

## A Design of Smart-based Education Gamification Platform Using Mobile Devices for Digital Content

Jun-Ho Huh<sup>1</sup>, Han-Byul Kim<sup>2</sup> and Kyungryong Seo<sup>3\*</sup>

<sup>1</sup>Department of Software, Catholic University of Pusan, Busan, Republic of Korea

<sup>2,3</sup>Department of Computer Engineering, Pukyong National University at Daeyeon, Busan, Republic of Korea

72networks@cup.ac.kr, khb6513@naver.com, krseo@pknu.ac.kr

### Abstract

*It's been observed that some of the researchers in the game industry and educational fields are developing the teaching materials in the form of games to make classroom learning more interesting, which involves 'gamification'. At the same time, they are trying to understand what kind of gaming factors are relevant to increase the students' interest in learning and have an educational effect. A model of the 'Education-Gamification Platform' has been designed in this study for the mobile device-based games to assist in such an effort. The platform can be adjustable to the level of the players and lets them to experience the intended educational effects. A lot of the discussion is focused on the process involving an IT technology but the platform can be applied to non-IT gadgets. Also, this platform will be able to recognize some of the problems which could arise during the gamification process with a simple mechanics.*

**Keywords:** Education, Gamification, Game, Computer Science Education, Software Engineering, Smart Phone Game

### 1. Introduction

Unexpected speed of development in the fields of IT/ ICT technologies and relevant mobile devices has brought a huge impact on our daily lives as well as traditional play culture. The 'N-generations', who are skillfully adapted to the up-to-date IT technologies, are continually increasing following the rapid development of the digital technology and their living environment is filled with new and novel IT devices or equipment [1-7]. They are autonomous and highly individualistic in using the information and prefer to be an active information provider/user. Aside from arising concerns that the current play culture is leaning toward personal and indoor activities instead of healthy outdoor plays, the effects of PC or mobile-based games have to be studied and the results should be used to create a better gaming environment. One of means to achieve such an objective is to graft or integrate gaming factors with education to provide more enjoyable and adaptable learning environments to current and future generations. The 'Education-Gamification Platform' described in this study is flexible in such a use and can be applied to non-IT areas.

---

\* Corresponding Author, Major of Computer Science Education, Graduate School of Education, Pukyong National University at Daeyeon, And Department of Computer Engineering, Pukyong National University at Daeyeon, Busan, Republic of Korea

## 2. Related Research

### 2.1. Gamification

The word, 'Gamification', is a newly coined word adding 'Game' with a suffix '-fication'. This means utilizing the usual elements of games (*e.g.*, fun, reward, competition, *etc.*) to the other areas. The core idea of Gamification is that people are willing to participate in any kind of play if they are interested (cf. A Theory of Fun for Game Design). Having a fun time is a basic instinct of human beings that is why Gamification is a method to make people enjoy the things which they normally do not feel fun or try to avoid by introducing some gaming elements into it, to have more fun [2-9].

A large number of firms are already involved in a task of Gamification for their contents and the reason for such Gamification can be applied across the society is that the history of computer games extends over 40 years, that is why most of middle aged people and the elderly are accustomed with the gaming culture [10-17]. On the other hand, the reason the Gamification is not active in the Republic of Korea (ROK) is that people in this country still has rather strong negative perceptions toward games. However, through Gamification, students will be able to enjoy learning even the subjects such as mathematics and science, understanding the pleasure of learning. Actually, there are some case reports that the students who were unable to concentrate on the school subject changed much when the experiment of Gamification was conducted in the school.

The on-line games industry in the ROK has reached the global level already. Although the industry is currently undergoing a difficult situation due to the rapid growth and advancement of Chinese on-line games industry into domestic market and the strengthening of regulations by the government, they have been relentlessly taking a leap forward as an independent industry despite of their rather short history of less than 30 years, lower turnover and slower overseas expansion, compared to international game conglomerates. At the same time, the game user base has expanded as well and it is promising to move forward with the Gamification that improves pessimistic realities with the game-oriented thinking and skills that by taking advantage of such situation.

### 2.2. Game Platform

The platform-based classification of a game can be made in terms of its hardwares, and as for the genre, in terms of its softwares, emphasizing each aspect [15-23]. However, both aspects are actually being mixed in consideration for the classification in game industry or in the related studies. The on-line games are being classified to be a single platform but it is simply highlighting their technological characteristics which various platforms would have such that defining them as a common single platform is not practical.

Also, when classifying the game genre, the arcade games are often described as the games that can be mainly played at the game centers by emphasizing their hardware characteristics only so that their genre is recognized as a superordinate concept which includes a variety of games such as adventure, FPS, sports and board games. Despite the fact that there are many cases where the distinction of game genre is often confusing because of unclear classification criteria, there is no unified consensus on this yet. For example, both the 'action' by the gamers and the game contents 'sports' are often classified as the same genre even if they differ in many aspects. Currently, such existing classification methodology is still used widely just modifying it partially from time to time.

A typical game genre that is being linked to a particular platform the role-playing games. Especially, the games called 'MMORPG' are known to be best suited to the PC game platform. Likewise, sports games are mostly played with the game consoles and the board/arcade games, on mobiles. Nevertheless, the recent emergence of mobile devices is

weakening the link between such platforms and particular genres and many game sequels are being played on smart phones, including 'MMORPGs'.

### **2.3. Classification of Game Platforms**

Currently, many more game platforms are emerging in the market, although there exist augmented reality games that uses Oculus Rift in addition to other diverse games, only the media characteristics of existing popular game platforms such as PCs, game consoles, Smart Phones, and Smart pads are briefly described in the following sections.

#### **2.3.1. Console (Video) Games**

Console games are also called as the video games which refer to the games that are played by using the certain exclusive portable devices or game devices connected to a TV or monitor. The popular console game devices include Xbox360, Playstation 1~3, Nintendo Wii, Nintendo DS and PSP). Different from other devices, these devices are solely used for the games such that they have a huge amount of aficionados compared to other game platforms. Although there are many 'soft' game users due to recent emergence of Wii, it is not easy to handle the game pads included in Playstation3 or Xbox360 and their game play levels are 'hard'. The portability of Nintendo and PSP is high but the video games that require a connection with a TV or monitor have lower or no portability that is why the latter has unfavorable time factors.

However, the interfaces used for these games are solely used for the games through their joystick and motion control, not through operation of joystick, keyboard or touch screen. Motion control allows recognition and mimicking of a series of behaviors taken by the gamer to assist him/her to enjoy the game dynamically, heightening the level of vividness. Moreover, in this game genre, while there are some family-type games like Mario Brothers and Donkey Kong by Nintendo Wii, the mainstream of console games are of those high-quality games which supports realistic descriptions and plays. As for their interactivity, console games provide various game objectives, operators and rewards as PC games, even though they cannot achieve the level of interaction to construct a virtual world where many gamers will be participating as the PC-based platforms. Also, the communications between the gamers are rarely possible

#### **2.3.2. Computer Games**

The computer games, which accounts to 75.5% of gamers prefer to play, are the most used game platforms and the easiest to enjoy are various types of games from flash games to the games requiring a high-specification PC. Many game genres can be played since they have lesser technological limitations than other platforms and the problems concerning PC capacity and graphical requirements are usually solved by simply replacing the hardwares. The majority of households have at least one PC at their home and on-line games can be played easily due to the development of internet networks.

Since PC is one of the most used platform in our daily lives, it is may be the most dominant platform that can achieve superior time share. However, desktop computers have the problem of a low portability when compared to notebooks or netbooks, but these notebook and netbooks also have much less portability than that of smart and mobile phones. Nevertheless, when considering vividness, desktop computers are relatively superior to other platforms in terms of implementation of game graphics and sound support, both in depth and ranges. Moreover, the recent technological developments (*e.g.*, 3D-monitors, touch-monitors, *etc.*) add an increased vividness.

Considering the interactivity, PC games offer higher social interactivity than any other platforms as the internet-based games are most actively played on these platforms. Computer games also offer various virtual worlds where many gamers participate. Actually, the gamers participating in a MMORPG game create a guild for themselves or

have a virtual wedding between the gamers who met on on-line games. Real-time conversations are possible while playing the game so that not only the simple discussions about the game but also many other communications with a diversified contents can be exchanged. Also, since the PCs have fewer limitations in genre, capacity, and storytelling, their technological interactivity is high as they offer a variety of game objectives, operators, and rewards.

### **2.3.3. Smart Phone Games**

The recent status of mobile games is recognized as a significant game platform due to the introduction and rapid distribution of smart phones. Their growth potential is expected to be greater as more than 70% of the smart phone games' users are consisting of age groups of teens to thirties. These games belong to subcategory of mobile games and have average characteristics of mobile games whose biggest benefit is that they do not have any temporal and spatial limitations as the games can be played any time anywhere one wishes because of their mobility which cannot be provided by PC or console games. Also, as smart phones can be carried always, both the time share and portability are high. The characteristics of mobile games are better exhibited with smart phones. In addition to mobility without temporal and spatial limitations, smart phones can assume various work that used to be processed with PC through WiFi and 3G networks so that their usages and operation time will be increased accordingly. Such time-related factor can affect smart phone games strongly. However, since the main function of existing mobile phones has been to establish communications and these phones have a minimized function as a game platform, they display the lowest level of vividness when compared to the other platforms. Also, the existing mobile phones have a small number of sensational dimensions that can be delivered simultaneously and their channel qualities are quite low because the graphic capacities and game sizes are limited, not to mention that the gamers have to play the game with just around 12 keypads. Thus, the games that could be played on a mobile phone were mainly the simple webboard games such as Go-Stop (Asian traditional card games) or other card games.

On the other hand, the interface of smart phone games, which can be played by touching the screen, has exceeded the limits of keypad operation and by adopting various multimedia features in addition to simple communication function and acquiring a larger graphic and memory capacities and number of pixels, they became much more vivid and exuberant as the game platforms. Especially, their game genres expanded from the strategy, simulation and RPG games to racing and shooting games after applying button controls of the game devices to mobile games using the capacitive touch method commonly used for the smart phone games. Expansion of game genres due to development of mobile devices, and easy and cheap game application download and installment method provide gamers opportunities to experience various games so that the technical interactions involving the object of game, operator(s) and rewards have increased also. The most aspect that stands out of the smart phone-oriented game platforms is a social interaction, resulting from the Social Network Games (SNG) which refers to the social games played through SNS. The social games are the games played through the personal connections management services such as Facebook (US) or Cyworld (ROK). In these games, the merits of SNS and the fun aspect of the games are integrated.

For example, by letting the gamers play the game using personal connections like the friends in Twitter or the closest friends in Cyworld to visit each other's farm to water crops or give presents, the game space is recognized as a virtual space where another new society will be built and the people within that society can also carry out realtime communications. In fact, Cyworld was the first SNS service who introduced the PC-based SNG but the real contributors who have created a boom for SNGs are the explosively increased SNS services following the emergence of smart phones. Also, the Cyworld's

SNG was a closed space available only for the Cyworld users but those games played through Facebook or Twitter are an open space for the gamers who do not use both services.

## 2.4. Current Status of Each Game Platform

### 2.4.1. Current Status of Game Genres

According to The User's Motivation for Game Platform Use (Hyunsu Ahn *et al.*, 2013) [2] the usage of each genre can be distinguished as shown below [Figure 1], where the RPG games are mostly played by PCs whereas console game device users prefer sports game genre and smart phone users actively enjoy board games. The result shows that the games played on smart phones and smart pads are similar but their frequencies of use are different.

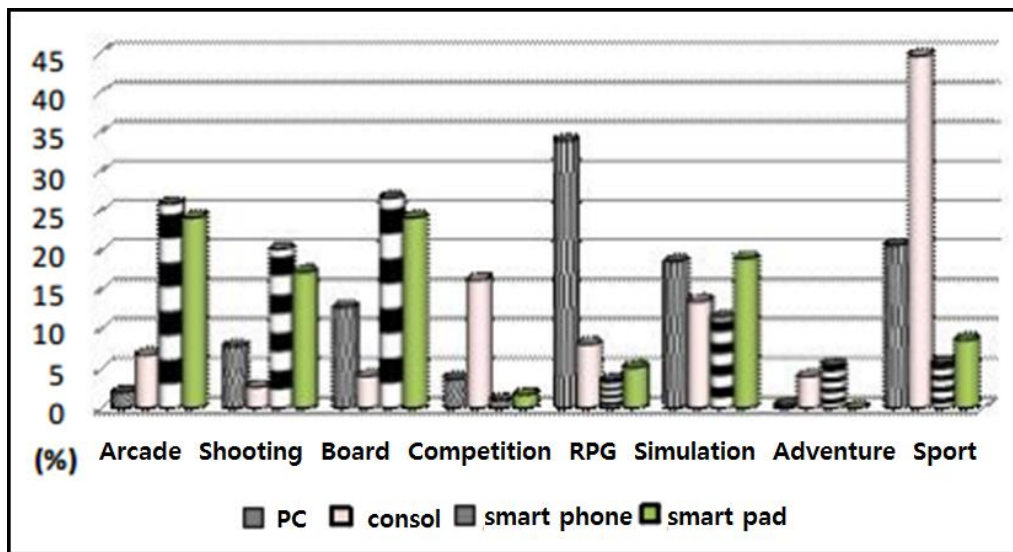
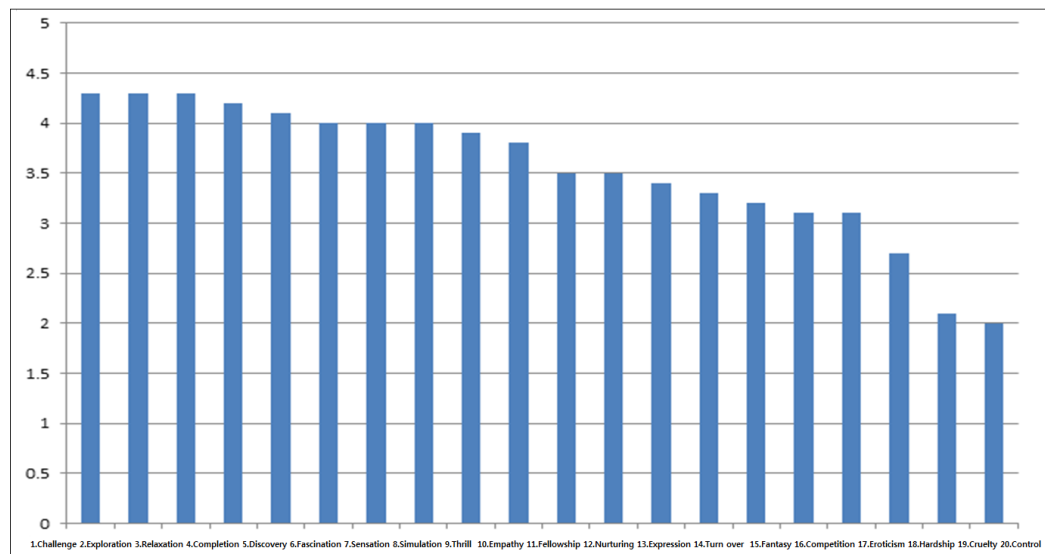


Figure 1. The Result of Survey for each Game Genre: in order of PC, Console, Smart Phone and Smart Pad [2]

### 2.4.2. Interest-inducing Elements of Educational Games

The educational games are the ones that integrate recreational element with education through the form of game. Since they are based on the characteristics of games, they can be considered as the mediums where the characteristics of multimedia stand out. These games have various and unique distinguishing elements (*i.e.*, interactivity, levels of actions, audio-visual effects and themes, clear objectives and substantiality) and the combination of such elements makes educational games to be more exciting, interesting and absorbing (Khalid Al Mubireek, B. A, 2003) [3].

That is, since the educational games are produced using the elements of games, the major question will be how to utilize these elements to induce user's interest. [Figure 2] shows Preference levels of PLEX fun experiences. The '20 kinds of fun experience of PLEX, which was integrated with other existing studies on the fun experiences, can be very helpful to inducing interests for the educational games.

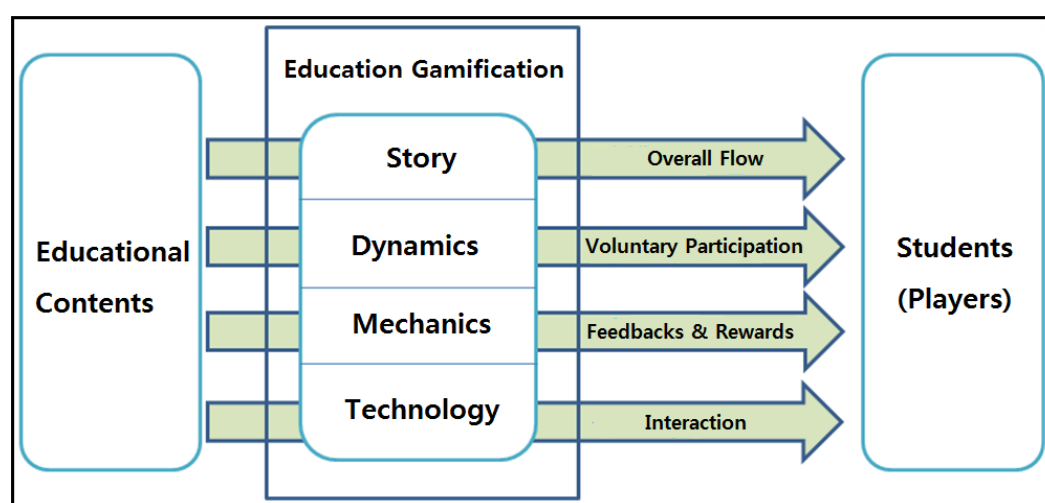


**Figure 2. Preference Levels of PLEX Fun Experiences [2]**

### 3. Design of Game Platform

As an example of the platform, this section describes a mathematical learning platform which covers difficulty levels from elementary to higher learning. This platform has been designed exclusively for the mobile devices to suit current IT environment where mobility is being emphasized to overcome some unavoidable restrictions in time and space. One of the merits in this platform is that it is applicable not only to the N-generations but to those who are in preschools or elementary schools, proving some basic mathematical learning processes. [Figure 3] shows the elements of Education Gamification and the Roles Played Between Students (Players).

Learners using such a gamified education material will be able to share the problem solving skills with others or compete with them through interactions. The platform model adopted some of the elements of education-gamification process researched by Schell, Hunicke *et al.*, Werbach & hunter and Bunchball for the development of a framework of educational games [1-9].



**Figure 3. The Elements of Education Gamification and the Roles Played Between Students (Players)**

Here, the story refers to the flow of the provided incident in the game, which requires some aesthetic elements and technological assistant. Dynamics induces student's voluntary participation and provides some sort of fun elements for the story. Mechanics is an element that achieves Dynamics and Technology includes situations, materials and hardwares necessary for developing the game.

### 3.1. Story

Story is the flow of the incident provided in the game and it can emerge into a single flow or can have several branches. Some aesthetic elements and technologies are needed to deliver the story effectively. The object of the story is to present a larger flow in leading the educational process and its elements include educational goal and the stories related to the object. [Figure 4] shows the story adopting '12 Phases of Hero's Journey'. As the story on an intended game platform will follow 'A Road to Saving the Princess' and employ the structural characteristics of '12 Phases of Hero's Journey' (Vogler, C. *et al.*, 2007) [4], which is the basic rules of story making.

Objective	Save the princess by completing the adventures.
Elements	Learn mathematics (educational goal), share information with other gamers through cooperation, or compete with them.
Story	<p>1st phase: Hero is an average man.</p> <p>2nd phase: One day, princess has been kidnapped by the devil king and the nation is in trouble.</p> <p>3rd phase: Hero tries to refuse challenges.</p> <p>4단계 : Hero meets his wizard master and receives some advices.</p> <p>5th phase: Hero abandon his daily life and sets off for an adventure (learning math).</p> <p>6th phase: Although hero undergoes a small ordeal, he finds a new friends (other gamers) because of it and improve himself.</p> <p>7th phase: Hero experiences a huge frustration (insoluble math problem) and take on a new challenge.</p> <p>8th phase: Hero experiences a life-or-death crisis (hero's danger).</p> <p>9th phase: Hero dramatically survives after getting help from others (by interaction with other gamers, or completing a mission for the quest with several gamers) and receives a big reward.</p> <p>10th phase: Hero returns to his ordinary days but there is a unsolved problem.</p> <p>11th phase: Hero faces the worst crisis (facing with the devil king) but rescues the princess by using all the knowledges he has learned so far (reviewing phase).</p> <p>12th phase: Hero comes back to his everyday life receiving applause.</p>

**Figure 4. The Story Adopting '12 Phases of Hero's Journey**

### **3.2. Dynamics**

Dynamics for the education gamification is based on the 20 fun experiences (*i.e.*, Challenge, Exploration, Relaxation, Completion, Discovery, Fascination, Sensation, Simulation, Thrill, Empathy, Fellowship, Nurturing, Expression, Turn over, Fantasy, Competition, Eroticism, Hardship, Cruelty and Control) of the PLEX Model suggested by (Korhonen *et al.*, 2009) [5]. As a element that forms the aesthetic element, the dynamics assumes the role of inducing student's voluntary participation for the gamification of the educational contents.

### **3.3. Mechanics**

Mechanics refers to the data expression and the algorithm used in the game. Its aim is to achieve detailed implementation of Dynamics and the included elements would be rewards, levels, points and badges.

#### **3.3.1. Levels**

The levels are used to indicate gamer' achievements by stages and will be applied on the game platform intended in this study to carry out the task. The hero (a player) ventures through the villages depending on each phase to acquire mathematical skills and can level-up himself by stages through his quests. He can also check his progress.

#### **3.3.2. Points**

Points refer to the rewards received after carrying out certain behaviors. When he completes the quest ordered by the village NPC, he will be rewarded with a virtual article or the Karma points with which he can do a favor to other player.

#### **3.3.3. Badges Points**

Badges are the images that visually represent gamer' achievements. These are used as a similar concept to the levels but sequential as them. These also are the distinguishable tokens of those who have accomplished the same task with other gamers and can be a means of inducing the interactions or cooperation among the gamers.

#### **3.3.4. Technology**

The technological extent in the education gamification depends on the hardwares and softwares that allow gamers to have fun. Normally, they do not have to be hardwares like PCs or IT devices, but the mobile devices which have lesser temporal and spatial limitations are preferred. As for the softwares, the elements such as game designing, data analysis, user-experience design, graphic design, programming, project management and quality assurance are considered. However, since this study aims to design the game platform only, just simple game and graphic designs will be considered.

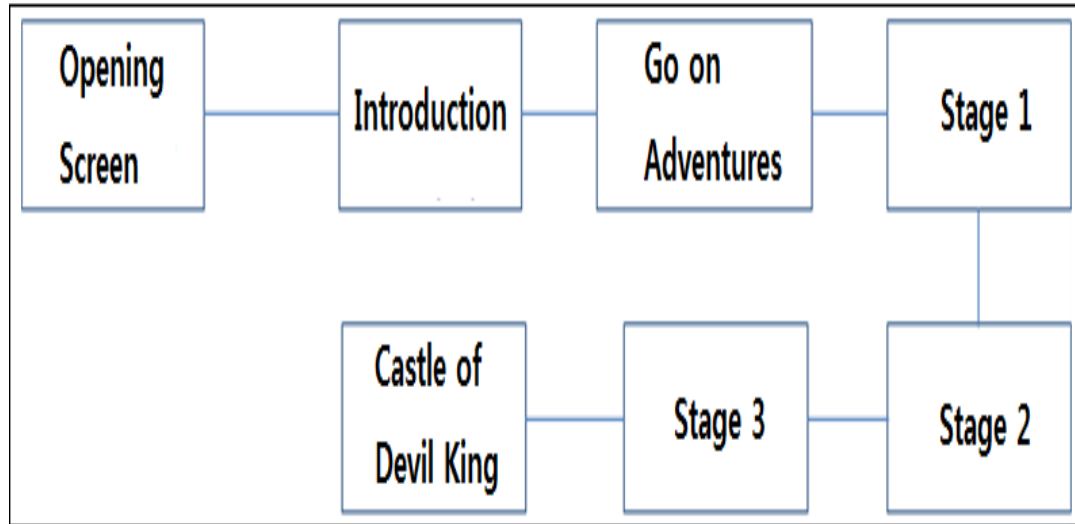
## **4. Game Model**

### **4.1. Educational Implication in Gaming Process**

The game process is quite a simple one as shown in [Figure 5]. It starts with an opening screen followed by the introduction and description of the game flow. The main character, who is a player him/herself and a hero, will be given a certain task from the village NPC at each stage and go forward to the next phase after the completion. During the game process, the hero interacts with other characters to fulfill the objectives until the final stage of the game called the Castle of Devil King where the hero must save the

incarcerated princess by reviewing all the contents and knowledge learned throughout the process.

In each phase, there is a building where village NPC stays. The player can check his badge obtained in accordance with his level and points. The rewards received for the completion of the quests can be used to decorate themselves or buy a variety of items at the village store.



**Figure 5. Game Process**

#### **4.2. Game Design**

In each phase, there is a building where village NPC stays. The player can check his badge obtained in accordance with his level and points. The rewards received for the completion of the quests can be used to decorate themselves or buy a variety of items at the village store.

##### **4.2.1. Stage 1**

At this stage, the simple four fundamental arithmetic operations of elementary school level will be mainly considered. The first stage is a village in the forest. The hero receives the tasks from the NPCs staying at each house and after completing all the tasks, he will head to the next stage.

##### **4.2.2. Stage 2**

The quest at this stage involves the functional problems in the mathematical curriculum of middle school level. The second stage is an Ice village. [Figure 6] a village and NPCs in stage 2. The same procedure is taken as in the Stage 1 to move on to the next stage.



**Figure 6. Sample of a Village and NPCs in Stage 2**

#### 4.2.3. Stage 3

The high school level mathematical problems will be given at this stage. The third stage is a desert village. [Figure 7] is a village and NPCs in stage 3. The hero will be completing the tasks by cooperating with other player(s) using wireless communications.



**Figure 7. Sample of a Village and NPCs in Stage 3**

#### 4.2.4. Castle of Devil King

Here, the hero will review the contents learned from previous stages. To reach the devil king's castle, the hero must defeat the monsters guarding the roads. He can do so by reviewing the past learning contents and will be able to rescue the princess.

## 5. Conclusion and Future Work

The gamification of learning process has been pursued in this study to provide more interest-oriented education. To facilitate this goal, an education-gamification platform, which can be applied to people of all ages by adjusting the level of difficulty, was developed.

The platform can be effectively used for the mobile devices but the IT support is not a prerequisite. The researchers' future task involves designing and implementation of a Java-Android game using the platform described in this study. A demo-version will be developed first followed by an actual release.

## Acknowledgements

The authors would like to thank Mr. S. J. Kim (M.S., Game Programmer, Nexon, Seoul, Republic of Korea) who has provided a valuable review on this paper.

## References

- [1] J. H. Huh, H. B. Kim and K. Seo, "A Design of Smart-based Education Gamification Platform Using Mobile Devices", *Advanced Science and Technology Letters, SERSC, ASTL*, vol. 127, (2016), pp. 85-90.
- [2] H. Ahn and S. Lim, "The Effects of the User's Motivations for Game Platform Use on Game Addiction", *Korean Society for Computer Game*, vol. 26, no. 1, (2013), pp. 99-106.
- [3] K. A. Mubireek and B. A., "Gender-oriented vs. gender-neutral computer games in education", *Doctoral dissertation, The Ohio State University*, (2003), pp. 1-22.
- [4] C. Vogler and M. Montez, "Mythic Structure for Writers. Michael Wiese Productions", *The Writers Journey*, (2007), pp.153-164.
- [5] H. Korhonen, M. Montola and J. Arrasvunori, "Understanding Playful User Experience through Digital Games", *International Conference on Designing Pleasurable Products and Interfaces*, (2009), pp. 274-285.
- [6] S. K. Kim, "Effects of a gamified learning environment on learning experiences: A case study on a general English course using relative evaluation policy", *Multimedia-Assisted Language Learning*, vol. 17, no. 3, (2014), pp. 69-95.
- [7] Y. K. Baek and Y. S. Jung, "The Effects of the Learners Game Ability and Learning Ability on Logical Thinking in Game Based Learning", *Multimedia-Assisted Language Learning*, vol. 10, no. 4, (2004), pp. 119-140.
- [8] M. H. Cha, "The Elementary course Mission Adventure Education Game Development for the Creativity Improvement", *Korean Society for Computer Game*, vol. 19, (2009), pp. 227-233.
- [9] R. Davis and M. Grant, "Children as Multimedia Critics: Middle School Students' Motivation for and Critical Analysis of Educational Computer Games Designed by Other Children", *Children as Multimedia Critics, AERA 2001, Seattle*, (2001), pp. 1-13.
- [10] J. Radoff, "Game On: Energize Your Business with Social Media Games", *Wiley*, (2011), pp. 1091-1092.
- [11] K. Werbach and D. Hunter, "For the Win: How Game Thinking Can Revolutionize Your Business", *Wharton Digital Press*, (2012).
- [12] Bunchball, "An Introduction to the Use of Game Dynamics to Influence Behavior", *Bunchball San Mateo, CA, USA*, (2010).
- [13] J. H. Huh and K. Seo, "Development of Competency-oriented Social Multimedia Computer Network Curriculum", *Journal of Multimedia and Information System*, vol. 1, no. 2, (2014), pp. 133-142.
- [14] J. H. Huh, T. Koh and K. Seo, "NMEA2000 Ship Area Network (SAN) design and Test Bed using Power Line Communication (PLC) with the 3-Phase 3-Line Delta Connection Method", *SERSC ASTL*, vol. 94 (Networking and Communication, (2015), pp. 57-63.
- [15] J. H. Huh and K. Seo, "Hybrid AMI Design for Smart Grid Using the Game Theory Model", *SERSC ASTL*, (Networking and Communication 2015), vol. 108, (2015), pp. 86-92.
- [16] J. H. Huh, N. Kim and K. Seo, "Design and Implementation of Mobile Push Service-Based Mobile Medication-Hour Notification System", *SERSC, ASTL, (Mobile and Wireless 2015)*, vol. 117, (2015), pp. 92-96.
- [17] J. H. Huh, S. Otgonchimeg and K. Seo, "Advanced metering infrastructure design and test bed experiment using intelligent agents: focusing on the PLC network base technology for Smart Grid system", *The Journal of Supercomputing*, Springer, USA, vol. 72, no.5,(2016), pp. 1862-1877.
- [18] J. Schell, "The Art of Game Design: A Book of Lenses", *CRC Press*, (2008), pp. 1-12.

- [19] R. Hunicke, M. LeBlanc and R. Zubek, "MDA: A Formal Approach to Game Design and Game Research", Proceedings of the Challenges in Game AI Workshop, Nineteenth National Conference On Artificial Intelligence, vol. 4, (2004), pp. 1.
- [20] J. H. Huh, D. Lee and K. Seo, "Implementation of Graphic Based Network Intrusion Detection System for Server Operation," International Journal of Security and Its Applications, SERSC, vol. 9, no. 2, (2015), pp. 37-48.
- [21] J. H. Huh and K. Seo, "Hybrid Advanced Metering Infrastructure Design for Micro Grid Using the Game Theory Model", International Journal of Software Engineering and Its Applications, SERSC, vol. 9, no. 9, (2015), pp. 257-268.
- [22] J. H. Huh, N. Kim and K. Seo, "GPS-Based Augmented Reality System of Past Topography Using Antique Maps", Asia-Pacific Journal of Multimedia Services Convergent with Art, Humanities, and Sociology, vol. 6, no. 2, (2016), pp. 453-461.
- [23] J. Park, "Design of the Real-Time Mobile Push System for Implementation of the Shipboard Smart Working", Advances in Computer Science and Ubiquitous Computing, Lecture Notes in Electrical Engineering, Springer, Singapore, vol. 373, (2015), pp. 541-548.

## Authors



**Jun-Ho Huh**, finished the Cooperative Marine Science and Engineering Program, Texas A&M University at Galveston, United States of America in Aug. 2006. Received B.S. in Science Degree from Department of Major of Applied Marine Sciences (Marine Aquaculture, Oceanography, Marine Life Sciences), B.S. in Engineering Degree (Double Major) from Department of Major of Computer Engineering from Jeju National University at Ara, Jeju, Republic of Korea in Aug. 2007. And completion of the Secondary School (Middle and High schools) Teacher Training Curriculum in accordance with Republic of Korea Secondary Education Act. M.A. in Education Degree from Department of Major of Computer Science Education, Graduate School of Education, Pukyong National University at Daeyeon, Busan, Republic of Korea in Aug. 2012. And completion of the Secondary School (Middle and High schools) Teacher Training Curriculum in accordance with Republic of Korea Secondary Education Act. Received the Ph.D. Degree in from Department of Major of Computer Engineering, Graduate School, Pukyong National University at Daeyeon, Busan, Republic of Korea in Fed. 2016. He received the Best Paper Award from Korea Multimedia Society five times (Nov. 2014, May. 2015, Nov. 2015, May. 2016, Oct. 2016). And he received Best Paper Award The 10th 2016 International Interdisciplinary Workshop Series from HSST (Aug. 2016). Also he received Best Paper Award The 16th International Conference on Control, Automation and Systems (Oct. 2016), ICROS with IEEE Xplore. Senior Research Engineer of SUNCOM Co., Busan, Republic of Korea (Aug. 2015- June. 2016). And Research Professor of Dankook University at Jukjeon, Republic of Korea (July. 2016-Sep. 2016). Also Clinical Assistant Professor of E-Green Remote Continuing Education, Seoul, Republic of Korea. (Mar. 2016- Nov. 2016). Currently he is Assistant Professor of Department of Software, Catholic University of Pusan, Busan, Republic of Korea (Dec. 2016-). His research interests are Design of App, Green IT, Smart Grid, Network Security, Curriculum of Computer, High Availability Computing.



**Han-Byul Kim**, Received Bachelor of Engineering Degree from Department of Major of Computer Engineering from Pukyong National University at Daeyeon, Busan, Republic of Korea in Aug. 2016. His research interests are Design of App, Smart Home Device, High Availability Computing.



**Kyungryong Seo**, received B.S. in Engineering Degree from Department of Major of Electrical Machinery Engineering from Pusan National University, Busan, Republic of Korea in Feb. 1983. M.S. in Degree in Electrical Engineering from Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Republic of Korea in Feb. 1990. Received the Ph.D. Degree in Electrical Engineering from Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Republic of Korea in Aug. 1995. He received the Best Paper Award from Korea Multimedia Society six times (Nov. 2007, Nov. 2014, May. 2015, Nov. 2015, May. 2016, Oct. 2016). And he received Best Paper Award The 10th 2016 International Interdisciplinary Workshop Series from HSST (Aug. 2016). Currently, he is a Full Professor (Tenure) of Computer Engineering Departments, Pukyong National University at Daeyeon, Busan, Republic of Korea. His research interests are High Speed Computer Network, Network Security, High Availability Computing.

