question/mission in the computer game.	0.867
LIKE_9	I like it when people talk about computer games.	0.769
LIKE_11	I am very interested in solving quests/questions/missions in computer games.	0.769
Eigenvalue		2.731
% of variance		68.281
LEI_Q16	I talk about computer games with my friends.	0.937
LEI_Q15	When I have free time, I play computer games.	0.936
LEI_Q14	Playing computer games is part of my life.	0.879
LEI_Q17	I am not alone in a computer game as I can make friends there.	0.782
Eigenvalue		3.138
% of variance		78.447

Extraction Method: Principal Component Analysis.

All Two Classes Students. Both two classes CGAS reliability are also analyzed, the overall (i.e., 0.935) and each of the factor's Cronbach's alpha values are still at the good level as Table 10 shows.

Table 10.

Revised Reliability Analysis of all 41 students

CGAS factors	Items	Cronbach's alpha if item deleted	Cronbach's alpha
Confidence	CON_Q1 CON_Q2 CON_Q3 CON_Q4	0.932 0.966 0.936 0.929	0.955
Learning	LRN_Q5 LRN_Q7 LRN_Q8	0.807 0.647 0.764	0.815
Liking	LIKE_Q9 LIKE_Q10 LIKE_Q11 LIKE_Q12	0.824 0.734 0.773 0.769	0.823
Leisure	LEI_Q14 LEI_Q15 LEI_Q16 LEI_Q17	0.884 0.839 0.861 0.899	0.901

Table 11 shows the principal component analysis result for the summarized two class. Each item's factor loading still higher than 0.65 which means it is a valid questionnaire.

Table 11.

Revised validity analysis of the CGAS questionnaire for all 41 students

		Component
CON_Q4	I am skilled at playing computer games.	0.966
CON_Q1	I am good at playing computer games.	0.957
CON_Q3	I understand and play computer games well.	0.952
CON_Q2	Playing computer games is easy for me.	0.895

Eigenvalue		3.556
% of variance		88.897
LRN_Q7	Playing computer games improves my eye and hand coordination.	0.905
LRN_Q8	Playing computer games enhances my imagination.	0.843
LRN_Q5	I like taking courses that use computers.	0.814
Eigenvalue		2.192
% of variance		73.078
LIKE_Q10	I feel comfortable while playing computer games.	0.871
LIKE_Q11	I am very interested in solving quests/questions/missions in computer games.	0.817
LIKE_Q12	I always try to solve the current quest/question/mission in the computer game.	0.811
LIKE_Q9	I like it when people talk about computer games.	0.734
Eigenvalue		2.623
% of variance		65.585
LEI_Q15	When I have free time, I play computer games.	0.932
LEI_Q16	I talk about computer games with my friends.	0.904
LEI_Q14	Playing computer games is part of my life.	0.856
LEI_Q17	I am not alone in a computer game as I can make friends there.	0.826
Eigenvalue		3.101
% of variance		77.534

Extraction Method: Principal Component Analysis.

5.3.2 Reliability and Validity Analysis for DoI Questionnaires

Graduate School of Education. The overall of Cronbach's alpha value is 0.858 for the first run of DoI which indicated that the questionnaire (and its items) can be seen as reliable because its internal consistency is good enough (i.e., exceeds 0.75). However, there were seven items, Q13, Q14, Q17, Q18, Q20, Q24 and Q25 should be removed based on the Cronbach's alpha value will raise after deleting the item and the validity smaller than 0.6. Table 12 shows the final run of the DoI reliability analysis.

Table 12.

Reliability Analysis of the DoI questionnaire for GSE

DoI factors	Items	Cronbach's alpha if item deleted	Cronbach's alpha
Reliability Advantage	REL_ADV_Q1	0.940	0.953
	REL_ADV_Q2	0.951	
	REL_ADV_Q3	0.933	
	REL_ADV_Q4	0.945	
	REL_ADV_Q5	0.938	
Compatibility	CPA_Q6	0.847	0.839
	CPA_Q7	0.734	
	CPA_Q8	0.785	
	CPA_Q9	0.811	
Complexity	CPX_Q10	0.985	0.947
	CPX_Q11	0.891	
	CPX_Q12	0.881	
Trialability	TRI_Q15	0.942	0.933
	TRI_Q16	0.867	
	TRI_Q19	0.907	
Observability	OBS_Q21	0.878	0.932
	OBS_Q22	0.895	
	OBS_Q23	0.926	

Table 13 shows the principal component analysis result for each factor, each item factor loading exceeds 0.65 which means it is a valid questionnaire.

Table 13.

2nd run validity analysis of the DoI questionnaire for GSE

		Component
REL_ADV_Q2	When a course has reward mechanism, I will improve the quality of learning activities while doing them.	0.905
REL_ADV_Q3	When a course has reward mechanism, I will more likely to be concentrate and participate in it.	0.902

REL_ADV_Q5	When a learning activity like assignment or exam has reward mechanism, I would more like to start doing it.	0.892
REL_ADV_Q1	When a course has reward mechanism, I will accomplish its learning activities quickly.	0.857
REL_ADV_Q4	When a learning activity like assignment or exam has reward mechanism, I receive better marks.	0.796
Eigenvalue		3.796
% of variance		75.922
CPA_Q7	For making me learn better, a course needs to have reward mechanism.	0.874
CPA_Q8	Adopting reward mechanism in a course fits well with the way I like to learn.	0.732
CPA_Q6	A course should have reward mechanism.	0.696
CPA_Q9	My learning style needs to have rewards for doing learning activities in a course.	0.681
Eigenvalue		2.247
% of variance		56.176
CPX_Q11	I understand the game mechanics of a trading card game.	0.976
CPX_Q12	Learning how to play a trading card game is easy for me.	0.976
CPX_Q10	Playing a trading card game like “Yu-Gi-Oh!”, “Pokemon” or “Hearthstone” is easy for me.	0.947
Eigenvalue		2.802
% of variance		93.386
TRI_Q16	I can satisfactorily try out various trading card games.	0.979
TRI_Q15	I’ve had great deal of opportunities to try how to play a trading card game.	0.933
TRI_Q19	I know where I can go to satisfactorily try out various trading card game	0.920

Eigenvalue		2.676
% of variance		89.186
OBS_Q22	I can see my friends like to play a trading card game.	0.956
OBS_Q23	I can see my friends like to use their powerful cards to beat their opponents.	0.925
OBS_Q21	I have had a lot of opportunity to see the trading card game being played.	0.887
Eigenvalue		2.558
% of variance		85.259

Extraction Method: Principal Component Analysis.

Department of Information Management. Reliability and validity analysis were also tested for those 25 items in the Diffusion of Innovation questionnaire. Table 14 lists the reliability analysis results, the overall Cronbach's alpha is 0.973, indicating that the questionnaire (and its items) can be seen as reliable because the internal consistency is very good (i.e., exceeds 0.80).

Table 14.

Reliability Analysis of the DoI questionnaire for DIM

Factors Affect System's Usability	Items	Cronbach's alpha if item deleted	Cronbach's alpha
Reliability Advantage	REL_ADV_Q1 REL_ADV_Q2 REL_ADV_Q3 REL_ADV_Q4 REL_ADV_Q5	0.940 0.951 0.933 0.945 0.938	0.953
Compatibility	CPA_Q6 CPA_Q7 CPA_Q8 CPA_Q9	0.847 0.734 0.785 0.811	0.839
Complexity	CPX_Q10 CPX_Q11 CPX_Q12 CPX_Q13 CPX_Q14	0.903 0.878 0.878 0.930 0.914	0.921

Trialability	TRI_Q15 TRI_Q16 TRI_Q17 TRI_Q18 TRI_Q19	0.904 0.882 0.918 0.921 0.882	0.920
Observability	OBS_Q20 OBS_Q21 OBS_Q22 OBS_Q23 OBS_Q24 OBS_Q25	0.956 0.951 0.955 0.957 0.952 0.957	0.962

The items' internal commonality for each construct in the research model was examined using principal component analysis. There is no item need to be removed since all of the item's factor loading are higher enough. Table 15 shows all construct's results for principal component analysis.

Table 15.

Validity analysis of the DoI questionnaire for DIM

		Component
REL_ADV_Q3	When a course has reward mechanism, I will more likely to be concentrate and participate in it.	0.951
REL_ADV_Q5	When a learning activity like assignment or exam has reward mechanism, I would more like to start doing it.	0.932
REL_ADV_Q1	When a course has reward mechanism, I will accomplish its learning activities quickly.	0.924
REL_ADV_Q4	When a learning activity like assignment or exam has reward mechanism, I receive better marks.	0.908
REL_ADV_Q2	When a course has reward mechanism, I will improve the quality of learning activities while doing them.	0.877
Eigenvalue		4.220
% of variance		84.400
CPA_Q7	For making me learn better, a course needs to have reward mechanism.	0.902
CPA_Q8	Adopting reward mechanism in a course fits well with the way I like to learn.	0.864
CPA_Q9	My learning style needs to have rewards for doing learning activities in a course.	0.808

CPA_Q6	A course should have reward mechanism.	0.743
Eigenvalue		2.765
% of variance		69.131
CPX_Q11	I understand the game mechanics of a trading card game.	0.947
CPX_Q12	Learning how to play a trading card game is easy for me.	0.941
CPX_Q10	Playing a trading card game like “Yu-Gi-Oh!”, “Pokemon” or “Hearthstone” is easy for me.	0.871
CPX_Q14	It is easy to know how I can get the reward when a course has reward mechanism.	0.845
CPX_Q13	It is easy to learn when a course has reward mechanism.	0.767
Eigenvalue		3.844
% of variance		78.876
TRI_Q16	I can satisfactorily try out various trading card games.	0.941
TRI_Q19	I know where I can go to satisfactorily try out various trading card game	0.939
TRI_Q15	I’ve had great deal of opportunities to try how to play a trading card game.	0.888
TRI_Q17	Before deciding whether or not to play the trading card game, I would need to get familiar with it on a trial basis.	0.804
TRI_Q18	Before deciding whether or not to play the trading card game, I would need to properly understand the game mechanics.	0.803
Eigenvalue		3.846
% of variance		76.923
OBS_Q21	I have had a lot of opportunity to see the trading card game being played.	0.945
OBS_Q24	I will play the trading card game after seeing my friends duel with each other in a trading card game.	0.938

OBS_Q22	I can see my friends like to play a trading card game.	0.910
OBS_Q20	It is easy for me to see others' game-play of a trading card game.	0.908
OBS_Q25	I have my own game-play strategy after seeing my friends duel with each other in the trading card game.	0.907
OBS_Q23	I can see my friends like to use their powerful cards to beat their opponents.	0.900
Eigenvalue		5.058
% of variance		84.294

Extraction Method: Principal Component Analysis.

In order to compare with GSE students' Diffusion of Innovation, I also removed Q13, Q14, Q17, Q18, Q20, Q24 and Q25 to do another reliability and validity analysis. The overall Cronbach's alpha value for the 18-item questionnaire is 0.961 which indicates that the questionnaire (and its items) can be seen as reliable because its internal consistency is good enough. Table 16 lists the reliability analysis results.

Table 16.

Revised reliability analysis of the DoI questionnaire for DIM

DoI factors	Items	Cronbach's alpha if item deleted	Cronbach's alpha
Reliability Advantage	REL_ADV_Q1	0.940	0.953
	REL_ADV_Q2	0.951	
	REL_ADV_Q3	0.933	
	REL_ADV_Q4	0.945	
	REL_ADV_Q5	0.938	
Compatibility	CPA_Q6	0.847	0.839
	CPA_Q7	0.734	
	CPA_Q8	0.785	
	CPA_Q9	0.811	
Complexity	CPX_Q10	0.985	0.947
	CPX_Q11	0.891	
	CPX_Q12	0.881	
Trialability	TRI_Q15	0.942	0.933
	TRI_Q16	0.867	
	TRI_Q19	0.907	

Observability	OBS_Q21 OBS_Q22 OBS_Q23	0.878 0.895 0.926	0.932

The items' internal commonality for each construct in the research model was examined using principal component analysis. There is no item need to be removed since all of the item's factor loading are higher enough. Table 17 shows all construct's results for principal component analysis.

Table 17.

Revised validity analysis of the DoI questionnaire for DIM

		Component
REL_ADV_Q3	When a course has reward mechanism, I will more likely to be concentrate and participate in it.	0.951
REL_ADV_Q5	When a learning activity like assignment or exam has reward mechanism, I would more like to start doing it.	0.932
REL_ADV_Q1	When a course has reward mechanism, I will accomplish its learning activities quickly.	0.924
REL_ADV_Q4	When a learning activity like assignment or exam has reward mechanism, I receive better marks.	0.908
REL_ADV_Q2	When a course has reward mechanism, I will improve the quality of learning activities while doing them.	0.877
Eigenvalue		4.220
% of variance		84.400
CPA_Q7	For making me learn better, a course needs to have reward mechanism.	0.902
CPA_Q8	Adopting reward mechanism in a course fits well with the way I like to learn.	0.864
CPA_Q9	My learning style needs to have rewards for doing learning activities in a course.	0.808
CPA_Q6	A course should have reward mechanism.	0.743
Eigenvalue		2.765
% of variance		69.131

CPX_Q12	Learning how to play a trading card game is easy for me.	0.975
CPX_Q11	I understand the game mechanics of a trading card game.	0.970
CPX_Q10	Playing a trading card game like “Yu-Gi-Oh!”, “Pokemon” or “Hearthstone” is easy for me.	0.905
Eigenvalue		2.711
% of variance		90.381
TRI_Q16	I can satisfactorily try out various trading card games.	0.967
TRI_Q19	I know where I can go to satisfactorily try out various trading card game	0.943
TRI_Q15	I’ve had great deal of opportunities to try how to play a trading card game.	0.929
Eigenvalue		2.688
% of variance		89.605
OBS_Q21	I have had a lot of opportunity to see the trading card game being played.	0.956
OBS_Q22	I can see my friends like to play a trading card game.	0.941
OBS_Q23	I can see my friends like to use their powerful cards to beat their opponents.	0.922
Eigenvalue		2.651
% of variance		88.351

Extraction Method: Principal Component Analysis.

All Two Classes Students. Table 18 shows the DoI’s reliability test result for all 41 students. The overall Cronbach's alpha value is 0.935. Each factor’s Cronbach's alpha value is higher than 0.7 which indicates that this questionnaire is reliable.

Table 18.

Revised reliability analysis of the DoI questionnaire for all 41 students

DoI factors	Items	Cronbach's alpha if item deleted	Cronbach's alpha
Reliability Advantage	REL_ADV_Q1 REL_ADV_Q2 REL_ADV_Q3 REL_ADV_Q4 REL_ADV_Q5	0.928 0.931 0.918 0.935 0.22	0.941
Compatibility	CPA_Q6 CPA_Q7 CPA_Q8 CPA_Q9	0.792 0.674 0.757 0.776	0.803
Complexity	CPX_Q10 CPX_Q11 CPX_Q12	0.982 0.912 0.908	0.956
Trialability	TRI_Q15 TRI_Q16 TRI_Q19	0.938 0.862 0.929	0.937
Observability	OBS_Q21 OBS_Q22 OBS_Q23	0.896 0.859 0.902	0.921

I also merged two classes students DoI questionnaire result and analyzed their validity. Table 19 shows the principal component analysis, each factor still reaches higher 0.65 which means it is a valid questionnaire.

Table 19.

Revised validity analysis of the DoI questionnaire for all 41 students

		Component
REL_ADV_Q3	When a course has reward mechanism, I will more likely to be concentrate and participate in it.	0.932
REL_ADV_Q5	When a learning activity like assignment or exam has reward mechanism, I would more like to start doing it.	0.919
REL_ADV_Q1	When a course has reward mechanism, I will accomplish its learning activities quickly.	0.895
REL_ADV_Q2	When a course has reward mechanism, I will improve the quality of learning activities while doing them.	0.884
REL_ADV_Q4	When a learning activity like assignment or exam has reward mechanism, I receive better marks.	0.871
Eigenvalue		4.053
% of variance		81.067
CPA_Q7	For making me learn better, a course needs to have reward mechanism.	0.889

CPA_Q8	Adopting reward mechanism in a course fits well with the way I like to learn.	0.790
CPA_Q9	My learning style needs to have rewards for doing learning activities in a course.	0.759
CPA_Q6	A course should have reward mechanism.	0.731
Eigenvalue		2.526
% of variance		63.143
CPX_Q12	Learning how to play a trading card game is easy for me.	0.976
CPX_Q11	I understand the game mechanics of a trading card game.	0.974
CPX_Q10	Playing a trading card game like “Yu-Gi-Oh!”, “Pokemon” or “Hearthstone” is easy for me.	0.926
Eigenvalue		2.758
% of variance		91.927
TRI_Q16	I can satisfactorily try out various trading card games.	0.974
TRI_Q19	I know where I can go to satisfactorily try out various trading card game	0.934
TRI_Q15	I’ve had great deal of opportunities to try how to play a trading card game.	0.934
Eigenvalue		2.693
% of variance		89.778
OBS_Q22	I can see my friends like to play a trading card game.	0.946
OBS_Q21	I have had a lot of opportunity to see the trading card game being played.	0.929
OBS_Q23	I can see my friends like to use their powerful cards to beat their opponents.	0.922
Eigenvalue		2.607

% of variance	86.694

Extraction Method: Principal Component Analysis.

5.3.3 Quantitative Analysis. In this section, I would use Pearson Correlation to see if there is any relation between two variables from H1 to H8 for Graduation School of Education students and Department of Information Management students respectively. For H9 and H10, only part of GSE students were given in-game cards as rewards so I just brought out the analysis results among the two groups students (i.e, DO give in-game cards as rewards and Not give in-game cards as rewards) from GSE. H11 to H15 are analyzed to compare two different classes students (i.e., Information relevant discipline vs Education relevant discipline) so I would use independent t-test to do the analysis at the end of this section.

The first hypothesis involves students' attitude toward playing computer games and their preferences of playing TCG. Table 20 shows the relation between students' TCG login times and their CGAS facotors. The learning factor of CGAS is postively significant correlated with TCG login times in GSE class; the liking factor of CGAS is postively significant correlated with TCG login times in DIM class. However, there is no significant correlated between TCG login times with other CGAS factors. Even both classes students login times are not correlated with each factor of CGAS. Therefore, H1b is supported. H1a, H1c and H1d are not supported for GSE; H1c is supported. H1a, H1b and H1d are not supported for DIM. All the first sub hypotheses are not sustatined for the whole students.

Table 20.

Correlation analysis between CGAS and TCG login times for both classes

Graduate School of Education		CGAS_CON	CGAS_LRN	CGAS_LIKE	CGAS_LEI
Login Times	Pearson correlation	.127	.540*	.399	-.011

	Sig.	.639	.031	.126	.969
	N	16	16	16	16
Department of Information Management		CGAS_CON	CGAS_LRN	CGAS_LIKE	CGAS_LEI
Login Times	Pearson correlation	-.304	-.336	.485*	-.167
	Sig.	.139	.100	.014	.426
	N	25	25	25	25
All (GSE+DIM)		CGAS_CON	CGAS_LRN	CGAS_LIKE	CGAS_LEI
Login Times	Pearson correlation	-.087	.116	.009	-.147
	Sig.	.588	.471	.953	.358
	N	41	41	41	41

*: $p < 0.05$; **: $p < 0.01$

I then analyzed the second hypothis in micro view as Table 21 shows. There is significant correlated between complexity factor of Diffusion of Innovation and System Usability Scale score. However there is no significant correlation between TCG login times and other factors of Diffusion of Innovation. H2c is confirmed. H2a, H2b, H2d and H2e are not sustained for GSE. As for Department of Information Management class, students' TCG login times have significant negative related to all off the Diffusion of Innovation factors, only observabilty have no significant correlation with TCG login times. There is still no corelation between the DoI facotors even I have merged all the students. Hence, H2a, H2b, H2c, H2d and H2e are not supported. All sub hypotheses of H2 are not applicable for all students. The findings will be discussed in Section 5.4.

Table 21.

Correlation analysis between DoI and TCG login times for both classes

Graduate School of Education		DoI_REL_ADV	DoI_CPA	DoI_CPX	DoI_TRI	DoI_OBS
Login Times	Pearson correlation	.295	-.093	.561*	.203	.236
	Sig.	.268	.733	.024	.127	.379

	N	16	16	16	16	16
Department of Information Management		DoI_REL_ADV	DoI_CPA	DoI_CPX	DoI_TRI	DoI_OBS
Login Times	Pearson correlation	-.403*	-.401*	-.481*	-.473*	-.335
	Sig.	.046	.047	.015	.017	.102
	N	25	25	25	25	25
All (GSE+DIM)		DoI_REL_ADV	DoI_CPA	DoI_CPX	DoI_TRI	DoI_OBS
Login Times	Pearson correlation	-.025	-.249	-.090	-.052	-.023
	Sig.	.875	.117	.577	.746	.885
	N	41	41	41	41	41

*: $p < 0.05$; **: $p < 0.01$

For the correlation between TCG login times and SUS, there is no significant effect for Grdauate School of Edication, Department of Information Management, and both group student as Table 22 shows. Hence, H3 is not supported for GSE and DIM.

Table 22.

Correlation analysis between SUS and TCG login times for both classes

Graduate School of Education		System Usability Scale Score
Login Times	Pearson correlation	.049
	Sig.	.857
	N	16
Department of Information Management		System Usability Scale Score
Login Times	Pearson correlation	.055
	Sig.	.794
	N	25
All (GSE+DIM)		System Usability Scale Score
Login Times	Pearson correlation	.054
	Sig.	.738
	N	41

Table 23 shows the relation between System Usability Scale score and Computer Game Attitude Scale factors. The results indicate that SUS has no significant correlation with all factors of CGAS for Graduate School of Education and for both group students. However, only confidence factor has significant relation to SUS for Department of Information Management. I can say that H4a, H4b, H4c, and H4d are all fail for GSE. H4a is confirmed, H4b, H4c and H4d are not sustained for DIM. All sub hypotheses of H4 are not applicable for entire students.

Table 23.

Correlation analysis between CGAS and SUS for both classes

Graduate School of Education		CGAS_CON	CGAS_LRN	CGAS_LIKE	CGAS_LEI
SUS	Pearson correlation	.238	.487	.336	.364
	Sig.	.375	.055	.203	.166
	N	16	16	16	16
Department of Information Management		CGAS_CON	CGAS_LRN	CGAS_LIKE	CGAS_LEI
SUS	Pearson correlation	.399*	.147	.087	.203
	Sig.	.048	.484	.681	.330
	N	25	25	25	25
All (GSE+DIM)		CGAS_CON	CGAS_LRN	CGAS_LIKE	CGAS_LEI
SUS	Pearson correlation	.289	.276	.220	.249
	Sig.	.067	.080	.167	.116
	N	41	41	41	41

*: $p < 0.05$; **: $p < 0.01$

Table 24 shows the relation between Diffusion of Innovation factors and System Usability Scale scores. The results indicate that there is no significant relation between SUS and DoI factors for Graduation School of Education, so H5a, H5b, H5c ,H5d and H5e are not supported for GSE. On the other hand, the results from Department of Information Management show that not only relative advantage factor but trialability and observability also have extreme positive correlation with System

Usability score. Even I combined the two group students, the results indicate that there is no correlation between the SUS and DoI. Therefore, H5a, H5d and H5e are supported, H5b and H5c are not supported for DIM. All H5 sub hypotheses are not sustained for entire students.

Table 24.

Correlation analysis between DoI and SUS for both classes

Graduate School of Education		DoI_REL_ADV	DoI_CPA	DoI_CPX	DoI_TRI	DoI_OBS
SUS	Pearson correlation	.233	.237	.222	.091	-.449
	Sig.	.386	.376	.408	.737	.081
	N	16	16	16	16	16
Department of Information Management		DoI_REL_ADV	DoI_CPA	DoI_CPX	DoI_TRI	DoI_OBS
SUS	Pearson correlation	.430*	.166	.344	.568**	.677**
	Sig.	.032	.428	.093	.003	.000
	N	25	25	25	25	25
All (GSE+DIM)		DoI_REL_ADV	DoI_CPA	DoI_CPX	DoI_TRI	DoI_OBS
SUS	Pearson correlation	.302	.179	.257	.281	.022
	Sig.	.055	.264	.105	.075	.893
	N	41	41	41	41	41

*: $p < 0.05$; **: $p < 0.01$

As Table 25 shows, students' TCG login times does not have significate correlation with their improvement from midterm to final exam. It shows that H6 is not sustained for both GSE and DIM- Even for whole two groups students, there is no correlation between their login time and improvements.

Table 25.

Correlation analysis between TCG login times and improvement for both classes

Graduate School of Education		Improvement
Login Times	Pearson correlation	-.156

	Sig.	.564
	N	16
Department of Information Management		Improvement
Login Times	Pearson correlation	.222
	Sig.	.285
	N	25
All (GSE+DIM)		Improvement
Login Times	Pearson correlation	.106
	Sig.	.509
	N	41

H7 focuses on the micro view of students' attitude toward playing computer games will positively affect their improvement from midterm to final exam. Despite leisure has positive significate correlation with improvement (i.e., $r = 0.504$, $p = 0.047$), other CGAS factors and their improvement are not significant related as Table 26 shows. Therefore, H7a, H7b, and H7c are not supported. H7d is supported for GSE. All CGAS factors came from Department of Information Management and both groups have no significant relation with students' improvement from midterm to final exam. I can say that H7a, H7b, H7c and H7d are not supported for all and DIM.

Table 26.

Correlation analysis between improvement and CGAS factors for both classes

Graduate School of Education		CGAS_CON	CGAS_LRN	CGAS_LIKE	CGAS_LEI
Improvement	Pearson correlation	.273	.081	.076	.504*
	Sig.	.305	.764	.780	.047
	N	16	16	16	16
Department of Information Management		CGAS_CON	CGAS_LRN	CGAS_LIKE	CGAS_LEI
Improvement	Pearson correlation	.371	.098	.184	.273
	Sig.	.068	.640	.380	.187
	N	25	25	25	25

All (GSE+DIM)		CGAS_CON	CGAS_LRN	CGAS_LIKE	CGAS_LEI
Improvement	Pearson correlation	.274	.067	.094	.179
	Sig.	.083	.676	.560	.264
	N	41	41	41	41

*: $p < 0.05$; **: $p < 0.01$

H8 discusses the correlations between students' System Usability Scale scores and their improvement from midterm to final exam. The results can be seen in Table 27, two classes students System Usability Scale scores have no significant relation to their improvement which means H8 is not allowed for both GSE and DIM.

Table 27.

Correlation analysis between SUS and improvement for both classes

Graduate School of Education		Improvement
SUS	Pearson correlation	-.193
	Sig.	.473
	N	16
Department of Information Management		Improvement
SUS	Pearson correlation	.166
	Sig.	.426
	N	25
All		Improvement
SUS	Pearson correlation	-.029
	Sig.	.857
	N	41

For H9 – students have been given rewards whose System Usability Scale scores are higher than those who don't have, I would use independent t-test to do the analysis because there are two groups of GSE students (i.e, DO give in-game cards as reward and Not give in-game cards as reward). Table 28 shows there is no significant

difference between giving in-game cards as rewards and not giving in-game cards as rewards in System Usability Scale score. Therefore, H9 is not supported.

Table 28.

Do give reward vs. not give reward on SUS

	Give in-game cards as rewards	N	Mean	Standard deviation	*t value*	*p*
SUS	No	7	57.857	17.9947	.011	.992
	Yes	9	57.778	11.8878		

For H10 I also use independent t-test to compare improvement from midterm to final exam among two groups. As the following Table 29 shows, the result indicates that there is no significant difference between the two groups' improvement from midterm to final exam. Of course, H10 is not sustained.

Table 29.

Do give reward vs. not give reward on CGAS

	Give in-game cards as rewards	N	Mean	Standard deviation	*t value*	*p*
Improvement	No	7	11.43	8.304	-.048	.962
	Yes	9	11.67	10.770		

H11 discussed the two classes' comparison of each factor of Computer Game Attitude Scale. I use the independent t-test to explore whether or not there are significant differences for the two classes. Table 30 shows the results which indicate there are significant differences between DIM and GSE students' perceptions of leisure. Both two group effect size (Hedges' g = 0.65) hits more than medium degree which means that DIM students show higher leisure feelings and enjoy playing computer games more than GSE students. H11d has been confirmed and will be discussed in Section 5.4.

Table 30.

Information relevant discipline vs. education relevant discipline on factors of CGAS

	Class	N	Mean	Standard deviation	*t value*	*p*	*Hedges'g*
Confidence	DIM	25	3.0800	1.16976	.358	.713	0.1175
	GSE	16	2.9531	.99674			
Learning	DIM	25	3.4136	.87293	.377	.700	0.1207
	GSE	16	3.3131	.76469			
Liking	DIM	25	3.3900	.76744	.423	.683	0.1354
	GSE	16	3.2813	.85574			
Leisure	DIM	25	3.0200	.90116	**2.027***	**.050***	**0.6489**
	GSE	16	2.4531	.82774			

***: p < 0.001, **: p < 0.01, *: p < 0.05

Table 31 shows the independent t-test of the two classes' DoI questionnaire. The results indicate that DIM students' mean value is superior to GSE students' except relative advantage. Especially the trialability factor is significant difference between the two groups. Therefore, H12d is supported but H12a, H12b H12c and H12e are not supported.

Table 31.

Information relevant discipline vs. education relevant discipline on factors of DoI

	Class	N	Mean	Standard deviation	*t* value	*p*	Hedges'g
Relative Advantage	DIM	25	3.4480	.76872	-.554	.565	0.1773
	GSE	16	3.5750	.63243			
Compatibility	DIM	25	3.3200	.80532	.877	.364	0.2808
	GSE	16	3.1094	.65172			
Complexity	DIM	25	3.0536	1.05671	1.340	.199	0.4289
	GSE	16	2.5831	1.15827			
Trialability	DIM	25	3.1332	.96726	**2.143***	**.038***	**0.6859**
	GSE	16	2.4781	.93469			
Observability	DIM	25	3.1868	1.05420	.718	.485	0.2299
	GSE	16	2.9375	1.12986			

***: p < 0.001, **: p < 0.01, *: p < 0.05

For the H13, H14 and H15, I also used t-test to verify whether or not the two classes have differences in terms of the times of playing the TCG, the score of System Usability Scale, and the improvement from midterm to final exam. The t-test results

listed in Table 32 show that GSE students has no significance difference on playing the TCG from DIM students. However, the Hedges' g value reach to medium effect size 0.5 which means GSE students' behaviour still different from DIM students – they played the game more. Therefore, H13 can be said partially supported.

Table 32.
Independent t-test result for TCG login times

	N	Mean	Standard deviation	*t value*	*p*	*Hedges'g*
DIM	25	2.72	1.487	-1.573	.124	0.50249
GSE	16	3.81	2.949			

The t-test is also applied on the given SUS scores from both groups and the result is listed in Table 33. The result shows the given SUS scores for the ICER web-based system from both groups are remaining at poor level (i.e., 51 to 68) [1] and there is no significance difference between the two classes. Therefore, H14 is not supported.

Table 33.
Independent t-test result for SUS scores

	N	Mean	Standard deviation	*t value*	*p*
DIM	25	57.4	7.2701	-.122	.903
GSE	16	57.8	14.3124		

In order to compare whether or not GSE students have better performance improvement from midterm exam, the research team applied t-test to compare the two classes of students' improvement (i.e., the difference from midterm to final) and the result is listed in as Table 34. The result shows both classes have positive improvement from midterm to final; however the GSE students' improvement is significantly different from DIM students. Therefore H15 is supported.

Table 34.

Independent t-test result for improvement

	N	Mean	Standard deviation	*t value*	*p*
DIM	25	3.2	8.367	-2.967	.005**
GSE	16	11.56	9.458		

*: $p < 0.05$ **: $p < 0.01$

5.4 Findings and Discussion

From the data analysis, there are several findings that can help us understand users' attitudes toward and perceptions of the proposed ICER web-based system as well as exploring whether or not the system can improve students' learning performance. I categorize these findings important findings (i.e., those that are supported by this research), and unexpected findings (i.e., those that did not support my assumptions in this research).

5.4.1 Important Findings.

Findings for H1: Students' attitude toward playing computer game will positively affect their preference of playing TCG. For education relevant discipline students, thy usually have rich experiences in game-based learning so they might think most of games can help they learn including the TCG. Therefore, there is moderately positive relation between Graduate School of Education students TCG login times and their CGAS learning factor.

For both classes' students, most of them could spend some time to play popular games such as League of Legends. They usually perceived enjoyment for playing computer games, so they could play TCG more as well.

Findings for H2: The perceived Diffusion of Innovation will positively affect

students' preference of playing TCG. Most of Information relevant discipline students contact new technology from their courses or Internet. They could accept new technology more than those who don't have information background, so their perceived Diffusion of Innovation usually higher than others. However, the results indicate that their perceived Diffusion of Innovation have significant negative relation to their TCG login times. The possible reason could be (1) The TCG is not fun for them (2) They probably don't think that TCG can meet their expectation since TCG is developed in flash.

Unlike information background students, education discipline relevant students could feel that TCG is fun and easy. They like to play TCG more to see what kind of in-game card they can get. Therefore, their perceived Diffusion of Innovation tend to positive correlation with their TCG login times.

Findings for H4a: DIM students' confidence toward playing computer game will positively affect their System Usability Scale scores. When users have confidence in playing computer games, they may quickly adapt in using other system. That's why DIM students may give higher SUS scores for ICER web-based system. However, there is no significant correlation between computer game attitude scale and System Usability Scale scores for GSE students. The possible reason could be the in-game cards redemption is not easy or unclear for GSE students.

Findings for H5: The perceived Diffusion of Innovation will positively affect System Usability Scale score. GSE students perceived observability factor Diffusion of Innovation have no significant relation to their System Suavity Scale scores. However, only students' perceived innovation is common to see give lower System Usability Scale score (r = -0.449, p = 0.081). The possible reason is that GSE

students don't think the ICER web system looks like what they are expected to see.

DIM students perceived Diffusion of Innovation is positive correlated to their System Usability Scale scores. Especially the relative advantage, trialability and observability factors are significant positive related to the SUS scores. Because they have more information or user interface experiences than others, they may also think that using ICER web-based system to redeem in-game cards as rewards is very easy and useful just like they use forum on web browsers.

Findings for H7d: Students' leisure toward playing computer game will positively affect improvement from midterm to final exam. The result indicates that students feel playing game more like leisure, their improvement from midterm to final exam will be more. Most of parents don't think that their children can get benefit from playing games. This finding shows us that playing computer game will not affect learning. If the student can assign proper times for his/her leisure activities (i.e, computer games) and study, they are allowed to play computer games.

Findings for H11d: Information relevant discipline students' leisure toward playing computer is higher than education relevant discipline students'. The results show both two group effect size (Hedges' g = 0.65) hits more than medium degree which means that playing computer game for information relevant discipline students is a kind of leisure. Most of information management students like to play computer games or mobile games when they are free, playing computer game indeed have become part of their leisure activities.

Findings for H12d: Information relevant discipline students think that having opportunity to try on new tech is more important than education relevant

discipline students'. T-test results of DoI show that there is no significant difference of using new technology between DIM and GSE that's because both classes' students have 3C devices such as mobile phones or laptops, if a new game or app publishes, they may want to check it out or play it. However, only trialability fits my expectation that's because information background students may take more time to concern new technology (e.g., watch apple events on YouTube) or they often share new information with each other from time to time via social media. In such case, they desire to approach innovative technology than those who don't have information related background.

Findings for H13: Education relevant discipline students play TCG more often than information relevant discipline students. The result is a kind of evidence that shows giving students in-game cards as rewards can stimulate and engage them to play the game. On the other hand, a question can be raised from the data analysis result and this finding – "why both groups are not playing the TCG as often as the research team expected?" The simplest explanations might be (1) the TCG is not fun or (2) the TCG is difficult to play. However, this finding might also have causal relation with the findings for H14.

Findings for H15: Education relevant discipline students' improvement from midterm to final exam is higher than information relevant discipline students'. This finding is what I am looking for and want to proof the effectiveness of adopting the in-game cards as rewards mechanism and the ICER web-based system do get students motivated to learn. Although the finding is what I expect to see, the experiment and its data collection still need to improve. First of all, the current two groups of students in the experiment were coming from two different departments or

even say different disciplines. In such case, not only the learning subjects and activities as well as their teachers are different but also their gaming experience, backgrounds, and attitude towards gaming might be different and may have influence on the results. Second, the research goal is not only seeing the improvements on the academic achievement but also wants to see the students will work hard on learning activities for getting in-game cards as rewards.

5.4.2 Unexpected Findings

Findings for H3: Students' system usability score doesn't affect their preference of playing TCG. Both educational and information relevant students don't think that ICER web-based system is good. Perhaps the user interface doesn't attract them or they don't have any interest of redeem reward.

Findings for H6: Students' preference of playing TCG will positively affect their improvement from midterm to final exam. The result shows that the students play TCG more, both groups improvement from midterm to final exam have no significant corelated to their TCG playing times. That's because the experiment duration was not long enough so that students may not attracted by the rewards and don't care about the cards. This finding will also explain the finding for H10: Students have been given reward whose improvement from midterm to final exam are higher than those who don't have. If the experiment is longer enough, students could play TCG more and may understand the meaning of in-game card. Once they desire to get powerful in-game cards they may put more effort on prepare their final exam.

Findings for H8: Students' System Usability Scale Score will positively affect their improvement from midterm to final exam. I expected to see that

students feel the ICER web-based system is easy to use, their improvement from midterm to final exam should be more. However, the unexpected results show that there is no significant positive relation between System Usability Scale Score and improvements. The possible reason can be the seen as the partial of H4 - even some students have good learning performance, they still think in-game cards redemption is not easy or unclear.

Findings for H9 and H14: Both group students (include those who have been given in-game card as reward) give low scores on the usability of the ICER web-based system. I was expecting to see that GSE group will have more positive perception toward the system due to they received in-game cards as rewards and did use the system. The unexpected results show that all students think the usability of the ICER web-based system is low. One possible reason is that the students may feel the process of getting in-game cards with ICER web-based system is different from or more complicated than they usually did in commercial trading card games.

It is acceptable as in the commercial games players actually purchase and redeem/open cards inside the game so no further permission granted step/process needed; but the extra redemption/open and permission grant steps outside of the game are necessarily from the viewpoint of educational reward as well as the privacy issue and the dependency between games and awarding system.

Last but not the least, this finding also explains the findings for H3 and H4. Perhaps the difficulty of redeeming the cards makes them have less motivation to play the game.

In summary, the following Table 35 shows all the results I found from data analysis to explain the proposed research hypotheses.

Table 35.

Hypotheses and analysis results

	No.	Hypothesis	Result	Page
H1	H1a	Students' confidence toward playing computer game will positively affect their preference of playing TCG..	GSE: Not supported DIM: Not supported ALL: Not supported	65
	H1b	Students' learning toward playing computer game will positively affect their preference of playing TCG.	GSE: **Supported** DIM: Not supported ALL: Not supported	65
	H1c	Students' liking toward playing computer game will positively affect their preference of playing TCG.	GSE: Not supported DIM: **Supported** ALL: Not supported	65
	H1d	Students' leisure toward playing computer game will positively affect their preference of playing TCG.	GSE: Not supported DIM: Not supported ALL: Not supported	65
H2	H2a	The perceived relative advantage will positively affect students' preference of playing TCG.	GSE: Not supported DIM: Not supported ALL: Not supported	66
	H2b	The perceived compatibility will positively affect students' preference of playing TCG	GSE: Not supported DIM: Not supported ALL: Not supported	66
	H2c	The perceived complexity will positively affect students' preference of playing TCG	GSE: **Supported** DIM: Not supported ALL: Not supported	66
	H2d	The perceived trialability will positively affect students' preference of playing TCG	GSE: Not supported DIM: Not supported ALL: Not supported	66
	H2e	The perceived observability will positively affect students' preference of playing TCG.	GSE: Not supported DIM: Not supported ALL: Not supported	66
H3	H3	Students' system usability score will positively affect their preference of playing TCG	GSE: Not supported DIM: Not supported ALL: Not supported	67
H4	H4a	Students' confidence toward playing computer game will positively affect their System Usability Scale scores	GSE: Not supported DIM: **Supported** ALL: Not supported	68
	H4b	Students' learning toward playing computer game will positively affect their System Usability Scale scores	GSE: Not supported DIM: Not supported ALL: Not supported	68
	H4c	Students' liking toward playing computer game will positively affect their System Usability Scale scores	GSE: Not supported DIM: Not supported ALL: Not supported	68
	H4d	Students' leisure toward playing computer game will positively affect their System Usability Scale scores.	GSE: Not supported DIM: Not supported ALL: Not supported	68
H5	H5a	The perceived relative advantage will positively affect students' system usability score	GSE: Not supported DIM: **Supported** ALL: Not supported	69
	H5b	The perceived compatibility will positively affect students' system usability score	GSE: Not supported DIM: Not supported ALL: Not supported	69
	H5c	The perceived complexity will positively affect students' system usability score	GSE: Not supported DIM: Not supported ALL: Not supported	69
	H5d	The perceived trialability will positively affect students' system usability score	GSE: Not supported DIM: **Supported** ALL: Not supported	69
	H5e	The perceived observability will positively affect	GSE: Not supported	69

		students' system usability score	DIM: **Supported** ALL: Not supported	
H6	H6	Students' preference of playing TCG will positively affect their improvement from midterm to final exam	GSE: Not supported DIM: Not supported ALL: Not supported	69
H7	H7a	Students' confidence toward playing computer game will positively affect improvement from midterm to final exam	GSE: Not supported DIM: Not supported ALL: Not supported	70
	H7b	Students' learning toward playing computer game will positively affect improvement from midterm to final exam	GSE: Not supported DIM: Not supported ALL: Not supported	70
	H7c	Students' liking toward playing computer game will positively affect improvement from midterm to final exam	GSE: Not supported DIM: Not supported ALL: Not supported	70
	H7d	Students' leisure toward playing computer game will positively affect improvement from midterm to final exam	GSE: **Supported** DIM: Not supported ALL: Not supported	70
H8	H8	Students' System Usability Scale Score will positively affect their improvement from midterm to final exam	GSE: Not supported DIM: Not supported ALL: Not supported	71
H9	H9	Students have been given reward whose System Usability Scale Score are higher than those who don't have	Not supported	72
H10	H10	Students have been given reward whose improvement from midterm to final exam are higher than those who don't have	Not supported	72
H11	H11a	Information relevant discipline students' confidence toward playing computer is higher than education relevant discipline students'.	Not supported	72
	H11b	Information relevant discipline students' learning toward playing computer is higher than education relevant discipline students'.	Not supported	72
	H11c	Information relevant discipline students' liking toward playing computer is higher than education relevant discipline students'.	Not supported	72
	H11d	Information relevant discipline students' leisure toward playing computer is higher than education relevant discipline students'.	**Supported**	72
H12	H12a	Information relevant discipline students' perceived relative advantage of using new technology is higher than education relevant discipline students'.	Not supported	73
	H12b	Information relevant discipline students' perceived compatibility of using new technology is higher than education relevant discipline students'.	Not supported	73
	H12c	Information relevant discipline students' perceived complexity of using new technology is higher than education relevant discipline students'.	Not supported	73
	H12d	Information relevant discipline students' perceived trialability of using new technology is higher than education relevant discipline students'.	**Supported**	73
	H12e	Information relevant discipline students' perceived observability of using new technology is higher than education relevant discipline students'.	Not supported	73
H13	H13	Education relevant discipline students play TCG more often than information relevant discipline students.	**Partially supported**	74
H14	H14	Education relevant discipline students give higher System Usability Scale score for the ICER web-based system than information relevant discipline students.	Not supported	74
H15	H15	Education relevant discipline students' improvement from midterm to final exam is higher than information	**Supported**	74

		relevant discipline students'.		

Chapter 6. Conclusions

6.1 Summary

ERIC API makes two systems capable of working together without asking users of one system to keep authorizing the system to access the service and the data that the other system offers. Also, ERIC API is developed to provide system administrators quick and easy installation process so they can integrate the services provided by two separate systems with very few efforts. In many cases, educational technology researchers design and develop good technology-enhanced learning systems and tools for administrative personnel, teachers, and students, but then they find that it is very difficult for them to make the stakeholders really benefit from or adopt their research results due to the difficulties, heavy efforts and concerns that the stakeholders may have for integrating the research systems/tools into the existing platform or system they are using. The development of ERIC API can not only make stakeholders be exposed to more useful applications, systems, and tools but also help researchers promoting and testing their research results effectively and easier.

In this research I developed In-game Card as Educational Reward (ICER) web-based system which is connected to TCG by using ERIC API. The ICER web-based system helps teachers give students reward in very few steps easily. Students can redeem in-game cards quickly after they received a specific URL given by their teacher. I have conducted a pilot to understand whether or not giving students in-game cards as rewards can improve their learning performance. The data analysis results show that giving students in-game cards as rewards with the ICER web-based system can improve their learning performance.

Moreover, I also summarize some results based on the findings in Section 5.4: (1) Education relevant students are more likely to play TCG because they feel that playing TCG can help them learn; (2) Information relevant discipline students

perceived enjoyment while playing computer games but they don't like to play TCG because TCG is not attracted them (3) Students have information background who can quickly adapt in using a new system so they have confidence while playing computer games; (4) Both groups of students give low scores on the usability of the ICER web-based system because the game is not fun or difficult to play; (5) Give students reward can improve their learning performance.

6.2 Future Work

According to the summarized results, I identified some limitations and correspondent future works may need to be planed and done further. First of all, the research has to at least recruit two classes from the same department or disciplines to get rid of the potential influences. Second, the experiment should be a longer term one that involves many different learning activities and students' performances of each activity should be recorded. In such case, the research team can investigate whether or not the ICER mechanism and system can really get students motivated. Moreover, using ICER system longer may eliminate or educate students the difference between commercial games and educational awarding.

References

Al-Ajlan A. S. (2012). A comparative study between e learning features, methodologies, tools, and new developments for e learning. In E. Pontes (Ed.), Information system Management college of Business and Economics Qassim University Kingdom of Saudi Arabia (pp. 191-214). Intech, ISBN: 978953-51-0029-4, Retrieved September 26, 2016 from http://cdn.intechweb.org/pdfs/27926.pdf

Al-Ajlan, A. S., and Zedan, H. (2008). The Extension of Web Services Architecture to Meet the Technical Requirements of Virtual Learning Environments (Moodle)". *Proceedings of ICCES08-IEEE International Conference on Computer Engineering & Systems, IEEE*, Cairo, Egypt, 27–32.

Bosch, T. E. (2009). Using online social networking for teaching and learning: Facebook use at the University of Cape Town. *Communicatio: South African Journal for Communication Theory and Research*, 35(2), 185-200.

Brooke, J. (1996). SUS: A Quick and Dirty Usability Scale. In Jordan, P.W., Thomas, B., Weerdmeester B.A. & McClelland, I.L. (eds). *Usability Evaluation in Industry*, pp. 189-194. London: Taylor & Francis.

Cavus N., and Zabadi T. (2014). A Comparison Of Open Source Learning Management Systems. *3rd Cyprus International Conference on Educational Research*, Nicosia, Cyprus, 521-526.

Chang, M.-H. (2019). *Bio-Inspired Clustering Approach Based on Students' Annotation on Online Reading Materials* (Unpublished master's thesis). Athabasca University, Athabasca, Canada.

Chang, M., Kuo R., & Liu, Eric Z.-F. Revised Computer Game Attitude Scale. In the Proceedings of International Conference on Computers in Education (ICCE 2014), Nara, Japan, November 30-December 4, 2014, 598-607.

Chappell, K. K., & Taylor, C. S. (1997). Evidence for the Reliability and Factorial Validity of the Computer Game Attitude Scale. *Journal of Educational Computing Researc*h, 17(1), 67-77.

Chen, P., Kuo, R., Chang, M., & Heh, J.-S. (2009). Designing a Trading Card Game as Educational Reward System to Improve Students' Learning Motivations. Transactions on Edutainment, III, 116-128. Berlin: Springer-Verlag.

Chen, Roger J.-H. (2007). *A pilot of the Computer Game Attitude Scale for Primary School Students*(Master thesis, National Chiao Tung University). Retrieved from https://hdl.handle.net/11296/jw3a8t

Dougiamas M., & Taylor P. C. (2003). Moodle: Using Learning Communities to Create an Open Source Course Management System. *World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Retrieved September 26, 2016, from http://research.moodle.net/33/1/Moodle%20Using%20Learning%20Communities%20to%20Create.pdf

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate Data Analysis* (5th ed.) Upper Saddle River, NJ: Prentice Hall.

Jin S. (2012). Design of an Online Learning Platform with Moodle. *The 7th International Conference on Computer Science & Education (ICCSE 2012)*, July 14-17, 2012, Melbourne, Australia, 1710-1714.

Jong, B.-S., Lai, C.-H., Hsia, Y.-T., Lin, T.-W., & Lu, C.-Y. (2013). Using Game-Based Cooperative Learning to Improve Learning Motivation: A Study of Online Game Use in an Operating Systems Course. *IEEE Transactions on Education* , 56(2) , 183-190.

Jurubescu T. (2008). Learning Content Management Systems. *Informatica Economica*, 12(4), 91-94.

Kohn, A. (1999). *Punished by rewards: The trouble with gold stars, incentive plans, A's, Praise, and other bridges*. Boston: Houghton Mufflin.

Lin, W.-C., Lai C.-H. , Ho J.-Y. and Jong B.-S. (2014). Mobile Game-based Learning to Inspire Students Learning Motivation. International Conference on Information Science, *Electronics and Electrical Engineering (ISEEE 2014)* , Sapporo, Japan, April 26-28, 2014, 810-813.

Liu, E. Z.-F., Lee, C.-Y., & Chen, J.-H. (2013). Developing a New Computer Game Attitude Scale for Taiwanese Early Adolescents. *Educational Technology and Society*, 16(1), 183-193.

Lu, C.- H. (2011). *Story Decorated Context-Awareness Role Playing Learning Activity Generation* (Master's thesis, Athabasca University). Retrieved from https://dt.athabascau.ca/jspui/handle/10791/13

Lwoga E. T. (2014). Critical success factors for adoption of web-based learning management systems in Tanzania. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 10(1), 4-21.

Marinak, B. A. (2007). Insights about Third-Grade Children's Motivation to Read. *College Reading Association Yearbook*, 28, 54–65.

McNinch, G. W. (1996). Earning by Learning: Changing Attitudes and Habits in Reading. *Reading Horizons*, 37(2), 186-194.

Mtebe J. S. (2015). Learning Management System success: Increasing Learning Management System usage in higher education in sub-Saharan Africa. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 11(2), 51-64.

Oproiu, G. C. (2014, November 7-9). A Study about Using E-learning Platform (Moodle) in University Teaching Process. *Paper presented at The 6th International Conference Edu World 2014: Education Facing Contemporary World Issues, Pitesti, Arges, Romania*. doi: 10.1016/j.sbspro.2015.02.140.

Orawiwatnakul, W., & Wichadee, S. (2016). Achieving Better Learning Performance through the Discussion Activity in Facebook. *Turkish Online Journal of Educational Technology*, 15(3), 1-8. Retrieved September 26, 2016, from http://www.tojet.net/articles/v15i3/1531.pdf

O'Reilly T. (2007). What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software. *Communications & Strategies*, 65(1), 17-37.

Pattnayak J., & Pattnaik S. (2016). Integration of Web Services with E-Learning for Knowledge Society. *2nd International Conference on Intelligent Computing, Communication & Convergence (ICCC2016)*, January 24-25, 2016, Bhubaneswar, India, 155-160.

Park, Y., & Chen, J. V. (2007). Acceptance and adoption of the innovative use of smartphone. *Industrial Management & Data Systems*, 107(9), 1349 - 1365.

Quadir, B., Yang, J. C., Chen, N. S., & Shih, M. J. A. (2017). The Effects of Perceived Innovation Game Attributes by Learners on Learning Performance in a Game-Based Achievement Learning System. *In Innovations in Smart Learning* (pp. 151-160). Springer Singapore.

Rogers, E. M., (2003). Diffusion of innovations (5th ed.). New York, Free Press.

Thuseethan, S., Achchuthan, S., and Kuhanesan, S. (2015). Usability Evaluation of Learning Management Systems in Sri Lankan Universities. Global Journal of Computer Science and Technology, 15(1). Retrieved September 26, 2016, from https://arxiv.org/ftp/arxiv/papers/1412/1412.0197.pdf

Winefield, A. H., Barnett, J. A. & Tiggemann, M. (1984). Learned helplessness and IQ differences. *Personality and Individual Differences*. 5(5), 493-500.

Appendix A : Full Questionnaire

Section A： Please answer the following questions:

Please fill out your student ID here:

_____

A1. What is your gender? [Please choose only one of the following]
○ A.Female
○ B.Male

A2. What is your grade? [Please choose only one of the following]
○ A.Freshman ○ B.Sophomore ○ C.Junior
○ D.Senior ○ E.First year of graduate school ○ F.Second year of graduate school

A3. Do you know what Trading Card Game is?（e.g., Yu-Gi-Oh!, Hearthston, Magic: The Gathering）[Please choose only one of the following]
○ A.Yes
○ B.No (Please go to A10)

A4. Have you ever played non-computer(i.e.,paper-based) or computer based trading card game before?
○ A.Yes
○ B.No (Please go to A10)

A5. What kind of non-computer based trading card game have you played?？ [Fill out]

_____

A6. How much time do you averagely spend on playing non-computer based trading card game? [Multiple choise]

	I don’t play	Half an hour	1 hour	1.5 hours	More than 2

					hours
Monday	□	□	□	□	□
Tuesday	□	□	□	□	□
Wednesday	□	□	□	□	□
Thursday	□	□	□	□	□
Friday	□	□	□	□	□
Saturday	□	□	□	□	□
Sinday	□	□	□	□	□

A7. What kind of computer or smartphone based trading card game have you played? [Please choose only one of the following]

○ A. I have NEVER played computer or smartphone based trading (Please go to A10)

○ B. I have EVER played _____

A8. How much time do you averagely spend on playing **computer** or **smartphone** based trading card game? [Multiple choise]

	I don't play	Half an hour	1 hour	1.5 hours	More than 2 hours
Monday	□	□	□	□	□
Tuesday	□	□	□	□	□
Wednesday	□	□	□	□	□
Thursday	□	□	□	□	□
Friday	□	□	□	□	□
Saturday	□	□	□	□	□
Sunday	□	□	□	□	□

A9. Have you ever **seen others** to play trading card game? [Please choose only one of the following]

○ A.Yes

○ B. No

A10. Have you ever played **video games**? (e.g., PS3, PS4, Wii, Xbox)? [Please choose only one of the following]

○ A.Yes

○ B.No (Please go to A12)

A11. How many hours do you approximately play video games everyday except Holidays and Summer/Winter vacations? [Multiple Choice]

	I don't play	Half an hour	1 hour	1.5 hours	More than 2 hours
Monday	□	□	□	□	□
Tuesday	□	□	□	□	□
Wednesday	□	□	□	□	□
Thursday	□	□	□	□	□
Friday	□	□	□	□	□
Saturday	□	□	□	□	□
Sunday	□	□	□	□	□

A12. Have you ever played **arcade games** (i.e., Coin-operated machines) ? [Please choose only one of the following]

○ A.Yes

○ B.No (Please go to A14)

A13. How many hours do you approximately play arcade games everyday except Holidays and Summer/Winter vacations? [Multiple Choice]

	I don't play	Half an hour	1 hour	1.5 hours	More than 2 hours
Monday	□	□	□	□	□
Tuesday	□	□	□	□	□
Wednesday	□	□	□	□	□
Thursday	□	□	□	□	□
Friday	□	□	□	□	□
Saturday	□	□	□	□	□
Sunday	□	□	□	□	□

A14. Have you ever played **mobile games**? (i.e., the games that can be played on smartphones like iPhone or Android phones) [Please choose only one of the following]

○ A.Yes

○ B.No (Please go to A16)

A15. How many hours do you approximately play mobile games everyday except Holidays and Summer/Winter vacations? [Multiple Choice]

	I don't play	Half an hour	1 hour	1.5 hours	More than 2 hours
Monday	□	□	□	□	□
Tuesday	□	□	□	□	□
Wednesday	□	□	□	□	□
Thursday	□	□	□	□	□
Friday	□	□	□	□	□
Saturday	□	□	□	□	□
Sunday	□	□	□	□	□

A16. Have you ever played **hand-held video games**?（i.e., PSP、PS Vita、N3DS）[Please choose only one of the following]

○ A.Yes

○ B.No (Please go to A18)

A17. How many hours do you approximately play **hand-held video games** everyday except Holidays and Summer/Winter vacations? [Multiple Choice]

	I don't play	Half an hour	1 hour	1.5 hours	More than 2 hours
Monday	□	□	□	□	□
Tuesday	□	□	□	□	□
Wednesday	□	□	□	□	□
Thursday	□	□	□	□	□
Friday	□	□	□	□	□
Saturday	□	□	□	□	□
Sunday	□	□	□	□	□

A18. Have you ever played **computer games** (i.e., the games that can be played on computers.)? [Please choose only one of the following]

○ A.Yes

○ B.No (Please go to A22)

A19. How many hours do you approximately play **computer games** everyday except Holidays and Summer/Winter vacations? [Multiple choice]

	I don't play	Half an hour	1 hour	1.5 hours	More than 2 hours
Monday	□	□	□	□	□
Tuesday	□	□	□	□	□
Wednesday	□	□	□	□	□
Thursday	□	□	□	□	□
Friday	□	□	□	□	□
Saturday	□	□	□	□	□
Sunday	□	□	□	□	□

A20. When did you start playing **computer games**? [Please choose only one of the following]
○ A.Before primary school
○ B.In primary school
○ C.In high school

A21. Where do you play computer games usually ? [You can choose more than one place if it applies]
□ A.Home
□ B.School
□ C.Friends' place
□ D.Internet bar
□ E.Others _____ *

A22. What kind of game type is your favorite? [Please choose only one of the following]
○ A. Standalone Game (The game you can play alone on your own computer without either internet connection or other PC's connection.)
○ B. Multi-player with less interactions (The game you can play with internet connection. In the game you see lots of players but you don't have to interact with them such as Candy Crush)
○ C. Multi-player with rich interactions (The game you can play with internet connection. In the game you see lots of players and you may team up, chat, fight, and interact with them such as League of legends.)
○ D. I don't like any of them.

A23. What kind of game genre is your favorite? (you can choose more than one genre if it applies)

□ A. Advergames（e.g., America's Army）
□ B. Adventure (e.g., Tomb Raider)
□ C. Arcade game
□ D. Fighting (e.g., Street fighter)
□ E. First Person Sneaker (e.g., Assassin's Creed)
□ F. First Person Shooters（e.g., Counter-Strike）
□ G.MMORPG：'Massively Multiplayer Online Role Playing Games'
□ H. Platform (e.g., Super Mario Bros)
□ I. Puzzle
□ J. Racing Games (e.g., Need for Speed、DIRT)
□ K. RPG: 'Role Playing Games' (Dark Souls)
□ L. RTS: 'Real Time Strategy' (e.g., Age of Empires)
□ M. Serious Games (Serious games are games aimed at teaching, discussing or debating real-world concepts via game-play.)
□ N. Simulations (e.g., SimCity and Flight emulators)
□ O. Sports Games (e.g.,NBA、MLB)
□ P. Third Person Shooters (TPS)
□ Q. VR Games (Virtual Reality Games)
□ R. MOBA Games (e.g., League of Legends, DOTA)
□ S. I don't like any of them
□ T. Others，such as _____ *

Section B： Please answer the following questions:

		Strongly Disagree	Disagree	Neutral	Agree	Stringly Agree
1.	**I am good at playing computer games**	○	○	○	○	○
2.	**Playing computer games is easy for me.**	○	○	○	○	○
3.	**I understand and play computer games well.**	○	○	○	○	○
4.	**I am skilled at playing computer games**	○	○	○	○	○
5.	**I like taking courses that use computers**	○	○	○	○	○
6.	**Using computer games in**	○	○	○	○	○

	school is a good way to learn.					
7.	**Playing computer games improves my eye and hand coordination.**	○	○	○	○	○
8.	**Playing computer games enhances my imagination.**	○	○	○	○	○
9.	**I like it when people talk about computer games**	○	○	○	○	○
10.	**I feel comfortable while playing computer games.**	○	○	○	○	○
11.	**I am very interested in solving quests/questions/missions in computer games.**	○	○	○	○	○
12.	**I always try to solve the current quest/question/mission in the computer game.**	○	○	○	○	○
13.	**Playing computer games makes me happy**	○	○	○	○	○
14.	**Playing computer games is part of my life.**	○	○	○	○	○
15.	**When I have free time, I play computer games.**	○	○	○	○	○
16.	**I talk about computer games with my friends.**	○	○	○	○	○
17.	**I am not alone in a computer game as I can make friends there.**	○	○	○	○	○

Section C： Please answer the following questions

*******Learning activity means such as homework, assignment or exams *******

		Strongly Disagree	Disagree	Neutral	Agree	Stringly Agree
18.	**When a course has reward mechanism, I will accomplish its**	○	○	○	○	○

	learning activities quickly.					
19.	**When a course has reward mechanism, I will improve the quality of learning activities while doing them.**	○	○	○	○	○
20.	**When a course has reward mechanism, I will more likely to be concentrate and participate in it.**	○	○	○	○	○
21.	**When a learning activity like assignment or exam has reward mechanism, I receive better marks.**	○	○	○	○	○
22.	**When a learning activity like assignment or exam has reward mechanism, I would more like to start doing it.**	○	○	○	○	○
23.	**A course should have reward mechanism**	○	○	○	○	○
24.	**For making me learn better, a course needs to have reward mechanism**	○	○	○	○	○
25.	**Adopting reward mechanism in a course fits well with the way I like to learn.**	○	○	○	○	○
26.	**My learning style needs to have rewards for doing learning activities in a course.**	○	○	○	○	○

27.	**Playing a trading card game like "Yu-Gi-Oh!", "Pokemon" or"Hearthstone" is easy for me.**	○	○	○	○	○
28.	**I understand the game mechanics of a trading card game.**	○	○	○	○	○
29.	**Learning how to play a trading card game is easy for me.**	○	○	○	○	○
30.	**It is easy to learn when a course has reward mechanism.**	○	○	○	○	○
31	**It is easy to know how I can get the reward when a course has reward mechanism.**	○	○	○	○	○
32.	**I've had great deal of opportunities to try how to play a trading card game.**	○	○	○	○	○
33.	**I can satisfactorily try out various trading card games.**	○	○	○	○	○
34.	**Before deciding whether or not to play the trading card game, I would need to get familiar with it on a trial basis.**	○	○	○	○	○
35.	**Before deciding whether or not to play the trading card game, I would need to properly understand the game mechanics.**	○	○	○	○	○

36.	**I know where I can go to satisfactorily try out various trading card game**	○	○	○	○	○
37.	**It is easy for me to see others' game-play of a trading card game.**	○	○	○	○	○
38.	**I have had a lot of opportunity to see the trading card game being played.**	○	○	○	○	○
39.	**I can see my friends like to play a trading card game.**	○	○	○	○	○
40.	**I can see my friends like to use their powerful cards to beat their opponents.**	○	○	○	○	○
41.	**I will play the trading card game after seeing my friends duel with each other in a trading card game.**	○	○	○	○	○
42.	**I have my own game-play strategy after seeing my friends duel with each other in the trading card game.**	○	○	○	○	○

ICER WEB-BASED SYSTEM

Please fill out your student ID :

_____

Please fill out your username of trading card game:

_____

Please answer the following questions

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	**It is easy to redeem a reward given by the teacher.**	○	○	○	○	○
2.	**I think that I would need the support of a technical person to help me redeem rewards given by the teacher.**	○	○	○	○	○
3.	**It is easy to use In-game Card as Educational Reward(ICER) web-based system.**	○	○	○	○	○
4.	**It is simple to see my card collection in the final step of the redemption.**	○	○	○	○	○
5.	**ICER web-based system is unnecessarily complex.**	○	○	○	○	○
6.	**I can easily know how to see my card collection from the ICER web-based system.**	○	○	○	○	○
7.	**I can see the information of my card collection after I grant ICER web-based system permission to access my card collection in the**	○	○	○	○	○

	TCG.					
8.	**I know how to use my TCG cridentials to authorize ICER web-based system to access my card collection in the TCG.**	○	○	○	○	○
9.	**The ways of getting cards from different learning activities are similar.**	○	○	○	○	○
10.	**I would imagine that most people would authorize ICER web-based system to access their card collection in the TCG very quickly.**	○	○	○	○	○
11.	**I can quickly become skillful with authorizing ICER web-based system to access my card collection information in the TCG.**	○	○	○	○	○
12.	**I still remember how to authorize ICER web-based system to access my card collection information in the TCG.**	○	○	○	○	○
13.	**I felt very confident in authorizing ICER web-based system to access my card collection information in the TCG.**	○	○	○	○	○
14.	**I try to complete learning activities quickly when my teacher has reward linked to learning activities like assignments, quizzes, and exams.**	○	○	○	○	○
15.	**It is practical to adopt reward mechanism for any learning activities.**	○	○	○	○	○

16.	**I can use the cards awarded in the course to play with my classmates in the TCG.**	○	○	○	○	○
17.	**Granting ICER web-based system permission to access my card collection in the TCG is good.**	○	○	○	○	○
18.	**I need to learn a lot of things before I am capable of authorizing ICER web-based system to access my card collection in the TCG.**	○	○	○	○	○
19.	**Once my performance of a learning activity meet the criteria, I can get cards for the TCG**	○	○	○	○	○
20.	**I can use any of my awarded cards to play with my classmates in the TCG.**	○	○	○	○	○
21.	**I will recommend other teachers to also adopt reward mechanism in their courses.**	○	○	○	○	○
22.	**After my teacher adopts reward mechanism for his/her course, I am more likely to participate in.**	○	○	○	○	○
23.	**After seeing the update of cards awarded for my good performance on learning activities, I put more efforts on doing the learning activities**	○	○	○	○	○
24.	**After my teacher adopts reward mechanism for his/her course, I put more**	○	○	○	○	○

	efforts on doing the learning activities.					
25.	**I hope my teacher can adopt reward mechanism for all kinds of learning activity in his/her class.**	○	○	○	○	○

Appendix B : REB Certificates

The REB Certificate : ERIC API

Athabasca University
RESEARCH CENTRE

CERTIFICATION OF ETHICAL APPROVAL

The Athabasca University Research Ethics Board (REB) has reviewed and approved the research project noted below. The REB is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2) and Athabasca University Policy and Procedures.

Ethics File No.: **22292**

Principal Investigator:

Mr. Cheng-Li Chen, Graduate Student

Faculty of Science & Technology\Master of Science in Information Systems (MScIS)

Supervisor:

Mr. Cheng-Li Chen (Principal Investigator)

Dr. Maiga Chang (Supervisor)

Project Title:

Educational Resource Information Communication API (ERIC API): The Case of Moodle and Online Tests System Integration

Effective Date: September 15, 2016 **Expiry Date**: September 14, 2017

Restrictions:

Any modification or amendment to the approved research must be submitted to the AUREB for approval.

Ethical approval is valid *for a period of one year*. An annual request for renewal must be submitted and approved by the above expiry date if a project is ongoing beyond one year.

A Project Completion (Final) Report must be submitted when the research is complete *(i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

Approved by: **Date: February 28, 2020**

Ali Akber-Dewan, Chair

School of Computing & Information Systems, Departmental Ethics Review Committee

---

Athabasca University Research Ethics Board

University Research Services, Research Centre

1 University Drive, Athabasca AB Canada T9S 3A3

E-mail rebsec@athabascau.ca

Telephone: 780.675.6718

ICER WEB-BASED SYSTEM

The REB Renewal : ERIC API

CERTIFICATION OF ETHICAL APPROVAL - RENEWAL

The Athabasca University Research Ethics Board (AUREB) has reviewed and approved the research project noted below. The AUREB is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS) and Athabasca University Policy and Procedures.

Ethics File No.: **22292**

Principal Investigator:

Mr. Cheng-Li Chen, Graduate Student

Faculty of Science & Technology\School of Computing & Information Systems

Supervisor:

Dr. Maiga Chang (Supervisor), Associate Professor, Faculty of Science & Technology

Project Title:

Educational Resource Information Communication API (ERIC API): The Case of Moodle and Online Tests System Integration

Effective Date: September 14, 2017 **Expiry Date**: September 13, 2018

Restrictions:

Any modification or amendment to the approved research must be submitted to the AUREB for approval.

Ethical approval is valid *for a period of one year*. An annual request for renewal must be submitted and approved by the above expiry date if a project is ongoing beyond one year.

A Project Completion (Final) Report must be submitted when the research is complete *(i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

Approved by: **Date:** September 14, 2017

Joy Fraser, Chair

Athabasca University Research Ethics Board

Athabasca University Research Ethics Board

University Research Services, Research Centre

1 University Drive, Athabasca AB Canada T9S 3A3

E-mail rebsec@athabascau.ca

Telephone: 780.675.6718

The REB Certificate : Educational Reward System

Athabasca University
RESEARCH ETHICS BOARD

The future of learning.

CERTIFICATION OF ETHICAL APPROVAL

The Athabasca University Research Ethics Board (AUREB) has reviewed and approved the research project noted below. The AUREB is constituted and operates in accordance with the current version of the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS)* and Athabasca University Policy and Procedures.

Ethics File No.: 22544

Principal Investigator: Cheng-Li Chen, Graduate Student, Faculty of Science & Technology

Project Title: 'Educational Reward Plug-In for Massively Open Online Course (MOOC) Platform'

Supervisor: Maiga Chang, Associate Professor, Faculty of Science & Technology

Effective Date: July 5, 2017 **Expiry Date**: July 4, 2018

Restrictions:

- Any modification or amendment to the approved research must be submitted to the AUREB for approval.
- Ethical approval is *valid for a period of one year*. An annual request for renewal must be submitted and approved by the above expiry date if a project is ongoing beyond one year.
- A Project Completion (Final) Report must be submitted when the research is complete *(i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

Approved by: **Date: July 5, 2017**

Joy Fraser, Chair
Athabasca University Research Ethics Board

Athabasca University Research Ethics Board
University Research Services, Research Centre
1 University Drive, Athabasca AB Canada T9S 3A3
E-mail: rebsec@athabascau.ca
Telephone: 780.675.6718

The REB Renewal : Educational Reward System

Athabasca University
RESEARCH CENTRE

CERTIFICATION OF ETHICAL APPROVAL - RENEWAL

The Athabasca University Research Ethics Board (AUREB) has reviewed and approved the research project noted below. The AUREB is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS) and Athabasca University Policy and Procedures.

Ethics File No.: **22544**

Principal Investigator:

Mr. Cheng-Li Chen, Graduate Student

Faculty of Science & Technology\School of Computing & Information Systems

Supervisor:

Dr. Maiga Chang (Supervisor)

Project Title:

Educational Reward Plug-In for Massively Open Online Course (MOOC) Platform

Effective Date: Jun3 29, 2018 **Expiry Date**: July 04, 2019

Restrictions:

Any modification or amendment to the approved research must be submitted to the AUREB for approval.

Ethical approval is valid *for the period noted on this certificate.* An annual request for renewal must be submitted and approved by the above expiry date if a project is ongoing beyond the expiry.

A Project Completion (Final) Report must be submitted when the research is complete *(i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

Approved by: **Date:** June 29, 2018

Joy Fraser, Chair

Athabasca University Research Ethics Board

Athabasca University Research Ethics Board

University Research Services, Research Centre

1 University Drive, Athabasca AB Canada T9S 3A3

E-mail rebsec@athabascau.ca

Telephone: 780.675.6718

The REB Renewal : Educational Reward System

Athabasca University
RESEARCH CENTRE

CERTIFICATION OF ETHICAL APPROVAL - RENEWAL

The Athabasca University Research Ethics Board (AUREB) has reviewed and approved the research project noted below. The AUREB is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS) and Athabasca University Policy and Procedures.

Ethics File No.: **22544**

Principal Investigator:

Mr. Cheng-Li Chen, Graduate Student

Faculty of Science & Technology\Master of Science in Information Systems

Supervisor:

Dr. Maiga Chang (Supervisor)

Project Title:

Educational Reward Plug-In for Massively Open Online Course (MOOC) Platform

Effective Date: July 05, 2019 **Expiry Date**: July 04, 2020

Restrictions:

Any modification or amendment to the approved research must be submitted to the AUREB for approval.

Ethical approval is valid *for a period of one year*. An annual request for renewal must be submitted and approved by the above expiry date if a project is ongoing beyond one year.

A Project Completion (Final) Report must be submitted when the research is complete *(i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

Approved by: **Date:** June 10, 2019

Carolyn Greene, Chair

Athabasca University Research Ethics Board

Athabasca University Research Ethics Board

University Research Services, Research Centre

1 University Drive, Athabasca AB Canada T9S 3A3

E-mail rebsec@athabascau.ca

Telephone: 780.675.6718