Doctoral Dissertation

Mobile Serious Game for Developing Skill of Ethical Decision Making of Inexperienced Disaster Responders

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March 2016

To my parent, my wife, and my children

Acknowledgment

First and foremost, I would like to thank God, Allah Jalla wa ‘Alla for giving me strength and faith throughout my entire life.

I would like to express my truthful gratitude to my principal advisor, Associate Professor Dr. Shinobu Hasegawa for the continuous support of my research. With his patience, motivation, enthusiasm, and immense knowledge, encouraged and advised the idea from the beginning to the end of my Ph.D study. I am delighted and grateful to be able to work under his excellent supervision.

I gratefully acknowledge the generous support and cooperation of Professor Dr. Hiroyuki Iida, who is my sub supervisor. He gave me strong spirit and invaluable intellectual effort to my research. I am deeply grateful to my minor research supervisor Professor Dr. Kokoro Ikeda, for the priceless advices.

I am truly indebted and relieved to all members of the examination committee who evaluated my Ph.D. dissertation. To the names of principal theme advisor Associate Professor Shinobu Hasegawa, main theme sub-advisor Professor Hiroyuki Iida, Associate Professor Kokoro Ikeda, and Associate Professor Kiyoaki Shirai of Japan Advanced Institute of Science and Technology and external examiner Associate Professor Hiroyuki Mitsuhara (Tokushima University) that gave me constructive comments and warm encouragement.

It is an indulgence to acknowledge with gratitude to the Directorate General of Higher Education of the Republic Indonesia (DIKTI), Indonesian Ministry of Research and Higher Education for granting the financial support.

I appreciate all members of Hasegawa Laboratory for their support and cooperation. I wish them success in their future endeavors. Special thanks to my lab mate Hangyu Li for his guidance and help since my arrival at JAIST. I would also like to thank to my colleagues at Electrical Engineering Department, Universitas Pendidikan Indonesia for all the great support.

Finally, I am forever grateful to my lovely wife, Rika Dewi Agustiani, my precious sons Syafiq and Shafwan and also my princess Syifa with the endless effort and patience. Special thank to my parent and family members for their never-ending love, support and prayer.

Publication Lists

Journal

1. Didin Wahyudin, Shinobu Hasegawa, "Mobile Serious Game Design for Training Ethical Decision Making Skill of Experienced Disaster Volunteers", The Journal of Information and System in Education (JSiSE), Volume 14, 2016, pp. (published).

2. Didin Wahyudin, Shinobu Hasegawa, "Students' Viewpoint of Computer Game for Training in Indonesian Universities and High Schools", The Journal of Educational and Information Technologies, (accepted).

Conference and Workshop

3. Didin Wahyudin, Shinobu Hasegawa, "Mobile Game Based Learning to Encourage Decision-making skill in Natural Disaster Response Management", SIG-ALST (JSAI) Conference, B202, Yokohama, November 2012, pp. 27-30

4. Shinobu Hasegawa, Didin Wahyudin, "A Game-enhanced Learning Approach for Developing Decision-making Skill of Novice Volunteer in Natural Disaster Response", Proceedings of The 27th Annual Conference of the Japanese Society for Artificial Intelligence, 4J1-OS-23-2, (2013 in Japanese).

5. Didin Wahyudin, Shinobu Hasegawa, Tina Dahlan, "Developing Ethical Decision making Skill of Novice Volunteers in Natural Disaster Response", Proceeding of The 7th European Conference on Games Based Learning ECGBL 2013, Porto, Portugal, pp. 800-803

6. Didin Wahyudin, Shinobu Hasegawa, Tina Dahlan, "Mobile Game Based Learning to Develop Ethical Decision Making Skill of Novice Volunteer in Disaster Response", Proceeding of The 21st International Conference on Computers in Education (ICCE 2013), Bali, Indonesia, pp. 590-599

7. Didin Wahyudin, "Mobile Game Based Learning to Develop Ethical Decision Making Skill of Novice Volunteer in Disaster Response", Doctoral Student Consortium. Proceeding of The 21st International Conference on Computers in Education (ICCE 2013), Bali, Indonesia.

8. Didin Wahyudin, Shinobu Hasegawa, "Game Narrative for Situating Ethical Dilemmas in Virtual Disaster Response Work", Proceeding of The 45th International Simulation and Game Association (ISAGA) 2014, Dornbirn, Austria.

9. Didin Wahyudin, Shinobu Hasegawa, "A Design Pattern of Role Playing Game for Supporting Ethical Gameplay". The 22nd International Conference on Computers in Education (ICCE 2014), Nara, Japan.

10. Didin Wahyudin, Shinobu Hasegawa, "Learners' Perspectives of the Mobile Serious Game for Training Inexperienced Disaster Responders, E-Learn World Conference on E-Learning (E-Learn 2015 AACE), Kona-Hawaii, USA.

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List of Abbreviation

BLE	Bluetooth Low Energy
CE	Concentration of Effect
CO	Control Group
Ex	Experience Participant
EX	Experimental Group
GPS	Global Positioning System
GUI	Game User Interface
HS	High School Educational Level
IRC	Indonesian Red Cross
Ix	Inexperience Participant
M	Mean
MC	Magnitude of Consequence
NDM	Naturalistic Decision Making
NFC	Near Field Communication
NGO	Non-Government Organizations
NPC	Non-player character
PC	Player Character
PE	Probability of Effect
PX	Proximity
RPG	Role Playing Game
UN	University Educational Level
SC	Social Consensus
SD	Standard Deviation
SG	Serious Game
TI	Temporal Immediacy

Contents

Abstract

Many responses of catastrophic natural disaster did not perform properly to an appropriate standard. This often occurred when first responders were involved—especially inexperienced first responder—did not have the accurate decision making skill. One of the main issues is the lack of regular training to develop such skills. It has been pointed out that exercise of the non-technical abilities, such as decision-making has enormous impact on effective disaster response. However, some researches show that there are difficulties to conduct a live practice for the disaster situation similarly. In addition, the inexperienced disaster first responders cannot receive maximum advantages from live training due to feedback limitation where reflection from actual circumstances.

Serious games (SG) may be a suitable approach to address some of the problems associated with training of disaster responders, because SG could give a real-life experience when the use of environments is impossible to establish and costly (Hulst & Ruijsendaal, 2014). However, one of the main issues associated with SG is lack of empirical evidence supporting the approach. This thesis will primarily concern on the application of SG to train inexperienced disaster first responders skill for making a decision ethically.

First of all, a preliminary survey was conducted to assess the awareness of the ethical decision-making skill of the inexperienced disaster first responders from high school and university organizations in Indonesia. The objective of this survey was to identify some issues in disaster response work, especially to recognize how first disaster responders ware to the ethical aspects that often appeared in disaster situation. To assess the awareness, we adopted six components of moral intensity invented by Jones that reflect the ethical consideration in the disaster setting. However, to confirm the basic criteria of the disaster responders, we firstly interviewed some experts from the official search and rescue (SAR) organization in Indonesia. Based on these preliminary surveys and interviews, a game for training called MAGNITUDE has been designed, which enables the inexperienced disaster first responders to develop their ethical decision making skill at all times during official disaster management training inside and outside of class. The study results show that there is a difference awareness of ethical situation between experienced (Ex) and inexperienced (Ix) participants. The result of statistical analysis found that from six components of moral intensity, the components of Magnitude of Consequence (MC), Concentration of Effect (CE), and Probability of Effect (PE) were provided the significant factors of differences.

I performed the evaluation of MAGNITUDE prototype. The conducted test was to evaluate the game quality at a very crude phase. The objective of this evaluation was to collect opinions from the learning subjects' point of view about the MAGNITUDE development progress in early stage.

I also was performed the second survey to measure of learners' viewpoint to the use of games for training. The aim of the survey is to determine which education level will more suitable to provide the potential of the learning subjects. The survey was conducted by collecting information on general demographics, general computer game playing habits, computer game preferences, motivations for playing computer games, motivations for playing computer games in training contexts, online game playing habits and acceptability of a SG approach training program. The survey results present that the university students were the most prospective learning subjects for MAGNITUDE implementation.

Finally, based on the findings of the survey about students' viewpoint to the use of game for training, I performed the second evaluation of MAGNITUDE. The conducted evaluation aimed to measure the effectiveness of MAGNITUDE. The results show that MAGNITUDE was considerably significant to improve the participants' awareness of the ethical issues. Thus the MAGNITUDE game has a potential opportunity to be used as a training method.

In summary, this thesis provides the original contributions to knowledge in the SG field, especially the fundamental implementation of embedding six components of moral intensity for delivering ethical gameplay in SG. Another originality is the important concept how to examine the learners' engagement to the ethical gameplay by measuring learners' concers to the game dialog. The thesis also gives a large amount of required empirical evidence of game playing preference and experience, and its relation to the use of serious game for training purposes.

Keyword: Mobile serious game, Inexperience disaster responder, Ethical decision making, Disaster preparedness, Game for Training

Chapter 1
Introduction

1.1 Problem Statement

There are many areas that are vulnerable to catastrophic disaster strikes. For instance, Indonesia is geographically located in the 'ring of fire'—a large horseshoe shaped region—and subject to nearly 90% of the world's earthquakes due to heavy seismic and volcanic activity. This puts Indonesia and nearby countries at an increased risk of natural disasters. In 2004, a massive earthquake measuring 9.2 on the Richter scale caused enormous tsunami as the ocean floor shifted along the boundary between the Indo-Australian plate and the Eurasian plate, from northwestern Sumatra to the Nicobar Islands and to the Andaman Islands. The tsunami affected 12 nations around the Indian Ocean, with Aceh in Indonesia suffering the greatest damage. In Aceh, the United Nations Field Office reported approximately 131,000 people dead and 37,000 missing. More than 80,000 houses sustained major damage or collapse and more than 500,000 people were made homeless in Sumatra alone. The tsunami caused unprecedented damage to vital public facilities including housing, utilities, roads, and bridges. Unfortunately, this situation is not the end of disaster strikes in Indonesia, any big catastrophic disasters occurred recurrently in this area (Cluff 2007; Siagian et al. 2013; Parwanto & Oyama 2014).

It is generally known that when a major disaster event occurs, disaster responders will come. Lesson learned from the past disaster works, there is evidence that most of the disaster responders come into the early periods of disaster response are community responders. Usually, they are novice and it is well known that they work in the disaster response as spontaneous volunteer with little planning beforehand. As a result, other's problems for instance safety-first issue will occur. And it has often been described as a disaster within a disaster.

It is argued that decision-making in emergency response is a vital skill for first responders. The decisions can impact the aptitude of response agencies to do their work properly (FEMA, 2010). On the other hand, many facts on disaster responses in Indonesia show that these activities are still sporadically performed. On the other hand, most of the responder in disaster response works were newcomers who did not have enough experienced in disaster response works. It must be admitted that many of the actions undertaken aim to decrease the impact of the risks posed by the disaster. For example, disaster rescue training for boy scouts and youth member of Red Cross Society. However, the responders must be trained as much as possible in order to have broad knowledge of disaster

response. In other words, the responders should be able to conduct training programs independently to increase their skills.

To response such problems, a serious game (SG) will be designed to provide an alternative learning system that focuses on developing inexperienced disaster first responders skill when making decision. SG is entertaining games for serious purposes that educate, train, and inform (Michael, Chen, 2002). SG supports the power of training and reduces the time. Thus, SG admits decision maker to experience various situations within a limited time span. In addition, SG is suitable media to give a real-life experience when the use of environments is impossible to establish and costly (Hulst & Ruijsendaal, 2014). With regard to the training of decision-making, SG provides learners to make a decision; hence they can have experience in learning the consequence of their decision-making. In summary, SG is potential to supply an interactive and entertaining tool that mimic a real-life environment with educational setting. To formulate the research more detail, there are three research questions as described in the next section.

1.2 Research Questions and Objectives

1.2.1 Issues in Disaster Response

In a disaster response work, there are some issues often occurred like how to deal with the selection of medical treatment priority among refugees and the injured victims, how to distribute the first disaster responders, etc. These problems need a quick decision made by a team of disaster responders (Paton et al. 2000). However, sometimes the first responders also need to make a decision individually when they facing the personal issues. Usually, problems occurred in the disasters response works consist of many aspects related the ethical consideration (Iserson et al. 2008). Hence, the disaster responders should have ability to select an advance action to keep the response work going well. As a result, these common problems were given a question, how are the first disaster responders aware of such aspects when they face the problem? To investigate this research question, a survey to measure inexperienced disaster responders will be carried out. Specifically, the objective of this survey was to examine the awareness of ethical consideration in disaster situations that affected the participants to measure the importance of the moral intensity components. To answer the research question, the operational research questions will be addressed as follows. (a) How are the participants aware of the ethical consideration of the disaster situation? And (b) are there any differences of the participants' awareness between inexperienced and experienced?

1.2.2 Students' Viewpoint of Serious Game for Training

The absence of evidence from SG research to support its use was related to the motivation of playing games (Marina Papastergiou 2009), and its connection to the viewpoint of training using serious games. To probe these problems, the second survey will be conducted. The objective of the survey is to collect information about the participants' gaming experiences, preferences and their viewpoints to the use of games for training purposes. The study will be conducted as a preliminary survey on the MAGNITUDE implementation. Collecting such information is expected to gauge the participants' viewpoint to the use of games for training. The survey's instrument will be disseminated to the high school (HS) students, and then the result will be compared to the findings from university (UN) students. Comparison such aspects between UN and HS participants, therefore, suppose to have the empirical evidence for selecting the educational level that appropriate for MAGNITUDE implementation.

To achieve this goal, the operative research questions are defined as follows. (a) What are gaming preferences of the participants from both educational levels? This research question is intended to collect their behaviors related to their gaming experiences. (b) What are the participants' viewpoints of the computer game for training purposes? This research question is envisioned the participants' perspective of the mobile game for training disaster responders based on the above research question. The general assumption in this research question is that the UN students have much experience than HS students and this is good influence for preference of games for training. In addition, I also suppose the UN students would have strong opinion that the game is suitable for the educational purpose because they might have much chance to play games for diverse intension.

1.2.3 Effectiveness of Training Inexperienced Disaster Responders using Serious Games

The game evaluation attempts to answer the research questions: (a) after playing MAGNITUDE, are they improve their ethical awareness? (b) How they make a decision in disaster response setting are? What the participants' perceptions to the MAGNITUDE game are? The research objective is to evaluate the participants' knowledge of the six components of moral intensity that embedded into the game scenario. If they could recognize all ethical consideration, the ethical knowledge would be improved; hence it might be not so difficult to determine the priority of response action. According to the results of the first and second questions, the next question is to measure what the participants' opinion MAGNITUDE are, including the quality of the game environment, narrative, and general conclusion of training using game. The study results will be reported to emphasis on pedagogy, the participants' perceptions, and effectiveness of the method used in

this study, training of ethical decision making through SG compared to the traditional approach.

1.3 Research Methodology

The work of this dissertation has led to the journal and conference publications. Thus the research methodology consists of sub-research themes described as follows.

For the first research questions related to the issue in disaster response, a study was performed to measure the participants' awareness to the ethical issues generally appeared in the disaster response works. Therefore, it was supposed to get the empirical evidence of participants' awareness of ethical decision before designing MAGNITUDE game. The study was carried out by a comparative survey of ethical awareness of two groups categorized as experienced disaster responders (Ex), and inexperienced disaster responders (Ix). The questionnaire was designed to measure the participants awareness to the ethical issue often appeared in the disaster response works formed in Likert-scale (Harpe 2015). Hence, it was analyzed by counting the frequency of participants' response, determining the mean (M) and standard deviation (SD), and using descriptive analysis, chi-squared test, because the participants' responses was assumed as non-parametric data (McCrum-Gardner 2008). To substitute the survey results, a number of disaster experts were interviewed to recognize what the basic requirements to be a disaster responder were. It was also important to confirm this requirement as a foundation of MAGNITUDE design and development.

For the second research question, a comparative survey was conducted. This survey collected the data of gaming experience, preference and viewpoint of the use of serious games for training purposes. A number of HS and UN student were involved in this survey. The questionnaire of this survey consisted of four-scale of Likert, and ten-point of response grading, and the open-ended questions. Thus, it was analyzed by counting the frequency of participants' response, determine the mean (M) and standard deviation (SD), and using descriptive analysis: Mann U Whitney test, because the participants' responses were assumed non-parametric data. The open-ended questions subjected to content analysis. Each answer in the open-ended questions was analyzed and assigned a code from a bank of codes that was created at the beginning of the analysis process. For example, the code for participants' response to the question of after-school activities that not listed in the questionnaire.

For the third research questions, the experimental study was carried out to compare the effectiveness of training by using two different training methods. This study involved university students that classified into two groups. The first group was the experimental (EX) group that uses MAGNITUDE game. The

second group was the control group (CO) that had a short session simulation in the classroom. To achieve this goal, three categories of the questionnaire were constructed. The first category was the demographic questionnaire. To analyze this data, the M and SD of the participants' response for both groups were calculated.

The second category was the questionnaire to measure the participants' ability to make ethical decision. This questionnaire divided into two parts, i.e., pre-test and post-test using a third-scale of point. The collected response was assumed as a parametric data. Hence to analyze it, the paired t-test to measure the learning progress for each group was carried out to compare the pre-test and post-test scores. However, the independent t-test to analyze the effectiveness of MAGNITUDE was also used to compare the post-test scores between EX and CO groups (Neideen & Brasel 2007).

The third category of the questionnaire was related to the participants' opinion about the used training method, and specific for EX group, it was about their view to the MAGNITUDE game. The questionnaire was formed in four-scale of Likert, tend-point of grading, and the open-ended questions. To analyze this data, M and SD of the participants' response was measured, and Mann U Whitney test for determining the differences between EX and CO groups was performed.

1.4 Ethical Aspects

Since the study concerned on educational services (not a medical purpose) and involved the participants almost no risk of harm, formal ethical approval was not required by local regulations in Indonesia. In addition, the participants involved in the survey and experiment were on a voluntary basis. They were informed that information collected by means of the questionnaires were going to be used for a research study to collect gaming experiences and opinions, not their performance, and the results would have been reported anonymously. Thus, to document their engagement in the studies, the consent agreement was distributed at the beginning of each survey.

1.5 Dissertation Overview

The dissertation is divided into an additional six chapters, as follows:

Chapter two will discuss the issues associated with disaster response. It will review the disaster first responders' requirement criteria collected from the interview of some disaster experts. This chapter also discusses the preliminary survey conducted in the early research stage to measure potential learning subjects about disaster response and decision-making. The chapter will conclude with a

discussion of how SG can be utilized to improve the ethical awareness of Ix first disaster responders.

Chapter three will present the literature review of game-based approaches for leaning decision making. It will briefly discuss with the definition of computer games, serious games and game based learning. The literature review will then examine: a) games utilized in general education purposes b) games used in learning decision-making. The chapter will conclude with a discussion of the advantages and disadvantages of SG.

Chapter four will provide a description of MAGNITUDE game. This will include high-level design objectives, game design process, and game play. The section of the game that has been developed for the purposes of this research will be outlined in terms of how the game was adapted, content development and integration, and selected scenarios for prototyping.

Chapter five will describe the survey of students' viewpoint to the use of games for training. This chapter provides a brief discussion of related research in game experience, motivation and preference, and its connection to the educational purposes.

Chapter six will focus on the evaluation of MAGNTUDE game. This will entail some separate evaluations: the first evaluation of the MAGNITUDE prototype and the second evaluation of the MAGNITUDE effectiveness. This chapter will present methods, procedures and analysis of each evaluation. The chapter will conclude with a discussion of the main findings and implications.

Chapter seven will present the conclusion, reflections and further work direction. It will review the general research process and its finding. This chapter discusses reflection to the research contributions and limitations, and exposed the future research directions.

Chapter 2
Issues in Disaster Response

2.1. Introduction

This chapter presents the preliminary research of MAGNITUDE development. I first discuss the interviews with disaster experts to confirm the requirements criteria of disaster first responders. Then, I describe the survey to identify participants' awareness of the ethical issues in disaster response scenarios. The survey involved 64 participants in high school or the early years of university who joined humanitarian related organizations. The survey results shows that the Magnitude of Consequence (MC), Probability of Effect (PE), and Concentration of Effect (CE) provided dominant factors of moral intensity that differentiated the experienced (Ex) and inexperienced (Ix) participants. In a real situation, the ability to recognize and to anticipate the effect of disaster work is very important; thus the participants should take into account these aspects.

2.2 Decision-Making in Disaster Response

A natural disaster is the aftermath or sequences of incidents that interrupt and force the lives and livelihoods of people affected by natural events leading to the emergence of environmental destruction and loss of property, physical and psychological effects, and personal catastrophes (Berz et al. 2001). Occasionally, we have to face a disaster event that becomes a part of daily life. Anyone can be impacted by a disaster, including a landslide, flooding, earthquake, tsunami, volcano eruption, or other serious calamities.

However, the response phase of those disasters is very complicated. On the other hand, the decisions in disaster response have to be made in a very short period of time and without appropriate information (Paton & Flin 1999). To eliminate the impact of a disaster, several teams should work in a cooperative and articulate manner as much as possible to carry out the response actions. Thus, decision-making is essential to all disaster work, both in terms of mission success and also the safety of disaster responders and equipment. One key issue in the preparation of disaster response is training of disaster first responders in dealing with catastrophic circumstances. Specifically, it has been highlighted that the exercise of non-technical abilities such as situation awareness and decision-making has a tremendous effect on successful and effective disaster response and management.

Disaster response is a set of activities carried out instantaneously at the time of a disaster, dealing with the unexpected impact from the rescue and evacuation of casualties, fulfillment of basic needs, protection of refugees, etc. (Madry 2014). These are important phases in the disaster response period, including ease of access in the deployment of human resources, such as first responders, emergency response command post, and emergency operations plans (Perry & Lindell 2003). In contrast, disaster response and rescue teams are sometimes unprepared. The short time span of disaster response necessitates the utilization of all resources and requires accurate decision-making that is a process of determining the best decision from a number of alternatives to perform activities in the future (İvgin 2013). The ability to distinguish present and probable difficulties can positively affect the victims (Crichton 2003). The process of making an ethical decision will face a failure if the decision maker failed at any step of these components.

Jones (Jones 1991) explains six components of moral intensity that are essential in the process of ethical decision-making: (1) Magnitude of Consequence (MC), which is defined as the sum of the harms (or benefits) affecting the victim by a moral act; (2) Social Consensus (SC), which is defined as the degree of social agreement that a proposed act is ethical (or unethical); (3) Probability of Effect (PE), which is defined as the probability of the harms or benefits caused by the act; (4) Temporal Immediacy (TI), which is defined as a period between the ethical action and the effects of the action; (5) Proximity (PX), which is defined as a sense of closeness of social, cultural, psychological, or physical intimacy between the actor and victims; and (6) Concentration of Effect (CE), which is defined as the number of people affected by a given magnitude of harms or benefits.

However, the majority of responders coming into the early period of disaster response work are spontaneous first responders (Rogstadius et al. 2013). They do not have enough experience associated with non-technical skills, especially ethical decision-making. Hence, they require training in such skill as much as possible. On the other hand, many research findings noted that live training is hard to organize, and it has been argued that inexperienced responders will not improve their skills from live training as much as an expert. This may be due to the feedback limitation in identifying a given situation from typical events. To replace this weakness, a virtual environment could be used for developing non-technical skills (Caird-Daley & Harris 2008).

2.3 Interviews with Disaster Expert

It is generally known that when a major disaster event occurs disaster responders will come (Helsloot & Ruitenberg 2004). They provide vital contributions to the disaster work phase to immediately reduce the impact (Pfefferbaum & Shaw 2013). As a lesson learned from past disaster work, there is evidence that most of

the responders that come into the early periods of disaster response are community responders (King 2006). Usually they are inexperienced and it is well known that they work in the disaster as spontaneous responders with little planning beforehand. As a result, other problems such as a safety-first issue will be occurred; it has often been described as a disaster within the disaster. In addition, some research found that they are more vulnerable to getting post-traumatic stress disorder symptoms compared to professional responders (Thormar et al. 2014) (Guo et al. 2004).

To confirm such issues, three disaster experts were interviewed. They were from the National Search and Rescue Agency (BASARNAS) and Non-Government Organizations (NGOs) that took part in many disaster responses. Most of them had experience to respond to some disasters such as an earthquake and tsunami in Indonesia and Japan, and earthquake in China. The purpose of the interviews was to grasp their experiences that corresponded to the issues that occurred in disaster response. The interviews were a very valuable phase to verify the responders' criteria and requirements. Furthermore, those interviews can be summarized as follows.

- Inexperienced first responders have a strong spirit but less skill. The majority responders that have worked in disaster response are spontaneous responders from communities. Most of them only rely on the spirit and are unprepared. Thus, confusion may happen when working in the disaster area if they do not have appropriate skills.

- Inexperienced first responders do not care about rules. Typically, spontaneous first responders do not have sufficient expertise. If they make a mistake due to their limitations, the effect of their action not only causes a threat to their safety but also disrupts the disaster response process.

- Inexperienced first responders should know the culture and environment where disasters strike. The responders doing disaster response work in various cultures are required for awareness of the diversity of cultures and area that has a potential disaster. Moreover, if someday disaster occurs in that area, they might adapt to the situation quickly. Therefore, they will be able to carry out emergency response duties with the best performance.

- Inexperienced first responders should demonstrate good behavior. They will find a lot of issues that require immediate decisions, and sometimes the issues are related to ethical matters. For these reasons, they should be able to adapt to the community impacted by the disaster wisely.

To eliminate some drawbacks and to achieve good skills for spontaneous responders, the experts emphasized that regular disaster training, and simulation

are necessary (Reissman & Howard 2008). The simulation should be conducted frequently in family, school or university, and community. This regular simulation would foster the necessary instinct to take instant response when disasters strike (Flint & Brennan 2006). Moreover, the experts pointed out the responders need to practice more. By doing so, responders would increase and maintain their skill recurrently until disaster happened (Gebbie et al. 2006).

2.4 Survey of Ethical Awareness

2.4.1 Participants

The purpose of the survey was to assemble ethical awareness of participants in disaster situations. The survey obtained data from participants who studied in high school and the early years of university. Both educational backgrounds were selected because the participants were the member of youth organizations, such as scout, Red Cross and adventure. They were potentially spontaneous responders in disaster responses because some of them were trained in technical skill exercises, such as High Angle Rescue Technique, Jungle Rescue, and Water Rescue that are necessary for search and rescue in the post-disaster event. With regard to measuring the awareness of participants to ethical dilemmas in disaster response situations, the hypothesis that experienced participants would oppose general unethical statements was defined. Furthermore, to accumulate the dissimilarities between experienced and inexperienced participants' views on various disaster response issues, the survey investigated the awareness of ethical situations that affected the participants to measure the importance of moral intensity components. Overall, there is an assumption that inexperienced participants would have less awareness and understanding of the ethical dilemma.

2.4.2 Materials

In order to collect quantitative data from the participants, the following instruments were used. Questionnaire set 1 asked the participants to give a number of demographic questions, including gender, age, year of education, and length of joining a humanitarian organization.

Questionnaire set 2 provided two ethical scenario categories in disaster response work. It was adopted from the ethical scenario that focused on an emergency situation (Liang et al. 2011). Each of the categories consisted of six statements that contained the component of moral intensity. The participants were asked to designate their agreement or disagreement with the statement on a five-point Likert-type scale anchored 'strongly agree' to 'strongly disagree'. The following is and example of a statement from the first category that formed the probability of effect.

> "Heavy rains almost drowned South Bandung suburb. There was a collapsed bridge that caused a little boy to be trapped. At the same time, flooding caused swift river currents. Mr. Pandu—an inexperienced disaster first responder—was desperate to cross the river without a life jacket to evacuate the victim. When he reached this location, he found the boy had stopped breathing. After that, the river current flowed swiftly, and he was trapped with the dead boy."

In this scenario, it is obvious that a victim trapped under a collapsed bridge was dead, so it was not too urgent to evacuate immediately. The participants should understand the basic principle of disaster response is to prioritize his or her safety before rescuing victims. However, to measure the participants' ability to distinguish ethical issue in different situations contradicted with the previous one, in the second category, the condition of the statement was different as in the first category. As such, the participants were encouraged to analyze the broaden possibility of issues might be occurred in disaster response work. The victim was injured, so the responder had the opportunity to save his life. If the evacuation finished quickly, he could save the victim from the effect of the river current.

> "Heavy rains almost drown South Bandung suburb. There was a collapsed bridge causing a little boy to be trapped. His leg was fractured. At the same time, flooding caused swift river currents. Mr. Pandu—an inexperienced disaster first responder—was desperate to cross the river with a life jacket to evacuate the victim."

Questionnaire set 3 contained open-ended questions reflecting the ethical intention that participants would take when a specific action was happened. The importance of providing such open-ended questions was to allow the participants to provide answers that they chose without forcing them to select from concrete options. The participants' responses were classified into three anchored scales, i.e. 'would [take the action]' if the participants answered the question related to first priority. In contrast, the participants might answer with the anchored response 'would not [take the action]' if they considered the opposite decision. However, the participants who refused to select a decision might answer with an 'unsure' anchor. The following question is an example of questionnaire set 3.

> "Mr. Pandu was a member of an advanced disaster response group that had a job to investigate the post disaster situation immediately. At the same occasion, he also had the responsibility to take care his family members including his sister and his beloved mother who were injured by the disaster. What was the best decision between the two options?"

In this statement, the respondents needed to think deeper than the previous questions. Now, Mr. Pandu faced two dilemmas. If he decided to take care of his

family members, a lot of problems appeared in the disaster response. His expertise was needed for accurate action and quick response. However, if he decided to go with his job and left his family, there was also a problem. Psychologically, he intended to help his family in advance, and it would cause an interruption of his concentration in first response activity. The complete questionnaire sets used in this survey can be found in the appendix A.

2.4.3 Procedure

The survey involved 64 participants from high school and university who belonged to the Scouts and the Indonesia Red Cross. At the beginning, the participants were asked to complete the questionnaire of demographic data. Then, they were asked to rate their opinion for the first and second category of questionnaire set 2. Before continuing to rate both categories of moral intensity, firstly, the example of the situation in the disaster area was described. Finally, the participants were asked to answer questionnaire set 3, and then conclude by discussion of their opinions more comprehensively.

2.4.4 Results

Response to Questionnaire Set 1

The purpose of this survey was to investigate the bearing of observed moral intensity upon the participants' ethical awareness. Data from the questionnaires showed that gender statistics of the participants were 74% males (n=47) and 26% females (n=17). The range of participants' age was 15–20 years old (mean=16.5, SD=1.22). The percentage of participants that joined a humanitarian organization for more than two years was 45% (n=30). The remaining 34 participants (55%) joined an organization for less than two years. The participants who were part of an organization for more than two years regarded as Ex participants. A number of them had actual experiences in flood and landslide disasters, and also had much practice in emergency and rescue, such as triage, wall climbing, and scouting. The remaining were novices in disaster and emergency voluntary service regarded as Ix participants, and they did not have enough experience in training and real situations of disaster.

Response to Questionnaire Set 2

The statistical analysis for the first category of statements that contained the moral intensity component was performed as shown in Table 2.1. The results of the chi-squared test for statements SC and PX provided a p-value >0.05. Therefore, it can be confidently claimed that there was an equal comparison of Ex and Ix scoring in each nominal category. Hence, the results indicated that between Ex and Ix

participants did not face a serious problem with regard to awareness of such ethical components of moral intensity.

Table 2.1 Statistical analyses of negative statements of moral intensity (first category)

Components	Participant Types	Response					Chi-squared test		
		Sa	A	N	D	Sd	X^2	DF	p
MC	Ex	0	1	2	17	10	6.0696	2	0.048*
	Ix	2	5	5	17	5			
SC	Ex	0	1	3	13	13	4.3439	2	0.114
	Ix	0	4	5	13	12			
PE	Ex	0	2	2	14	12	8.1016	2	0.017*
	Ix	1	2	8	16	7			
TI	Ex	0	4	3	20	3	6.2957	2	0.043*
	Ix	1	10	5	15	3			
PX	Ex	0	6	2	16	6	5.8240	2	0.054
	Ix	0	7	10	13	4			
CE	Ex	0	2	4	17	7	6.7594	2	0.034*
	Ix	2	7	8	15	2			

Note: *p < 0.05, **p < 0.01
MC = Magnitude of consequence, SC = Social consensus, PE = Probability of effect,
TI = Temporal immediacy, PX = Proximity, CE = Concentration of effect
Sa (5) = Strongly agree, A (4) = Agree, N (3) = Neutral, D (2) = Disagree, Sd (1) = Strongly disagree

Conversely, the chi-squared tests of the statements MC, PE, TI, and CE gave a p-value <0.05. It is clear that there were unequal proportions of Ex and Ix scoring in each nominal category. Table 2.2 shows the results of statistical analysis for the statements of the second category. The results of the chi-squared test for statements SC, TI, and PX indicated that scoring in each nominal category for Ex and Ix participants is similar (p-value >0.05). Hence, there were no significant differences between both groups. In contrast, the results of the chi-squared test for statements MC, PE, and CE gave a p-value <0.05. It was shown that the statements provided a significant difference between the Ex participants' and Ix participants' responses.

The survey result of questionnaire set 2 determined that participants had trouble identifying the effect of such actions. However, as Jones (Jones 1991) notion that 'moral intensity is expected to play a major role in the recognition of moral issues and, hence, in the actual engagement of moral decision-making processes instead of, or in addition to, other decision-making schemata'. Thus, there was significant evidence that the participants should pay attention to all components of moral intensity. If the participants failed to recognize the effect of their action, it could cause a crucial negative impact in the future not only for the victims but also for the community and themselves.

Table 2.2 Statistical analysis of positive statements of moral intensity

Components	Participant Types	Response					Chi-squared test		
		Sa	A	N	D	Sd	X^2	DF	p
MC	Ex	2	17	4	7	0	7.0395	2	0.0296*
	Ix	2	10	3	12	7			
SC	Ex	1	17	3	8	1	2.7222	2	0.2564
	Ix	0	14	3	12	5			
PE	Ex	3	20	4	3	0	11.0194	2	0.0041**
	Ix	2	10	12	9	1			
TI	Ex	6	14	2	8	0	5.4144	2	0.0667
	Ix	1	16	10	7	0			
PX	Ex	2	16	2	10	0	4.0166	2	0.1342
	Ix	1	13	7	13	0			
CE	Ex	6	17	2	5	0	8.3050	2	0.0157*
	Ix	2	12	7	11	2			

Note: *p < 0.05, **p < 0.01
MC = Magnitude of consequence, SC = Social consensus, PE = Probability of effect,
TI = Temporal immediacy, PX = Proximity, CE = Concentration of effect
Sa (5) = Strongly agree, A (4) = Agree, N (3) = Neutral, D (2) = Disagree, Sd (1) = Strongly disagree

Table 2.3 Statistical analysis of open question

Questions	Participant Types	Response			Chi-squared test		
		Would Act	Wouldn't Act	Unsure	X^2	DF	p
Q1	Ex	20	10	0	9.6639	2	0.0080**
	Ix	13	13	8			
Q2	Ex	20	8	2	6.3893	2	0.0410*
	Ix	14	10	10			
Q3	Ex	21	3	6	4.7686	2	0.0922
	Ix	15	4	15			
Q4	Ex	16	10	4	7.5853	2	0.0225*
	Ix	10	9	15			
Q5	Ex	25	5	0	11.0091	2	0.0041**
	Ix	17	8	9			

Note: *p < 0.05, **p < 0.01

Response to Questionnaire Set 3

With regard to the open-ended questions in questionnaire set 3, Table 2.3 shows the results of the statistical analysis. The chi-squared tests for the participants' responses to statements Q1, Q2, Q4, and Q5 gave a p-value <0.05. Therefore, there were significant differences between the Ex and Ix participants' responses to the statements. Moreover, the result of the chi-squared tests for statements Q1 and

Q5 (p-value <0.01) indicated that both statements showed a strongly significant difference between both groups. On the other hand, a p-value >0.05 as the result of the chi-squared test for statement Q3 indicated that between both groups there were similar responses. From Table 2.3, a large difference between Ex and Ix participants was the number of Ix participants that gave the response of 'Unsure' for all statements. This meant they were sometimes confused in selecting responses compared to the Ex participants. Thus, there is a notion that the Ix participants had difficulties making a decision.

2.5 Summary

This survey sought to examine the participants' awareness of moral intensity of ethical scenarios in disaster response. The results presented in section 3.3 supported a strong conclusion that there was a significant difference between Ex and Ix participants. Moreover, the results of the statistical analysis for both categories in questionnaire set 2 showed that Ix participants had lesser awareness of ethical scenarios. In addition, there is indication that PE and CE provided dominant factors of moral intensity that differentiated the Ex and Ix participants. In actual disaster response work, both PE and CE are related to the consequence of their acts. Thus, both moral intensity components should be improved by training in a real disaster. On the other hand, the result of the statistical analysis for questionnaire set 3 indicated that Ix participants had difficulties in making a decision.

The findings described within this survey indicate that in different ethical contexts, participants in different groups will differ according to what factors of a moral situation will distress their ethical (or unethical) behavior. Therefore, the most important consequence that emerged from this survey is to accurately recognize ethical decision-making behavior between Ex and Ix participants. Thus, the participants need to be aware of how different groups gauge the moral intensity of an ethical situation, and how these insights could successively impact their ethical decision-making behavior.

The overall findings from this survey indicate that throughout the ethical decision-making process, a number of the Ix participants had problems recognizing the overall harm caused by their actions. Consequently, if the objective of the participants is to both foster and encourage ethical decision-making behavior, they should be cognizant of the severity of the consequences caused by an unethical action. Moreover, for issues of low awareness of moral intensity, it may be possible to encourage ethical decision-making by increasing their understanding of the negative consequences associated with an undesirable action. Based on the survey results, MAGNITUDE has been designed. It provides learners a mobile virtual training environment. They can use it to improve their soft-skills, especially related to MC, PE, and CE anywhere and anytime. The implementation

in the appropriate participants group is supposed to show the maximum advantages of training inexperienced first disaster responder using the game. In summary, it can be concluded that there is an enormous opportunity to use the developed game to achieve this goal.

Chapter 3
Literature Review

3.1 Introduction

This chapter reviews the related research that enabled games for educational purpose. First of all, I discuss characteristic of serious games. I then discuss the game approach for educational setting focused in learning decision-making and emergency training.

3.2 Various Methods for Disaster Training

One of key success factors of disaster response work is coordination and organizations of disaster response work related to the decision-making (Van de Walle, 2008). However, to have a good coordination, the disaster responders needs to train their ability in individual in order to match with the organizational work. They also should have a comprehensive knowledge and understanding of the situation in a disaster. Hence, programs for developing such factors are obligated. However, developing an effective program for disaster response gives benefits to the disaster response organization. Especially for non-affiliate responders, their response work should be organized partially. The followings are the possible way for training of disaster response.

Discussion-based training
Discussion-based training familiarizes learners with the established plan, policy and procedure of the disaster response work. This training is also possible to develop new effective disaster response procedures based on the problem that found in the discussion. However, this type of training will give much benefit if the event involves the experienced disaster experts. This type of disaster training includes:

- Seminar: It is an informal dialogue, intended to familiarize the learners to a new or restructured plan, or procedures, for example a seminar conducted to review established procedure of evacuation.
- Workshop: It is looks like a seminar, but is retained to construct detailed outcome, for instance an outline plan or policy for scheduling multi years or regular training of disaster responders.

Tabletop Training
Tabletop training is a scenario in an informal setting that focuses on development of individual and team performance. Tabletop empowers a discussion among the

learners and key personnel or experts in disaster responses (Chi, Chao, Chuang, Tsai, & Tsai, 2001).

Games
A game-based training is a mockup of operations that could be involved more than a group or team of disaster responders. Each learner will have a different role to represent a real-life disaster situation. Using game approach, the learners can acquire necessary skill on the competitive environment; hence this method could ignite the learners' motivation.

Drill
A drill is a supervised training by experts to measure the readiness of disaster responders in a specific skill within a single entity, for instance to test the rapid rescue of an evacuation team.

Full-Scale Exercises:
A full-scale training is an event to simulate a real-life of disaster situation that involves multi-agency with various disciplines of expertise. The involved teams could be consisted of a national disaster command officer, advanced first responders, a medical team, a logistic team, an authority officer, and a community.

3.3 Serious Games Characteristic and Trend

Games are artifacts that constructed to provide learners a competitive activity with a particular goal and context within a set of rules. Serious games (SG) use the terminology and technology of entertaining games that implement for education (non-entertain) purposes. SG in recent years was common to be used for research of policy and decision-making, and also for training and learning. According to the increasing of gaming technology, SG also adopted the new paradigm, not only for learning by playing but also possible to encourage learners to have high motivation and engagement in such learning process.

As noted by Prensky, games would expand their benefits if they can involve the learners in all situations within particular characteristics. In addition SG empower their characteristics to assist the learners acquired appropriate knowledge with the precise learning experience through seamless integration of entertainment and learning (Gee 2003) (Prensky 2001). Therefore, Prensky proposed six elements of the game to achieve this goal. He claimed that a digital game could engage the learners to attain new experiences if the game adopted the following features (Prensky 2001).

(1) *Rules:* is defined as a set of instruction. If a game does not have rules, it would not be meaningful. The rules will direct the learners to follow the game flow to reach a goal.

(2) *Objective:* is defined as the purpose of the game, which motivates the learners to achieve a future state.

(3) *Outcomes and feedback:* are the responses from the game to measure learners' progress against the goals. The feedback informs the learners whether their action is positive or negative, closer or further away from the goals, and breaking or staying within the rules.

(4) *Conflict/competition/challenge/opposition:* are obstacles facing by the learners. They should try to solve obstacles and they will get the balance of the game.

(5) *Interactions:* there are two kinds of interactions, which is the interaction between the learners and the computer and social interaction between two learners or among many learners.

(6) *Representation and story:* are elements that are included in the game. These are abstract or concrete and direct or indirect patterns of the game. For example, a battle game commonly has a hostile situation for the hero character against the enemies.

Furthermore, nowadays, serious games use the advancement of immersive technology of virtual game world such as virtual reality (VR), augmented reality (AR), global positioning system and gesture sensors such as Kinect, and Motion Leap. Thus, the serious games offer a fascinating interaction that can boost the learners' motivation in learning.

3.4 Serious Game Based Approach for Learning Decision Making And Emergency Response

Recently, the number of SGs has increased rapidly. They have been fostered in the education field for a long time. SGs have provided environmental behavior that simulates a real environment's behavior, and it can engage learners in order to familiarize them to a situation (Bellotti et al. 2010). Despite the fact that most SGs are on an investigational stage, there are SGs that could be very valuable for training. SGs are one of the well-known methods that are promising for training in different subjects, for instance, in nursing and health (Petit dit Dariel et al. 2013) (Wattanasoontorn et al. 2013), and in the military (Smith 2010).

Moreover, some research revealed the evidence that training or learning using game are more effective than traditional ways, for example a study of game approach for medical learning subject (Boeker et al. 2013). In addition, there was also evidence that training of disaster in the classroom; there was a major weakness, i.e., lack of realism of the environment. However, to provide realistic simulation, not only expensive and also the chaos situation is undesirable. Hence, such shortcoming can be replaced by a serious game world that can mimic the real environment of disaster situation. As such, the learners would learn a solution of wrongdoing, which is not permitted in a real life. To comprehend the understanding of serious games in particular domain that adopts in MAGNITUDE design, the discussion of the related game research will be structured as follows.

3.4.1 Serious Games for Learning Decision Making

There are a number of serious games focused on delivering particular context learning of decision-making, for example serious games for environment education, military, and health and medicine.

On environment education, there were several serious have been developed and evaluated. Park et al. developed role-playing game (RPG) that utilizes a multi-agent system (MAS) through location-based RPG. It is the didactic tool that facilitates learners to understand a complex system on the process of negotiation in ecosystem management. RPG used to understand contextual factor that influences Peasant-colonos when making decision on land use, and land cover transformation of individual property, and how they generate a landscape dynamics in the zone (Pak & Brieva 2010). Sordoni et al. utilized SIMPARC, a role-playing game, to help learners discover and understand various factors and dilemmas that influence and importance dialog for effective parks monitoring. The learners are invited to have a certain role that represents a stakeholder position. The game simulates a negotiation process in a council of park management that focused on a discussion for making a decision about zoning of parks, for instance, a consideration of park conservation. (Sordoni et al. 2010).

Decision-making issues have been also getting special attention for the military training purpose. For instance, Hulst and Ruijsendaal studied to measure the military staff on complex decision making through serious game named Job Oriented Training (JOT). JOT dedicated to improve the learners ability on Naturalistic Decision Making (NDM) (Hulst et al. 2014). Another concern of SG for military was studied by Caird-Daley et al. They delivered various serious games for military context. For example, SANDBOX game—meaning of an unrestricted game that children play—that allow learners to fully freedom and Control within the game play by taking the risk and try several options to have solution of the problem appeared on the game (Caird-Daley & Harris 2008).

On health and medicine education, Sung et al. implemented a concept of contextual learning for their game development that intend for improving learning performance in a health education course. Game adopted a contextual decision-making distributed within storyline. Learners should complete a different mission, which consist of various conflicts by making a correct decision according to the reference of knowledge in the textbook of health education. Sung argued that the result of its effectiveness experiment showed that the game has an advantage to highly motivate learners to acquire health knowledge. Compared to the traditional learning, they will have better understanding and experience, and motivation to problem-solving competence acquisitions (Sung et al. 2015). Katsaliaki et al. developed and evaluated GeriatriX, a serious game for teaching geriatric medical decision-making. The game development based on the evidence that the medical students have less training in complex geriatric medical decision making. This game evaluating patient oriented goals and preferences, and appropriateness and cost of medical care. The study of effectiveness proved that medical students have highly self-perceived competence in evaluating patient preferences, appropriateness, and costs of medical care for making complex geriatric medical decision. Katsaliaki also argued that GeriatriX game offered the learners to have complex geriatric problem analysis, as a result, the learners could manage this complex problem within stimulating and challenging situation in a safe environment (Lagro MD et al. 2014).

Above evidence on research on learning decision-making through serious games were proved that such ways have potency to provide the learners with a challenging method of learning. In addition, it could motivate learners to grasp learning subject in safe environment especially in the situation, which the real-life environment is dangerous or expensive to establish.

3.4.2 Serious Games for Emergency Response Training

Disaster response works require personal skills in project management, teamwork, effective communication, and other soft skills (Walsh et al. 2012; Daily et al. 2010). The disaster responder, therefore, should increase their soft skills regularly. However, it is difficult to create a realistic exercise due to limited environment. Training game is an approach to deal with the above issue. Researchers in this area found that games have the potential to enhance the training and performance of a disaster response team. Training games may improve the emergency team skill by providing regular training opportunities. The idea of enabling games as tools for education and training is not new. With decades of research on games for learning, the games were usually developed for specific learning outcome.

Some research studies have developed SGs on various platforms and for several purposes. Disaster Readiness Through Education (DREAD-ED): The DREAD-ED game trains learners dealing with an evolving emergency situation. The game

harnesses an SG for training communication between members and staff of crisis management. As a member of an emergency management team, learners have a role with a unique ability to tackle issues that occur in emergency response. It allowed 3–6 learners to play the game in the same session to simulate communication between team members (Haferkamp et al. 2011). Triage Trainer: the game is designed for training of triage sieve accuracy in major incident casualties. As a first responder, learners should immediately identify victims that appear in the game scene (Knight et al. 2010). AtomicOrchid: it is a location-based real-time mixed reality game that proposes to train emergency responders in the scenario of radioactive explosion. In the game, learners have a specific role in emergency responder work. Only learners with specific roles can do specific response actions. The game trains the learners to perform better team coordination (Fischer et al. 2012). Advanced Medical Post (AMP)-management game: it is a policy management game, which addressed to train the emergency staff in general incident including man-made and natural disasters, so they could assist the policy maker. Learners asked to perform as incident commander that has a duty to manage the resources of emergency response including staff of disaster responders for triage and treatments room, as well as managing transportation from on-site medical treatment room in the hospital (Rauner et al. 2014). Another game for emergency training is Emergenza. It is a virtual reality game that empowers interaction in an immersive environment using Kinect. The goal of this serious game is to train the medical personnel's by facilitating them a clinical decision support. By doing so, it enabled the medical personnel's to enhance the procedure of patients' rehabilitation (Ferracani et al. 2014).

On the other hand, widespread use of mobile and portable devices in education has encouraged progressive revolutions in ways of learning. They provide a benefit for blended formal and informal learning properties. Because mobile devices are small, they also provide the main advantage of mobile learning, that is learners can carry the system anywhere and use it for training activities all over (Park 2011) (Wu et al. 2012). Furthermore, because of these benefits, mobile learning has become popular and many learners nowadays use this technology. Another advantage of such system is that mobile game implementation can be directly suitable to the desired learning situation. Klopfer claims that 'mobile games provide many opportunities to consider the game play thoughtfully, discuss it with others, and reflect on its significance, without requiring substantial investments in game-play time' (Klopfer 2008). In summary, learners can use mobile games for a few minutes daily or weekly, and it has enabled learners to grasp educational subjects within individual playful learning.

3.5 Summary

The review related study proved that learning by playing game was considerably more effective than traditional way to improve the learners' achievement on

specific learning subject. From the analysis of serious games focused on the decision-making and its relation to the emergency response, there is an opportunity to unlock the game potency for training such topics. However, according to the comparison and the evidence of related study, none of those research encouraged skill development of inexperienced volunteers when making ethical decisions in disaster response work. Hence, the MAGNITUDE idea was to take into account on delivering an alternative learning environment of disaster response work with the mobility benefits.

Chapter 4
MAGNITUDE Design and Development

4.1 Introduction

The use of digital games for learning purposes can foster the quality of learners' satisfaction and promote education to an appropriate level because games have the capability of grasping learners' attention by creating an enjoyable impression in learning (Ferracani et al. 2014). Digital games take into account the important role of learning through games by facilitating learners' ability to engage and participate in conditions that would otherwise be terrible to be involved in. This chapter will discusses the process of MAGNITUDE design and development. First of all, the ethical model of MAGNITUDE game—which adopts the six-components of moral intensity described in the chapter 2—will be reviewed. Then, it continue to comprehensively present the design of MAGNITUDE including the game architecture, applicable of RPG pattern borrowed from entertainment game rules, and game mechanics. The discussion will be concluded by explaining the workflow of MAGNITUDE development.

4.2 Ethical Model in MAGNITUDE

Ethics has been defined as the study of the general nature of morality and specific moral choices that are made by people (Comitas 2000). However, ethics are different from morals even though they are closely connected. Ethics is a moral compass and a standard of conduct, which can be applied to a range of situations, for instance, the decision to stop medical treatment of a patient—requested by the patient's family—who is suffering from a serious disease for a long time. In this example, the medical team will be faced with an ethical dilemma: whether to approve the family's request or to continue the treatment (Luce 2010). McConnell noted that an ethical dilemma is a condition where a person—who is responsible for making a decision—encounters many different possibilities. They have many ethical choices, but they cannot select all of them (McConnell 2002). The ethical dilemma makes the decision-making process more difficult than others. However, a game is suitable for training awareness of ethical values in a disaster responder by embedding ethical game play (Zagal 2011). To accomplish this concept, Sicart (Sicart 2013) proposed two ways for implementing ethics in game play. The first is the design of the game itself, which produces meaningful experiences within ethical rules, and the second is the possible interaction between learners and the design of the game. According to these notions, by embedding ethics in game play, learners have to consider moral dilemmas in different behaviors. They can

do anything related to these behaviors without worrying that their actions will harm others as in real life.

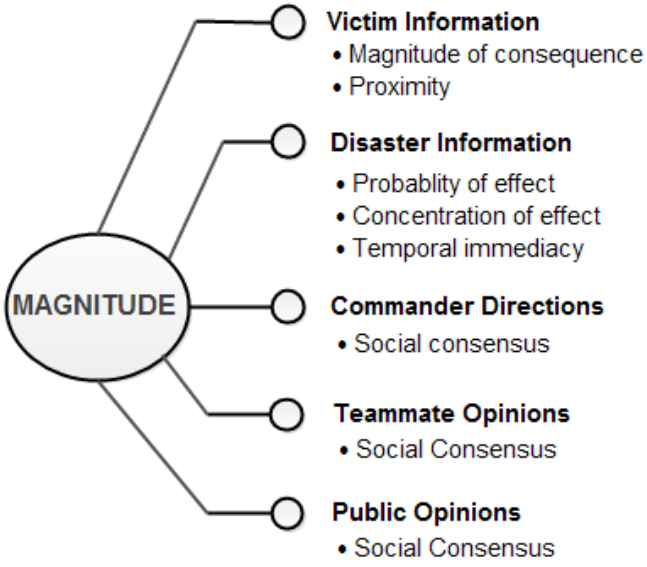

Figure 4.1 Ethical model in MAGNITUDE

Ethical decision-making is a critical aspect of successful and efficient disaster responses. However, most inexperienced responders have difficulties in solving disaster issues. Specifically, difficulties often come up in the process of making an ethical decision because of an unclear understanding of these factors. Consequently, it is necessary that inexperienced disaster responders are aware of ethical issues in disaster work.

To provide an ethical dilemma in the game, the six components of moral intensity (Jones 1991)—as shown in Figure 4.1—embedded into the game narrative by which learners should collect this information. The following are explanations of MAGNITUDE elements that contain specific components of moral intensity.

(1) Victim Information is victim data regarding the number of victims, illness suffered, and social background. MC and PX components might be included in it. Furthermore, learners must know information about victims to distinguish which victims need immediate help.

(2) Disaster Information is data about the type, scale, location of the disaster, and knowledge of the circumstances that will occur later. The elements consist of PE, CE, and TI. By having this information, learners can estimate which actions in disaster response could potentially affect the environment or community in a short or long time period.

(3) Commander Directions are all instructions from the disaster response commander related to the response stages. The commander is responsible for managing and directing the response process. It is important to keep the action plan process on track because the longer the process goes, the more difficult for the commander to set up the next step.

(4) Teammate Opinions are comments or judgments from other members of the team. As a part of social collaborative teamwork, each member of the disaster response team has his or her own rational thinking. Some of them have supporting arguments, whereas others dispute the learners' analysis.

(5) Public Opinions are comments and responses that come from the community and victims regarding the action that has been carried out.

Commander Directions, Teammate Opinions, and Public Opinions are MAGNITUDE elements that contain SC. However, with regard to survey results the MC, PE, and CE components determine Ex and Ix participants that MAGNITUDE takes into account to encourage Ix participants to be aware of these components. As shown in Figure 4.1, these components are distributed in Victim Information and Disaster Information; thus, the game narrative addresses both elements of MAGNITUDE.

4.3 MAGNITUDE Architecture

Some game genres can potentially support learning of decision-making skills (Prensky 2001). A simple game genre definition describes as the way of the story expressed. A genre is how narrative—that influence the story structure, character act, and others storytelling components—presented. According to the Prensky notion, therefore, MAGNITUDE combines two genres to achieve the research goal, i.e. simulation and role-playing. By applying the simulation genre, MAGNITUDE imitates diverse types of disaster in an artificial environment. MAGNITUDE simulates post-disaster settings where disaster responders might be faced infrastructure breakdown, social chaos, and governmental disruption. On the other hand, the general appeal of implementing a role-playing game genre is to encourage the development of learners' abilities to confront NPCs with ethical conflicts.

MAGNITUDE has been developed using unity3D, currently one of the popular game engines. Use of the existing game engine allows us to focus on developing game play. Figure 4.2 shows the architecture of MAGNITUDE, which consists of two sides: the training manager and learner sides. On the training manager side, the game designed to allow the training manager to create new game scenarios using an authoring interface. There is a function to configure the game environment including type of disaster, number of tasks, and type and number of

NPCs involved. This side will also create a dialog editor so that the training manager can write new conversations between learners and NPCs. In addition, the training manager has the authority to collect and analyze the learning progress data using analytic tools. Therefore, he or she can evaluate the objective of established game scenarios.

On the learner side, the learners can update the level and narrative of the game, and send the assessment results to the cloud. Each game session will be recorded in a data log and stored in a database in the cloud. It includes the information of the date and time that the session was played, their responses, which questions were attempted, how long it took them to answer those questions, their score, and event and position of the learners' navigation. The data log is used to track learning progress and analyze learning outcomes. MAGNITUDE implemented by C# scripting in Unity3D. In the current development, it was available for iOS and optimized for iPad 4. With the power of this game engine, further development would cover all types of iOS and Android devices. The followings are the description of MAGNITUDE components.

- The Simulation Component is a set of unity class intended to simulate the disaster environment.

- The RPG Pattern and Ethical Components are a set of rules that consists of an established RPG pattern. They are applicable for delivering ethical game play by embedding six components of moral intensity.

- The narrative manager is a set of finite state machines (FSM) for handling game flow.

- The Artificial Intelligence (AI) component is a set of behavior trees to control the NPCs.

- For the authoring interface, a mobile application designed for the author, hence he or she able to construct new game scenarios and adding new conversation for the dialog system. All necessary game assets such as, character model, pre-build terrain, dialog creator, etc. have been prepared when the authoring application was installed. The training manager or author just defines the new scenario configuration that will be saved in the JSON format data. The configuration file will be sent to the server when completed. To install the new game scenario, learners just need to download the configuration file, and then the game app on the learner side will extract it into the new levels of the game. The authoring app also has ability to show the learning progress of the learners. All learner data will be retrieved from the cloud and then it will be saved in a local SQLite format and will be presented in an analytics tool. However, due to priority of game development, the authoring interface is not implemented in

this phase. It is planned to feature in further version of MAGNITUDE development and evaluation.

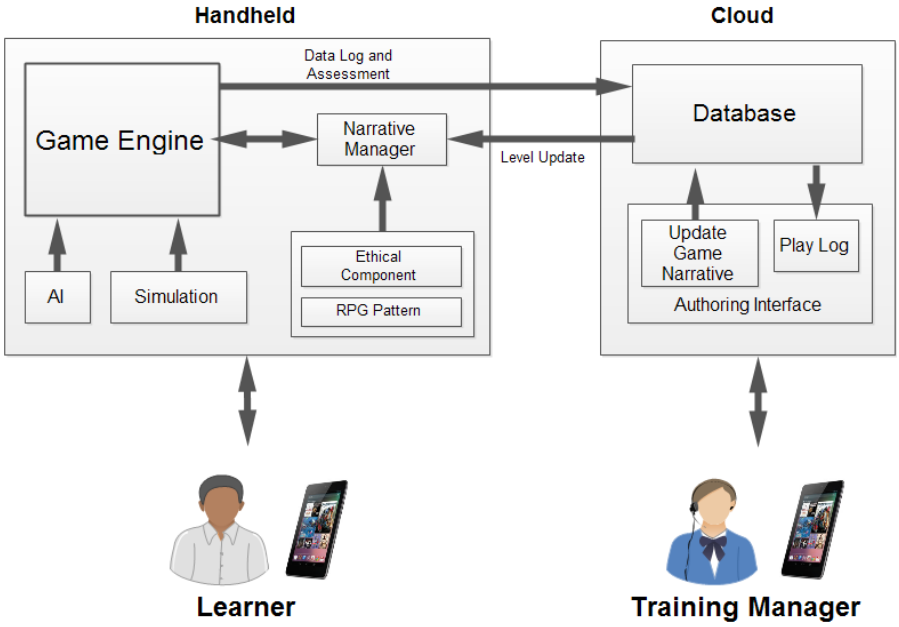

Figure 4.2 Architecture of MAGNITUDE

4.4 RPG Pattern for Ethical Gameplay in MAGNITUDE

The aim of this section is to describe an RPG pattern in MAGNITUDE. These works discovered that embedding ethical values into gameplay in MAGNITUDE is meaningful for encouraging the learners to be aware of the real post-disaster situations. There are many patterns presented in the success commercial RPG, but only the specific patterns will be discussed, which are suitable for ethical gameplay.

Sicart noted, “Ethical gameplay is the outcome of a game sequence in which learners take definitive choices based on moral thinking, rather than instrumental thinking. Ethical gameplay is, in other words, the outcome of moral play” (Sicart 2014). He argued that ethical gameplay in the game could be incorporated by providing wicked problem. This section discusses the design pattern of RPG, which can implement in MAGNITUDE to achieve the notion.

4.4.1 Applicable RPG Pattern

RPG by default uses term of quest to represent a mission, which the learner will be confronted with some problems in completing the task. There are a lot of

common patterns discovered from established RPG games. The following are applicable patterns of RPG.

Character

A character is the game personality. The character may either controlled by the learner, or by the computer. The character has characteristic, such as age, gender, strength, etc. that differentiates one by one. In a specific purpose, the character in MAGNITUDE can be classified into two classes, these are:

Classes of character based on type

- Player Character (PC): A PC in MAGNITUDE is Pandu, which mean a boy scout. He is a teenager and a student in a high school. His hobby is adventurer, and he enjoys regular activities such as hiking, climbing, diving, caving, etc. He becomes an active student after joining a student organization at his school, which focuses on outdoor and humanitarian activities.

- Non-player character (NPC): NPC types can be distinguished into two categories. First NPC type is an interactive character that has a big contribution to the presentation of ethical tension in MAGNITUDE gameplay, because they will be involved in dialog trees. Another type is non-interactive character, with which the learner cannot start a dialog. Usually, non-interactive NPC is only decoration for the game world.

a) The NPCs of the disaster response team such as paramedic, commander, technical expert, etc.

b) The NPCs of victims and community including elder, teenager, children, etc.

Classes of character based on behavior

- Protagonist: This character has good behavior. The learner usually acts as a protagonist.

- Antagonist: This character has bad behavior. Antagonist might come from the disaster response team or from the community. For instance, it always has a bad judgment to any actions taken by the learner or annoys the main character actions.

- Dynamic: This character is usually an NPC appeared in all situations. In some situations the NPC expresses good behavior, but in another condition it conducts bad behavior or does not react anything to the main character. For example, if the commander or the others disaster response team feel exhausted during

disaster response works, they will express their bad mood. But usually, the disaster response team will give the learner good advices and supports.

Reward

- Success reward: It is an incentive given to the learner to encourage him/her showing up the session and success to pass the obstacle or solve the problem. This reward is presented by increasing scores of the learner, and some trophies of success.
- Social Reward: It is an incentive given to the learner when the NPC was satisfied with his/her act. If he/she does satisfied job, the NPC will give him/her one point of Social Reward and vice versa. This reward is presented by percentage of love symbol. If the NPC fully satisfied with the learner's action, full percentage of love symbol will be given and vice versa.
- Failure Reward: It is negative rating given to the learner when he/she commit to a fatal mistake. This reward is presented by various ways, decreasing the learner deposit, and giving failure trophies.
- Teammate Reward: It is a satisfaction of the disaster response team when the learner shows good collaborative works. Similar to the social reward above, this reward is presented by a percentage of love symbol and trophy.
- Total reward: It is an incentive given to the learner to encourage. It is also known as Character Point, and XP. It is calculated from Success Reward, Social Reward, Teammate Reward, and Failure Reward. It performs the results of the activities' appropriate acquisition parameters. If the Total Reward reaches a certain value, their level will go up.

Hit Points

Hit Points are known as Damage Capacity, Health, and Life. The learner's ones are status of the character's health during disaster response woks. Doing a lot of work, he/she will lose his/her Hit Points. If his/her Hit Points decreases, he/she needs to add source of energy. It can be added by earning food items found in the game world. For the NPCs of the disaster response team, Hit Points will lead to the slow of response, and it is related to the mood of those NPCs. For the NPCs of the victims, once Hit Points lost rapidly, it will affect loss of the opportunity to save their life.

Resources

Resources are properties with limited amount in the game world that the learner may earn, manage and expend in certain ways. For instance, he/she should find food to keep the energy in sufficient level. He/she may fight with the bad NPC to obtain the food items so that he/she can assure that his/her energy is maintained. On the other hand, if he/she discovers the victims who need food items, he/she can expend the reserved foods to help the victims' life.

Quest Pattern for Transforming Ethics Values

Quest provides the learner with purpose and direction of the disaster response works. It also promotes him/her to explore the game world and make interaction with the NPC or static objects. The followings are typical patterns of RPG quest, which are possible to transform ethical values (Smith, 2011).

Actions

Actions are abstractions of the learners' steps to complete the quests. For example, a quest which pushes him/her to do search and rescue operation when a natural disaster strikes. The following are elements of quest actions applied in MAGNITUDE.

- Options: It is the element which, PC will be confronted with the ethical dilemmas. Every option has Type and Outcome. Type is the kind of being made by PC such as, amputated victim's leg, destroyed hill, etc. Outcome is the result based on what the learner opts.

- Equipment: It is a specific item needed to solve confronted problems. The variables of this element are the amount and function of them. For example, when the PC discusses the response works, he/she will be asked to prepare safety equipment's and should determine and gather the necessary equipment related to the type of disaster.

- Moxie: The element pushes the PC to use his/her personal knowledge to attain the objectives. This is a very important element in MAGNITUDE, because it promotes him/her to use his/her skills for making decisions rather than just using the virtual skills of his/her character.

Objectives

Objectives are tasks needed to solve to complete the quest. The learner will be assigned the main objectives, such as, determining the type and scale of the disaster, preparing emergency equipment, collecting the food items, searching and evacuating the victims, gathering information, and making decisions when response actions faced the dilemmas.

Quest Structure

Quest structure causes the actions and the quest merging together. In MAGNITUDE, Quest Structure consists of:

- Ethical Dilemmas: The learner will be confronted with the problems of search and rescue activities. Every problem contains minimum one of six components of moral intensity.

- Deadline: It is a set amount of time. The learner should complete the quest before it automatically ends. It will put him/her on pressure. If he/she cannot finish such tasks in a specific time, he/she will get the false point and the quests will be marked as failed.

4.4.2 Judgment of Ethical Decision

Disaster response activities might contain one or more components of the moral intensity. The learner's decision is judged from a Teammate Reward and Social Reward. Teammate Reward is the gift from rescue team members when he/she makes an appropriate decision; which does not inhibit the evacuation process. Social Reward is the gift from the victims or the community in response to his/her actions. If his/her decision causes a disruption of the disaster works, this leads to a decrease in the Teammate Reward. On the other hand, if the decision causes the victims' disappointment, this may decrease the Social Reward. A balance between the Social Reward and the Teammate Reward will contribute to gain a high Total Reward. If they reach a certain defined Total Reward, they can move to the next level of the game.

4.5 Narrative of MAGNITUDE

Many researchers have debated the balance between the narrative and game mechanics. However, there is evidence that the narrative is a significant element of the game. The narrative encourages the learners to connect emotionally to the story. There are two functions of the narrative in the game: informing the learners what the next actions are that they need to do, and prompting the learners about what they have already completed. Reeve explained numerous narrative forms for the serious games based on Bateman's structure (Bateman 2005) (Reeve 2009).

- Linear Traditional, it reflects single path and single conclusion of game story. The learners should successfully complete a task before taking the further task.
- Branching, it is unconstrained interactive narrative as the opposite of traditional linear narratives. The learners have choices to follow narrative branch and taking action as the consequences of their selection. Event though

the learners restricted by the definite narrative that influences the total of game outcome, the learners have the freeway to control over the course of the action.

- Parallel Paths, it is the solution of strict branching narratives. Parallel paths offer 'junctions' where two or more tracks combine. Hence, the learners could return back to predetermined points to manage the story flow.
- Dynamic, it offers object-oriented storytelling. These experiences may contain discrete storylines but have possible connections to other event nodes built into them. Hence, the learners could define their narrative at will, where the relationship between characters or the plot revelation unfolds unpredictably.

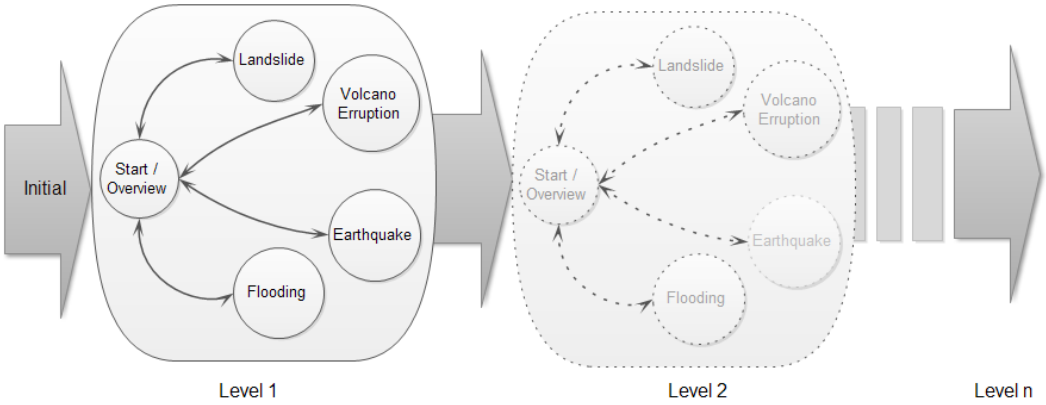

Figure 4.3 MAGNITUDE narrative forms

According to Reeve, the MAGNITUDE game adopts a combination of linear traditional and branching narrative. Using linear traditional narrative, the learners should follow the narrative from the starting level to an undefined end of the level. This means as long as the training manager – using the authoring system – can generate new scenarios for quests with different grades containing ethical tensions, the game will challenge the learners. In addition, by implementing the branching narrative in each quest, the learners can prioritize the action. They can start by choosing the easiest quest in every level and follow the main game flow based on the objective of the educational aspect, i.e. to improve the learner's skill gradually from novice to expert level.

The main character in MAGNITUDE is Pandu. He is a teenager and a student in high school. His hobby is adventurer, and he enjoys regular activities such as hiking, climbing, diving, caving, etc. He becomes an active student after joining a student organization at his school, which focuses on outdoors and humanitarian activities. Experiences in various adventurers' activities have led him to have technical expertise. Pandu has undergone various training programs, such as the basic techniques of emergency response, water rescue, etc. One day a disaster hits the suburb where he lives. As an adventurer, he is passionate to help his

community in the problems they face post-disaster. Afterwards, various disasters continue to occur. His experiences from one disaster to another enable him to acquire a lot of knowledge about disaster response work and about building a strong spirit to be a humanitarian activist.

Figure 4.3 illustrates the flow of the MAGNITUDE narrative. The game starts with an initial condition. Initial demonstrates the opening narrative that shows the main character profile and roles. Each level contains branching narratives formed by four quests, which represent the types of disaster. The Start/Overview point is a position where the learners prepare. At this point, they discuss some plans for the disaster response work and the objective of the current quest. At this narrative point, the learners should identify many aspects of the disaster, i.e. the type and scale of the disaster and the objective of the mission. They will return to the Start/Overview position when they have completed a quest, and they should answer some questions regarding the completed quest. From this position, they can start to complete the remaining quest(s). Success in completing the requested task will increase the learners' XP. However, the difference between the levels is in the ethical tensions that emerge. For instance, in level 1 each quest contains three evacuation tasks, whereas in level 2 each quest might contain four evacuation tasks. Every evacuation task might contain one or more component of moral intensity. The learners' decision is judged from a teammate satisfaction and social point of view. Teammate satisfaction is the reaction from rescue team members when the learner makes an appropriate decision; which does not inhibit the evacuation process. The social point of view is the rating from the victim and the community in response to the learner's actions. If the decision taken by the learner causes a disruption of the disaster works, this leads to a decrease in the teammate satisfaction point. On the other hand, if the decision causes the victim disappointment, this may decrease the social point. A balance between the social point and the teammate satisfaction point will be combined to give the overall judgment of the learner's XP'. If the learners reach a certain defined total number of points, they can move to the next level of the game.

4.6 Game Mechanics and Learning Objectives

There are extensive discussions about what game mechanics are is. Adam define that the mechanics of game comprise the set of rules, which learners could engage on interaction with the game world, and processes, and data at the heart of a game (Adams & Dormans 2012). Based on the survey results that MC, PE and CE were significant factors in distinguishing the Ex and Ix participants, the game events were deployed with regard to emphasize these components. Learners will be asked to play the role of a member of the disaster first responder team. The learners are tasked with the objective to response disaster issues spontaneously. As shown in Figure 4.3, MAGNITUDE gameplay starts to guide the learners to understand the brief information of the disaster situation by game introduction and

cut scene. Further, they will be invited to discuss with the main NPC (Commander), who introduces the objective of the quest and directs the flow of its completion. In an initial task, they should recognize type, impact and scale of the disaster, and also ethical consideration about conducting disaster response. In learning domain, this initial step is to warm up them about their duty as disaster responders. The mechanics continue to the main feature of ethical gameplay that involved them into many tasks emphasized into MC, PE, and CE. How many tasks will be imposed to them depends on their level. For example, in entry (novice) level, the game quest only exposes 1-2 problems (tasks), which they requested to rescue injured a victim and to identify how many refugees that need to evacuate. The task objective will be given to them in the first meeting, which they will be involved in a discussion with the requester NPC. Thus, they can observe and analyze the possible ways to satisfy the requester need. Each task will represent either one component of moral intensity, i.e., MC, PE, and CE. But sometimes all of these components emerge in such tasks. For instance, a rescue request from a mother of an injured boy whose leg is trapped by a pile in his house. They should be aware of the MC, PE, and CE consideration. The example case is the injured boy needs to evacuate in advance because of lost a lot of blood. On the other hand, to remove the pile, they need to use heavy equipment, but it is impossible to be transported immediately. They should take responsibility to choose either to amputate the boy's leg or waiting the equipment, which is very risky for the boy's life.

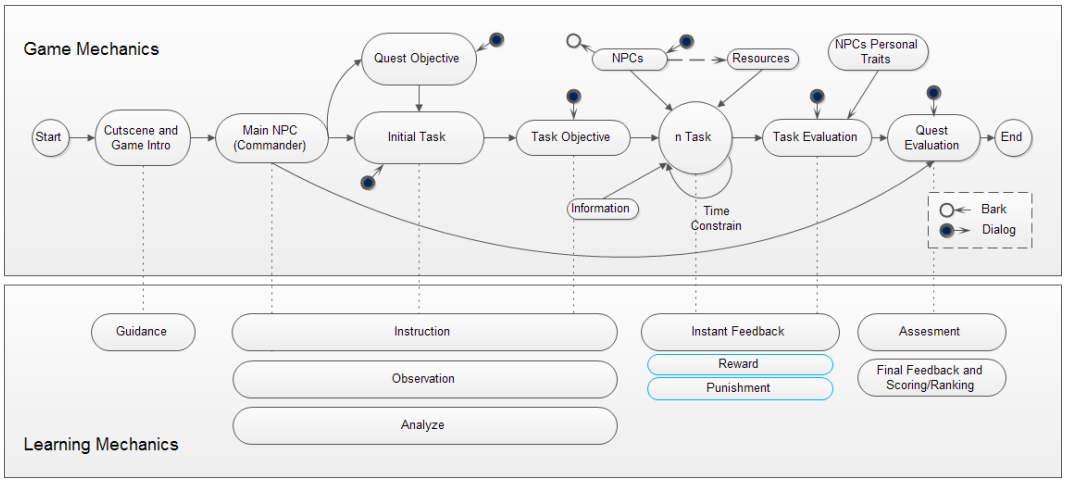

Figure 4.4 The Game and Learning Mechanics of MAGNITUDE

However, every task has different time constrain, hence they should be aware of this time limitation. The fastest learner completes this task; the highest success point can be obtained. However, beside the success point, they will also achieve social point. This point is depending on the personal traits of the requester NPC. The importance of such instant feedback is to keep their engagement in the game

narrative. In addition, as described in the section 4.4, the RPG pattern for MAGNITUDE, the type of NPCs depends on the task objective. For example, if an NPC that involves in the task is a teammate, the NPC type is dynamic. Personal traits will be changeable depending on their action. In one time, the NPC will assist the learner' action; in another time perhaps this NPC will annoy their deed. Nevertheless, to complete the task, they obligate to collect necessary information and to find appropriate resources. Either a task is complete or incomplete; the task evaluation will examine their deed. If the involved NPC feels that its need was satisfied, it will give the learners a subjective social point. In the final gameplay, main NPC will be re-engaged with the learners in a comprehensive discussion to examine the learners' achievement in performing their duties. Thus, they will get the final score for the current quest. This end of the process will also give them a conclusion according to the quest objective introduced in the starting phase.

4.7 Dialog System

As described in the MAGNITUDE architecture, the dialogue system empowered as a main gameplay component to expose the ethical conflicts. By doing so, interaction between learners and NPCs would be often appeared to involve learners to thinking ethical consideration. Hence, MAGNITUDE should have suitable game dialogue management. As explained in many game design theories, NPC interaction gameplay is a mandatory feature in the modern game development. An aspect to deliver such interaction is by providing conversation between player and NPCs. However, there are some forms of dialogue. First form, it can be only a barking from NPCs. In this from, involved NPCs might talk some arguments without asking player character to response. Second form, there is a simple interaction between involved NPCs and the learners just choosing yes or no to response a question. The last form is a fully interactive conversation, that learners' responses will determine the branching of next conversation lines. The following are types of dialogue system that common in the game development.

Non-branching dialogue

Non-branching dialogue uses a simple way of interaction, when player character comes to the NPCs to initiate the conversation. In this form of conversation, the NPC just gives their lines until the ends of the conversation. Non-branching dialogue is the easiest way to advance the game narrative. As static, the game author scripts the conversation beforehand. The NPCs will 'talk' line by line from the beginning until the end. As a result, the non-branching dialogues tend to passive and non-interactive conversation, because there are no responses from the player.

Branching Dialogue

Opposite to the non-branching dialogue, a purpose of the branching dialogue is to give interactive conversation between the player character and NPCs. In the branching dialogue, even though the conversation written-out entirely beforehand by the author, with some game rules, the NPCs talk could be jumped to others lines based on the player responses and status. For example, when an NPC asked the player to find a bag of blood, the conversation will be changed to the others lines when the player can satisfy the NPC need.

Teammate 1 (Rescuer): "We should evacuate him now. But there is a pillar trapping his leg. We need to get rid of that first!"

Teammate 2 (Doctor): "It should be done soon, because we might lose him."

Teammate 3 (Field Commander): "Huh… we need heavy equipment to do it. So… just wait until the equipment arrives."

Basecamp Commander: "Sorry… there is a problem with sending equipment."

Teammate 2 (Doctor): "Yeah…We cannot wait, because he needs immediate treatment in the hospital. It's bleeding heavily! Should we amputate the boy's leg?"

Boy's Mother: "No…. No… I would never allow that. He is my only son."

Teammate 2 (Doctor): "I know that. But if we don't amputate immediately we will lose your son."

Figure 4.5 Dialog example

Based on MAGNITUDE design that focuses to the gameplay rather than to technological point of view, the game conversations maintained by mature Unity3D plugin for dialogue management. Actually, there are a number of popular dialogue systems in the Unity3D asset store. However, because of a vital requirement of the MAGNITUDE authoring system that author should have ability to create new conversation, *Dialog System*[1] was chosen. By doing so, in the authoring system, the training manager can use own system to construct new MAGNITUDE's dialogue, and then the scripted dialogue will be compiled into JSON format. In learners' game app, the scripted dialogue could be imported into the Dialog System easily with a defined format. Nevertheless, in current development phase, which the authoring system is not yet established, the game conversations written using Dialog System editor. Figure 4.5 shows an example of the conversation between the player and the NPCs.

4.8 Development Workflow

[1] http://www.pixelcrushers.com/dialogue-system/

The nature of game development is undertaking by a large team that consists of various fields of expertise, such as, game designer, narrative writer, graphic and audio artist, 3D modeler, programmer and etc. However, current trend of game development was rapidly changed. An independent (indie) game developer—might only consists of one or two people—could produce a good game that was potential to be a popular game (Michael & S. L. Chen 2005). This can be done with support of good game engine and its ecosystem. In addition, it is generally known, that a good and mature game engine like Unity3D might supports this trend due to the easiness of development workflow.

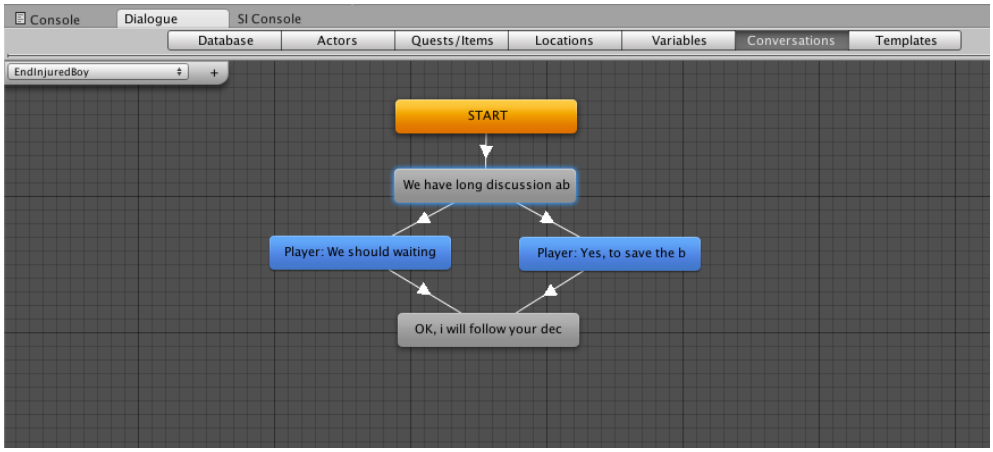

Figure 4.6 *Dialog System* editor

Using Unity3D, indie developer only need to develop the initial game in one platform—for instance, prototype version of MAGNITUDE was developed for iOS and optimized on iPad 4—and later deploy the final product into various platforms. Another benefit of developing games using mature engine is that there are a bunch of ready to use of plugins and game assets to construct game with the easy steps. Hence, they could focus to design the game play rather than to prepare the game assets that sometime consume half of development time. Based on this reason, MAGNITUDE was developed using some of ready to use game assets and plugin, such as, *Dialog System* for dialog editor and management as shown in Figure 4.6 and Figure 4.7, and *Next Generation User Interface (NGUI)*[2] for game user interface (GUI). As such, I can focus on game design and write thousand lines of code only for delivering main feature of MAGNITUDE game, for example, how to bundle ethical components and RPG pattern into enjoyable narrative flow, and how to maintain NPCs behavior. As described in the section

[2] http://www.tasharen.com

4.3, MAGNITUDE architecture, divided the development tasks into main three parts in the further section.

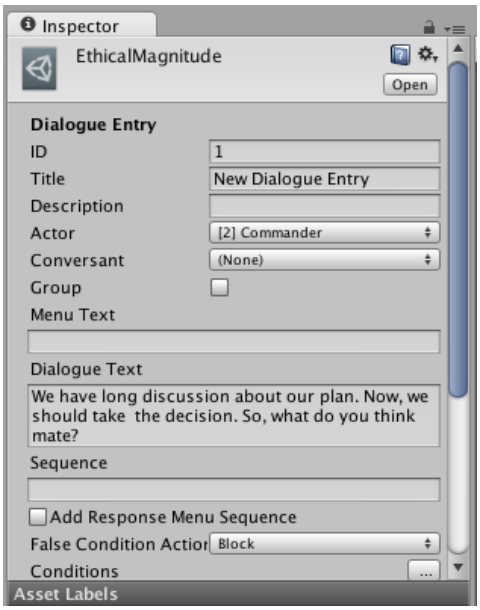

Figure 4.7 Dialog entry

4.9 Summary

The RPG patterns of ethical gameplay have been identified, and there is result that the pattern of RPG applied to the example quest shows the game is potential to produce the meaningful of ethical gameplay. Embedding ethical values into ethical game play in MAGNITUDE is meaningful for encouraging learners to be aware of the real post-disaster situations. Furthermore, the narrative flow to facilitate the ethical values influenced the game goals have been designed. It was mixed linear and branching narrative structure to tie adopted game genre work well together. The game narrative is one of the game components that make a game exciting for the learners. Hence, prototype game level was developed that picked up the narrative from selected natural disaster scenario. It was generally organized into game mechanic of MAGNITUDE that control what learners could do from start to the end so they can achieve the learning objectives.

Chapter 5
First Evaluation of MAGNITUDE

5.1 Introduction

This chapter presents the first evaluation of the MAGNITUDE. The conducted test was to assess the system at a very crude level. It compared the participants' experience playing MAGNITUDE prototype and their appeal playing iPad version of Emergency game from *Deep Silver*[3]. The objective of this test is to gather opinions from the learning target's point of view about the progress of MAGNITUDE development.

5.2 Participants

The participants in the first evaluation were students who have potential opportunity to be inexperienced disaster responders for disaster response. They have joined the Indonesian Red Cross community at least 2 years. They were picked up randomly from the second to third grades of a high school student in Karawang, Indonesia. As the members of Indonesian Red Cross (IRC) chapter in their school, they have a regular training in humanitarian and adventure weekly. Some of them have experience in technical skills training related to disasters, i.e. triage, water rescue, mountaineering, etc. But most of them did not have experience in real-life disaster work. The participants comprised of 25 students, eight of them (32%) were males and 17 of them (68%) were females. The participants age were 14 – 16 years old. Figure 5.1 shows the captured images from the play-testing event.

Figure 5.1 First evaluation of MAGNITUDE

[3]http://www.deepsilver.com

5.3 Material and procedures

A set of questionnaires was provided. It consisted of questions regarding demographic data and the participants' impression of playing MAGNITUDE. At the beginning, the participants were asked to answer the first set of questionnaires with regards to the demographic data. Then the participants were directed to play the MAGNITUDE prototype on an iPad. After they played the prototype, they were asked to enjoy playing Emergency game. The participants were then asked to answer the questionnaire to evaluate the prototype. After collecting the participants' responses, it was continued by interviewing each participant to discuss his or her impression and also collected a written feedback throughout the prototype test.

5.4 Results

Table 5.1 shows the results of the questionnaire regarding the participants' rating after playing MAGNITUDE. Those participants were asked to rate their overall opinion about the developed prototype. The results show 60% of them Agree and 24% Strongly Agree that they understood MAGNITUDE's goals. They also taught that MAGNITUDE could improve their skills in ethical decision making, with 56% choosing Agree and 28% for Strongly Agree. However, most of the participants disagreed that the game prototype satisfied their expectation for auditory and visual quality, game control, and game challenge. There were also some meaningful suggestions from written feedback.

Table 5.1 Participants' experiences playing MAGNITUDE

Questions	Sa	A	N	D	Sd
1. The purpose and flow of this game can be clearly understood	0.24	0.60	0.04	0.12	0
2. The auditory and visual aspects of the game had me involved	0.04	0.12	0.04	0.56	0.24
3. I like the challenge of the game	0.08	0.16	0.12	0.44	0.20
4. I can control the movement and the events of the game	0.04	0.20	0.24	0.40	0.12
5. The game will help me improve my skill when making decisions	0.28	0.56	0.08	0.04	0.04

Note: Sa (5) = Strongly agree, A (4) = Agree, N (3) = Neutral, D (2) = Disagree, Sd (1) = Strongly disagree

Selected participants' opinions related to the goals of MAGNITUDE

> 'I felt unfamiliar with this game type at the beginning. But after I understood the game flow, I am sure that MAGNITUDE has the potential of a game story.' (Female, 16 years)
>
> 'It is hard to play the game, because I am not familiar with mobile games.' (Male, 15 years)
>
> 'I don't know what a training game is, but I hope that MAGNITUDE is a game that has encouraged me to understand ethical conflicts that will be appear in disaster.' (Male, 14 years)
>
> 'This game will have many benefits for disaster responders. I hope it will encourage me to become familiar with ethical aspects during a post-disaster.' (Female, 15 years)
>
> 'I hope I can play a mature version of MAGNITUDE, because it is very useful for developing my skills.' (Male, 15 years)

The result of this evaluation gained some significant insights, which is necessary for the future development and implementation of the game. There are two interesting problems of the research from both the technological and educational point of view. In the domain of technology, an applicable authoring tool for the system managers should be developed. Therefore, MAGNITUDE will have a flexible way to generate new quests, so the game becomes more challenging. From an educational point of view, a fixed assessment framework should be defined for measuring the ability to distinguish ethical problems in the game. The findings also highlight the important direction for future work to develop the complete playable game level. Thus, the effectiveness of MAGNITUDE can be examined by applying a designed narrative in the second phase of MAGNITUDE evaluation.

5.5 Summary

Generally, the MAGNITUDE evaluations indicate that the training disaster response using serious games was potential to improve learners' skill especially in the domain of ethical decision making. The first evaluation of MAGNITUDE that aim to measure the learners satisfaction when using MAGNITUDE—compared to Emergency game—shows that the participants had enthusiasm to use MAGNITUDE for training. They argued that MAGNITUDE invited them to build the awareness of some ethical issues in disaster.

Chapter 6
Students' Viewpoint of Serious Game for Training

6.1 Introduction

Barraket et al. studied that disaster first responders mostly came from the community who worked spontaneously at the first time of a disaster strike (Barraket et al. 2013). On the other hand, most of them have been joined in related humanitarian organizations, such as, boy scouts, Red Cross, and adventure clubs. Hence, the students who have experienced joining in such activities are potential to be disaster first responders. There is usual situation in Indonesia that educational institution from elementary to higher-education levels officially organized such activities. Therefore, the experiences in such organization were contributed to their willingness to be the disaster first responders (Fulmer et al. 2015).

Due to the purposes of my research that proposes the use of the mobile game for training of disaster first responders, it is important to know the contribution of participants' viewpoints for the game to their readiness as a way of training. However, there is a lack of comprehensive information about these aspects, and there is insufficient empirical evidence concerned in gaming preferences of Indonesian students. On the other hand, such information has a huge contribution to the future direction of MAGNITUDE research, i.e., to consider learning subjects' selection for the effective implementation of MAGNITUDE game. Thus, it was motivated me to conduct a comparative survey among students in UN and HS groups about their viewpoint of computer games in training context.

This chapter describes the survey—conducted in Indonesian—whose concern is to examine preferences and influences of computer game for training. The comparison of the students' viewpoint between both educational levels could determine which educational level would satisfy the need of MAGNITUDE implementation. The survey involved 276 participants from both educational levels, i.e., two universities with different field of studies (engineering, social, and arts) and two high schools that focused on vocational education. The survey results show that 79% of the participants (n = 226) believed that games could be used for training of disaster first responders. The results give me a significant insight that UN education level would be more suitable than HS group for implementation of game for training purpose. The UN group had more interest than another one that the games could be used for training besides just for

relaxing and leisure. In addition, with regards to their favorite game genre and platform, learning abilities and necessary skills that could be obtained from the game for training, responses from the UN participants were corresponded to the MAGNITUDE requirements. Hence, there is evidence that UN education level would give more suitable learning subjects than HS education level. In summary, to maximize the role of MAGNITUDE in such training, the UN students should be promoted as learning subjects.

6.2 Game Preferences, Experience, and Acceptance in Education

Current study on computer game preferences has progressed to observe the fundamental motivations for individuals express to play computer games. One of interesting factor is player preference, such as, game genres and platform. There are suggestions that accommodating such individual differences in game intentions may be essential to uncovering aspects that lead to the effectiveness of educational games (Giammarco et al. 2015). Throughout the academic references, there are also some conclusions that games are ultimately motivating and they can be empowered for learning.

A number of research have been conducted to collect student gaming experiences and preferences, and their perception about games for the educational purpose. For example, there was a study to observe student perception about video games in the teaching and learning in the classroom (Bourgonjon et al. 2010). The study involved numerous students in Flemish secondary school. The aim was to examine their acceptance of video games in the teaching process. The results showed that the usefulness and ease of playing games and the potential of learning using games are straightly exaggerated the students' perception for games in the classroom. Karakus et. al. studied the playing habits, expectation and high school students' preferences and consideration with regards to computer games. The study involved a number of Turkish high-school students. It proved that games could be used for delivering Mathematic and History course, and it was also prominent in developing mental skill (Karakus et al. 2008). In summary, implementing digital games in education enables students to easily absorb content knowledge through its role-plays (Han & Zhang 2008).

This comparative study is the extension of the previous survey in secondary educational level that aimed to collect preliminary information about potential learners subject for MAGNITUDE implementation. Former survey involved 100 students from two high schools in Indonesia. The survey findings revealed that most participants (82%) believed that the games could be used for training. In addition, the survey results regarding significant aspects of the participants' behavior in playing games showed that most participants agreed that games had the potential to be used in training, particularly that games can provide the important features of training (i.e., reflection and problem solving). Both features

are necessary to play games for training purposes in order to provide feedback to learners, who can thereby reflect on previous activities to select the best way of finding solutions.

On the other hand, I also studied about UN educational level contribution to the number of disaster responders worked in the disaster response. There was an assumption that the UN level will more have attention to do training using game. However, due to insufficient academic references, it was difficulties to gauge their gaming preferences. Hence, it was encouraged us to also examine the universities students' viewpoint of the use of game for training.

6.3 Participants

This study involved 286 voluntary students from different educational level that conducted this study through two stages. First stage consisted of 160 students from sophomore and senior class from different HS, i.e. HSs located in Karawang and Bandung, the capital city of West-Java province. Both HSs focused on vocational education, which prepared the students for work in industries immediately after graduated. They studied in the different fields, i.e. automotive, mechatronic, electrical and computer engineering. However, from 160 participants, 9 responses were rejected because they returned uncompleted answers that unsatisfied criteria of the survey. Thus, the sum of the participants from the HS group was 151 students.

Second stage selected 120 participants from the first and second years of two universities—public and private universities—that resided in Bandung. They were picked up from different field of studies, i.e. engineering (control, electric, telecommunication, and educational), librarian and art. Some UN students were also invited by email to fill the survey. However, after waiting several weeks, only 5 participants responded. This occurred due to the academic calendar, which started to the final exam season, and also most of the invited students were used university's computer center for their academic needs. Hence, they could not access this facility during the survey period. So the total of the participants from the UN level was 125 students. Overall, 276 completed responses were collected.

6.4 Material

A set of questionnaires was compiled including close-ended and simple open-ended questions for gathering the following data.

Demographic Data

This set of the questions was to collect some information, such as, name and age of participants, and after-school activities. The purpose to collect the participants' after-school activities was to gauge the potential participants for MAGNITUDE implementation as explained in the previous section that the game designed for training of inexperienced disaster responders in the disaster response work.

Game Behavior and Preferences

This set of questions was collected the information of the participants' gaming experiences. However, It was formulated in different forms. First form was consisted of multiple choice questions that asked them to give their response to the following aspects: (a) type of favorite game platform, (b) category of game, i.e. single player, and multiplayer, and (c) average hours spent by them for playing games per week. To represent their attitude's information, close-ended questions was assembled by offering five options, i.e. less than two hours, 2-5 hours, 6-10 hours, 11-15 hours, 16-25 hours, and more than 25 hours.

Second form was consisted a number of questions using a ten-scales of measurement. The form of questions contained the following queries. (a) What are the participants' reasons to play a game? (b) What are the popular genres of the game that the participants play mostly? Thus, several choices of the most popular game genre nowadays were provided, including the game genre that implemented in MAGNITUDE. These questions were anchored from "rare" to "often" of responses.

Third form was comprised of the questions using four–scales of Likert that anchored from "strongly agree" to "strongly disagree". The neutral choice was eliminated to avoid unclear participants' answer (Hartley, 2014). This form of question, including queries about what are the important reasons of why people playing games?

Participants' Viewpoint to Computer Game for Training

Similar to the questions for game behavior and preferences, different forms were used to compile the questions of the participants' viewpoint of computer game for training. First form was used multiple choices to collect data of the following queries. (a) Participants' agreements that computer game can be used for training. Open-ended questions also were providedin which the participants could freely express their opinions concerning to their argument. (b) Necessary features should be incorporated in the game for training.

Second form was consisted of questions using the ten-scale of measurement that collected the participants' opinion about general aptitude expected to incorporate into a game if they have a chance to use it for training.

Third form was consisted of questions using the four-scales of Likert that anchored from "strongly agree" to "strongly disagree". It used for gathering the participants' agreement with the statements of motivation of playing game for training.

6.5 Procedure

There was the difference of daily use and ownership of computer between the participants of HS and UN groups. Generally, the participants from HS group were not often to use such devices in learning activities. In contrast, the majority of the participants from UN group were study in the subject that laptop were necessary. Hence, the survey was conducted with different ways i.e. using paper-based and Internet-based survey. First way was used paper-based questionnaire that collected data from the participants who did not have a computer and Internet access. By doing so, even though a number of participants were complete with answer the questionnaire during a class. Some of them was encouraged to finish the survey questionnaire at their home. Second way was used Internet-based survey in Google Forms and the participants were invited by email. Most of them were UN students.

At the beginning, the MAGNITUDE development and its purpose were described. Then, It continued by explaining the aim of the survey was to congregate their gaming habits and preferences, and also their outlook to the potential of computer game for training. In addition, there was explanation that if they had a complaint to some questions, they could avoid answering the questions. For the ethical concern, They were formally wished to sign the consent agreement that stated the data of the survey would be used for academic papers and presentations only, and their identity would be kept private and no identifying information about them would be included. There was a statement emphasized that if they felt the survey procedures were humiliated them; they could leave their full participation at any time without punishment.

After the participants signed this agreement, they continued to answer the full set of the questionnaire. Most of the participants of paper-based survey were taken time to complete the questions about 15 to 30 minutes long, and some of them finished the questionnaire at their home. However, how long the participants of internet-based survey completed the questionnaire was not measured.

6.6 Results

Demographic Data

As explained in the sub-section of research method, the data were collected from 276 participants. For demographic data, it shows that gender statistics of the UN group were 60 females (48%) and 65 males (52%). As shown in the Table 6.1, the range of the participants' age was between 18 and 20 years old with mean 20.13 years, and standard deviation 0.88. However, the gender statistics of the HS group were 45 females (30%) and 106 males (70%). The range of the participants' age was between from 15 to 19 years old with mean 16.60 years, and standard deviation 1.02.

Table 6.1 Age of participants

Gender	University		High School	
	M	SD	M	SD
Female	19.80	0.70	16.86	0.99
Male	20.42	0.92	15.98	0.77
Total	20.13	0.88	16.60	1.02

The participants' responses to the question of after-school activities can be seen in Table 6.2. The scores express that a number of the participants from the university group joined boy scouts (n = 41). It followed by adventure clubs (n = 29) on second place, and Red Cross (n = 25) in third place. Related results found from the HS group that the first ranking of after-school activities was boy scouts (n = 45), and the second rankings of the HS group's activity were Red Cross (n = 34).

A number of the participants from the UN group selected other categories of activity. In addition, this activity option was placed in forth ranking. Conversely, for the HS group, this category was placed in third ranking, and it followed by charity clubs (n = 19) in fourth ranking. The result of open-ended response to other activity options shows that they had diver activities, such as, sport, photography, art, and music.

Nevertheless, a huge number of the HS participants responded that they did not have any after-school activities. So it can be presumed that the HS group had a different view to look the after-school activities. In contrast, none of the participants from the UN group gave negative response to this question. It can be assumed that all of the participants from the UN group were the active humankind. In that case, such students would have diver after-school activities to empower their ability that corresponded to their interest.

In summary, it is not a surprise to see the results that after-school activities such as boy scouts, Red Cross and adventure clubs were accepted among UN and HS students in Indonesia. Almost at the whole of the year, the students can explore the nature environment in Indonesia, such as offshore exploration, mountaineering, climbing, caving and diving. These kinds of adventure events were included in the syllabi of such after-school activities. So, these activities were attracted many students to join.

Table 6.2 After-school activities

Activity	University			High School		
	Female	Male	Total	Female	Male	Total
Boy scouts	23	18	41	18	27	45
Adventure clubs	6	23	29	0	11	11
Red Cross	15	10	25	14	19	34
Other	11	8	19	4	23	27
Charity clubs	4	7	11	7	12	19
No answer	0	0	0	2	13	15
Total	59	66	125	45	105	151

Game Playing Behavior

Regarding to the participants' game playing behavior, the data about the platform game favored by the participants were collected. Table 6.3 shows the result of the participants' responses sorted by the rating of the participants from the UN group. Mobile game was placed in the first ranking of the popular game among the participants of the UN group (n = 37), and it was followed by console game (n = 30). In contrast, the participants' responses from the HS groups placed mobile game (n = 51) in second ranking, whereas console game (n = 59) was placed as the first ranking of the game platform. On one hand, it was not surprised that mobile game was widespread among the participants because the result was in agreement with Forbes report that in Indonesia, the shipment of smart phone was skyrocketed to 55% in 2014 (Cunningham 2014). This trend predicted to continue in the subsequent years. On the other hand, console game was also famous in Indonesia, especially for HS students, because the console devices and games were so popular in both cities for long time. There are many shops for renting such devices and game sources with reasonable prices that all participants could access them easily.

In the consecutive sequences, third to fifth rankings of the game platform favored by both groups were Online (UN = 29, HS = 22), Facebook (UN = 18, HS = 16) and Desktop (UN = 11, HS = 3). However, even though statistical data of Facebook's user laid Indonesia in the fourth biggest of Facebook's user in the world, it was not put the position of Facebook's game as the famous platform among the participants.

Table 6.3 Game platforms

Game Platform	University			High School		
	Female	Male	Total	Female	Male	Total
Mobile	24	13	37	30	21	51
Console	9	21	30	2	57	59
Online	13	16	29	6	16	22
Facebook	11	7	18	4	12	16
Desktop	3	8	11	3	0	3
Total	60	65	125	45	106	151

Table 6.4 shows the participants' responses to the question about hours they spent in playing games per week. Approximately half of the participants from UN group were played games between 2-5 hours per week (n = 56). It was followed by the participants who played the games between 6-10 hours (n = 29) and less than 2 hours (n = 20) per week. In the same ranking, more than half of the HS participants (n =98) were played games about 2-5 hours per week. It followed by the participants who playing games less than 2 hours (n = 32) and 6-10 hours (n = 15) per week.

However, there was a little number of the participants from the UN group reported that they were playing games between and 16 and 25 hours per week (n = 5), and the participants from the HS group who were playing games more than 25 hours a week (n = 3). It was a bit peculiar for the HS students to spend more than 25 hours per week for playing games, because the schedules of HS learning activities were very tight. HS students in Indonesia should appear in learning class from 7 a.m. to 3 p.m. and from Monday to Saturday.

Table 6.4 Hours spent for playing game

Hours	University			High School		
	Female	Male	Total	Female	Male	Total
Less than 2	11	9	20	15	17	32
2-5	36	20	56	27	71	98
6-10	9	20	29	3	12	15
11-15	1	14	15	0	3	3
16-25	2	3	5	0	0	0
More than 25	0	0	0	0	3	3
Total	59	66	125	45	106	151

The participants were asked to rate their opinion about what are the reasons for playing games. As shown in Table 6.5, rating from the participants of the UN group gave the significant differences compared to the HS groups for relaxation ($Z = -2.9146$, $p = 0.0036$), learning ($Z = -2.2626$, $p = 0.0237$), leisure ($Z = -3.1353$, $p = 0.0017$), competition ($Z = -2.7951$, $p = 0.0052$), and social ($Z =$ -

1.9664, p = 0.0492). Thus, the participants from the UN group more enjoyed when playing games and more engaged to use it for leisure time than the HS group.

The results also gave an important expectation that the participants from the UN group could acquire learning content while playing game. Playing games also facilitated them to interact each other and for competition. In addition, if the result of a game platform question, it can be argued that Facebook and online games were contributed to the participants' rating for the reason of playing game. Usually, game play of those game platforms accentuates social interaction among players. Conversely, there were no significant differences of rating between UN and HS groups for the reason of fantasy (Z = -1.1693, p = 0.2423). Hence, it can be assumed that both groups of participant have same intension to use games for fulfilling their fantasy.

Table 6.5 Reason of playing game

Reason	University		High school		Mann-Whitney U test	
	M	SD	M	SD	Z	p
Relaxation	8.10	2.38	6.93	3.30	-2.9146	0.0036**
Learning	7.57	1.38	6.60	2.47	-2.2626	0.0237*
Leisure	7.54	2.63	7.02	1.96	-3.1353	0.0017**
Fantasy	7.36	2.71	7.44	1.80	-1.1693	0.2423
Competition	7.11	2.99	6.54	2.18	-2.7951	0.0052**
Social	6.72	2.64	7.67	5.50	-1.9664	0.0492*

*$p < 0.05$, **$p < 0.01$

Table 6.6 Genre of games

Game genre	University		High school		Mann-Whitney U test	
	M	SD	M	SD	Z	p
Adventure	8.02	1.85	7.29	2.81	-1.218	0.2225
Role-playing	7.43	2.67	6.73	2.87	-2.0869	0.0369*
Simulation	7.41	2.67	6.75	2.85	-1.9899	0.0466*
Racing	7.11	2.65	7.48	2.63	-0.8264	0.4086
Strategy	7.06	2.67	6.64	2.87	-1.0772	0.2814
Sports	6.97	2.71	8.08	2.18	-3.1118	0.0019*
Fighting	6.18	3.08	6.48	2.43	-0.4545	0.6495

*$p < 0.05$

With regards to the favored game genre, the participants were asked to rate the preferred genres mostly played. Table 6.6 shows the ranking of the favorite genre sorted by the rating of the participants from the UN group. The participants of the UN group preferred to play a game (top five) as follows: adventure (M = 8.02, SD

= 1.85), role-playing (M = 7.43, SD = 2.67), simulation (M = 7.41, SD = 2.67), racing (M = 7.11, SD = 2.65), and sports (M = 6.97, SD = 2.71). In contrast, top five rankings of the HS group rating were sports (M = 8.08, SD = 2.18), adventure (M = 7.57, SD = 2.77), racing (M = 7.48, SD = 2.63), role-playing (M = 6.73, SD = 2.87), and strategy (M = 6.64, SD = 2.87).

Mann-Whitney U statistical test was applied to analyze the differences between two groups of the participants based on the UN group ranking. The results show that there was an important disparity of the participants' preferences for genres of role-playing (Z = -2.0869, p = 0.0369), simulation (Z = -1.9899, p = 0.0446), and sports (Z = 3.1118, p = 0.0019), whereas there were no differences between the UN and the HS groups for the remaining genres. Those dissimilarities give us a concern that the participants from the UN group have a higher intention to play a game with role-playing and simulation genres that were adopted by MAGNITUDE game.

Furthermore, the participants were asked to response the question regarding to the type of game, whether playing single-player or multi-players. As shown in Table 6.7, the majority of the participants from the UN group enjoyed playing single player games (n = 98), and the remaining were selected multi-player games (n = 27). In the same position, approximately half of the participants from the HS group favored the single-player games (n = 80), and the remaining was selected the multi-players games (n = 71). Despite Internet access in Indonesia was rapidly increased in current decade, it can be assumed that it was not led to the growth of the multi-players games. Perhaps, this fact was related to the acceleration of mobile device owners. Hence, most people owned such devices tend to play a game on their gadget with many benefits that can play any game at anytime and anywhere even though when Internet access is limited.

Table 6.7 Game categories

Game Type	University			High School		
	Female	Male	Total	Female	Male	Total
Single Player	51	47	98	12	68	80
Multi Player	8	19	27	33	38	71
Total	59	66	125	45	106	151

Viewpoint of Computer Game for Training

This sub-section presents the results of the research question about the students' viewpoint to the use of computer game for training disaster responders. First question was to collect the participants' opinion, "Can computer games be used for training?" Table 6.8 shows the analysis of participants' response.

Table 6.8 Rating to the game for training

Opinion	University			High school		
	Female	Male	Total	Female	Male	Total
Believe	51	57	108	38	80	118
Unbelief	9	8	17	7	26	33
Total	60	65	125	45	106	151

The results show that most of the participants from the UN group (n = 108), and the HS groups (n = 118) believed that games could be used for training context. The simple open-ended response were also collected the participants' thought. Mostly, they supposed that the user would get some benefits if they could train their skills through this approach. The following statements are selected the participants' comments to the general perception about game for training or learning.

"I love to play strategy games, because I can learn how to defeat the enemies, and how to collaborate with my team to defend our kingdom. Such game can be used to train a player to have patience, speed response, skill, and strategy that necessary to struggle in life," (Male, UN group).

"The experience obtained after playing such game made me confident of beat any problem appeared in daily life. I felt, playing games was trained me to have a six-senses, so I can be aware and anticipate future situation," (Male, HS group).

"I believe that games can satisfy for training specific skill. The game can be used for sharpening our brain, and drilling our critical thinking," (Male, UN group).

"It is really fun and it trained us to cooperate with others, how to work together, and how to fix a problem with thinking," (Female, UN group).

"Game stimulates the brain and forces it to work but in a fun way, and it gives more imagination and a new view on something," (Female, UN group).

In contrast, the remaining participants from the UN group (n = 17) and the HS group (n = 33) did not believed that games could be used for training. They argued that games were used just for fun. The following statements are the selected opinions from both groups of the participants. Generally, the comments were reflected that a game was unsuitable to deliver knowledge and skill.

"Playing games is wasting time, only for people who did not have a passion to be a productive person, " (Female, HS group).

"I spent some hours in playing sports games. I did not think that the game can be used for training, because the game are suitable only for fun, for filling my free time, and also for competition," (Male, UN group).

After collecting data about the participants' opinions on using games for training, they were asked to give their thought about skills and features that could be gained from using computer games for training. Based on the mean of the responses from the UN group, the participants' responses were sorted as shown in Table 6.9. The results reveal that there were disparities between the UN and the HS group for the responses of reflection ($Z = -2.9148$, $p = 0.0036$), critical thinking ($Z = -2.1210$, $p = 0.0339$), motivation ($Z = -2.1005$, $p = 0.0357$), and cooperation ($Z = -2.0172$, $p = 0.0437$). In addition, the tendency of rating from both groups was not significant difference for analyzing, problem solving, and classifying. Hence, these results were correlated to the primary research design that MAGNITUDE—as a training game for disaster first responders—should have features to accommodate those skills.

Table 6.9 Skill could be obtained from game for training

Feature	University		High school		Mann-Whitney U test	
	M	SD	M	SD	Z	p
Reflection	8.06	2.03	7.33	2.17	-2.9148	0.0036*
Analyzing	7.50	1.55	6.89	2.30	-1.5135	0.1302
Critical Thinking	7.45	1.97	6.86	2.20	-2.1210	0.0339*
Problem Solving	7.34	1.86	6.52	2.99	-1.3976	0.1622
Motivating	7.25	1.68	6.77	1.96	-2.1005	0.0357*
Cooperation	7.22	1.83	6.74	2.04	-2.0172	0.0437*
Classifying	6.94	1.93	6.65	2.27	-0.7636	0.4451

*$p < 0.05$

Table 6.10 Attitude of playing games in training

Motivation	University		High school		Mann-Whitney U test	
	M	SD	M	SD	Z	p
Challenge	3.17	0.57	3.09	0.59	-0.8754	0.1894
Inviting Competition	3.16	0.64	2.93	0.59	-2.8588	0.0021*
Gives me a sense of recognition	3.12	0.71	3.23	0.53	0.7682	0.2207
Stimulates my interest	3.11	0.67	3.01	0.64	-1.2408	0.1075
Fills my leisure time	3.10	0.72	3.18	0.54	0.3028	0.3821
Enjoy my life	3.10	0.65	3.01	0.71	-1.0184	0.1539

*$p < 0.05$

In the last question, the participants were asked to rate the fourth-scale Likert statements with regards to attitude of playing games in training context. As shown in Table 6.10, the results show a tendency that there were no significant differences in all of the participants' rating except for the statement "inviting competition" ($Z = -2.8588$, $p = 0.0021$). It can be supposed that the participants had similar argument that while training by playing games, they expected to get challenge, a sense of recognition, and a trigger of their interest about the subject matter. They also expected that playing game could fill their time to enjoy the life.

6.7 Summary

Computer games are somewhat fun and amuse that dispense some benefits of cognitive, motivational, social, and emotional (Granic et al. 2014). In addition, video games were so popular especially among teenager, and it provides the flawless medium to deliver educational content. As a result, there have been trends to maximize computer games with serious and complex development for serious purposes combined with fun elements.

The aim of this survey discussed in this chapter is to examine the students' viewpoint with regard to the use of computer games for training purposes. To achieve this aim, the survey was measured the participants' playing behaviors, perceptions and thoughts in terms of training context. In summary, the survey result provided some fundamental findings with regard to the approach to empower mobile SG for training of inexperienced disaster responders.

Chapter 7
Effectiveness of Training Inexperienced Disaster Responders using Serious Games

7.1 Introduction

SGs contribute to the transformation of computer for education, provide comprehensive tool of pedagogical purposes that deliver important features of active, experiential and problem-based learning. On the other hand, current researches showed that experiential learning typically get extensive concern from academic, and professional. SGs can boost the learners' knowledge through triggering the motivation and engagement that can engross the knowledge and skill by playing (Boyle et al. 2012) (Hainey et al. 2013; Prensky 2001).

However, to proof that a SG will improve learners' knowledge in the educational setting, the evaluation is necessary step and it is taking into account the main role of SG development. This chapter presents the aim and result of MAGNITUDE evaluation. It was distinguished into two phases: first phase was the to evaluate the first prototype of MAGNITUDE that involved a number of HS students who actively joined in the related humanitarian organization. Second phase was measured the effectiveness of training decision-making using MAGNITUDE. It was a comparison of training outcome of decision-making using MAGNITUDE games and the results of training in the classroom.

7.2 MAGNITUDE gameplay

The quest example takes place after an earthquake strikes a city. However, based on the survey results that CE and PE were significant factors in distinguishing the Ex and Ix participants, the game events generated with regard to these components. For the purpose of this evaluation, five tasks were deployed, which should be solved by the learners in a limited time. The learners will be asked to play the role of a member of the disaster first responder team. Figure 7.1 depicts the narrative flow of the earthquake disaster in the prototype of the MAGNITUDE game quest. Learners are tasked with the objective to rescue the victims spontaneously. At the beginning, they should discuss the objective of the disaster response with the disaster commander. By mean of the discussion as shown in Figure 7.3—which is one of the important features in the game—they will be asked to distinguish the type and impact of the disaster. The commander will give a Teammate Point if they successfully answer the questions. Afterwards, they should be able to list the equipment used in an action. As a member of the

first-responder team, it is essential for them to be able to choose the appropriate response aids. Hence, they are convinced that their activities in first response will be done efficiently. Moreover, it is necessary to pay attention to the safety-first rule. After completing the discussion with the commander, the game mechanics continue to choose a selective dilemma of a disaster environment. Figure 7.2 shows the task cycle of the earthquake quest.

There are many collapsed buildings in the location. A little boy with a broken leg is trapped in his home. Learners should find complete information about his status and the building condition. They may gather reports from news highlights in the game user interface. The news highlights will inform learners about statistical reports of the disaster situation, weather prediction, and some information from witnesses and community as shown in figure 7.4. In this example, learners should evacuate the injured boy as soon as possible because he is losing a lot of blood. A pile is squashing his leg and learners need equipment to move the pile. They should take action to move it using standard equipment, but it is taking a lot of time and is dangerous. If the building collapsed suddenly, it would cause not only a loss in the opportunity to rescue the boy, but also cause problems for learners' safety. They can wait until other teammates arrive with suitable equipment, but this may result in the loss of the boy's life. Also, there is his mother who is emotionally involved. In regard to this situation, learners should discuss the circumstance with the paramedics. The paramedics claim that the boy is bleeding too much. If they do the evacuation slowly the boy will die because he needs urgent hospital treatment.

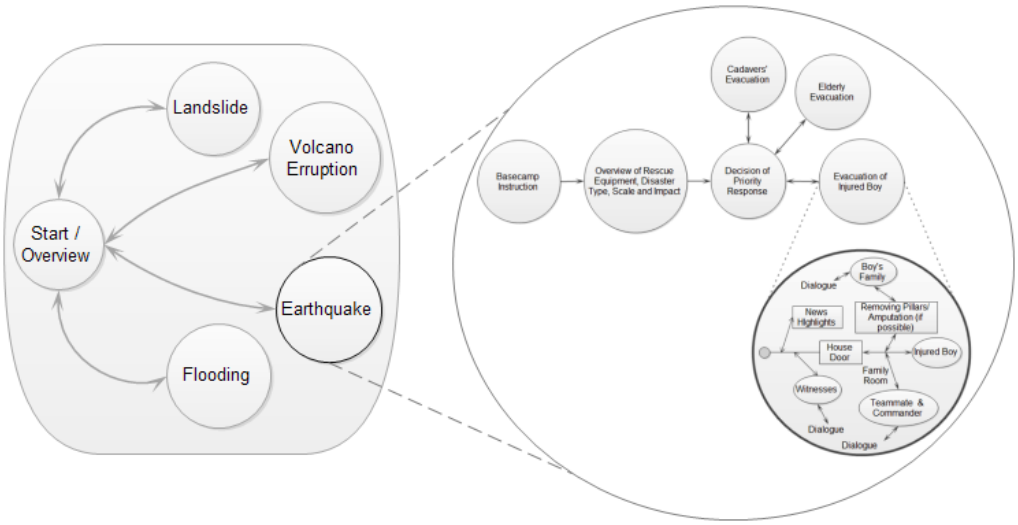

Figure 7.1 Task map of earthquake quest

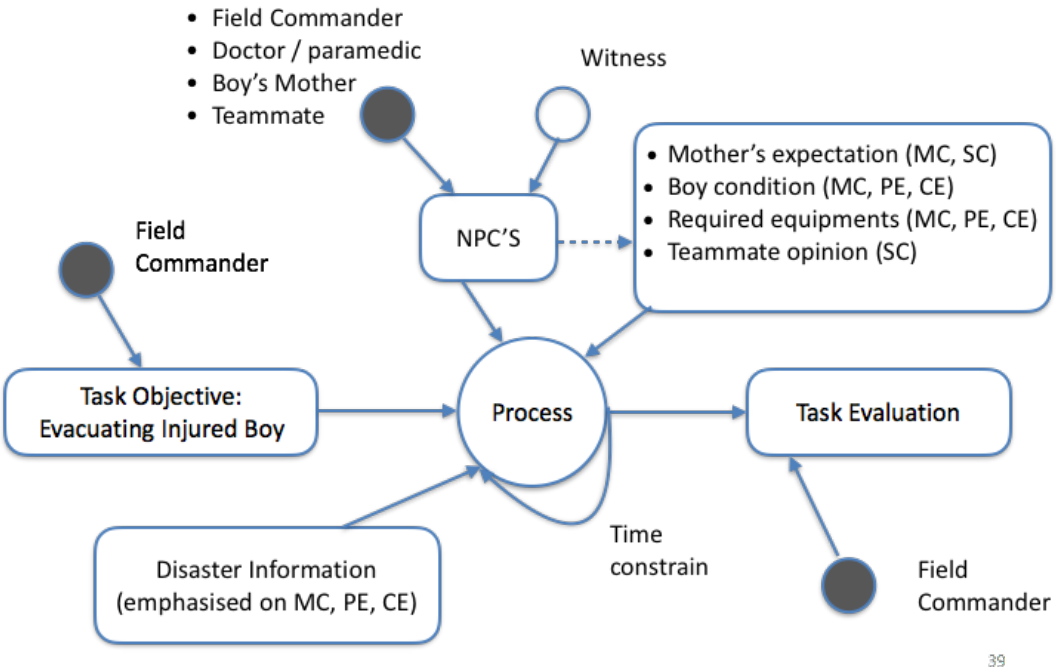

Figure 7.2 Task cycle on the earthquake quest

Figure 7.3 Meeting with the base commander

Learners can consider discussing the situation with other teammates to get the best suggestion, for example a discussion with the field commander as shown in Figure 6.5. The decision will affect the social points of the main character. For instance, if the decision satisfies the mother's expectation, the social points of the

main character will increase. Conversely, if the decision is considered to interfere with the evacuation process—the boy dies—it will reduce teammate satisfaction and learners will get a failure point.

Figure 7.4 Getting an information from the community

Figure 7.5 Discussion with the field commander

To consider the solution for this situation, learners need to gather a lot of information from the environment. There are plenty of information resources and some of them are informative. The informative resources might guide learners to make a comprehensive decision. However, the other resources may give learners hoax or junk information. By contrasting information from a reliable source and others, learners will be forced to build widespread analytical thinking. The information would allow learners to consider making a suitable decision regarding the further effect of their actions. It is emphasized to the magnitude consequence, probability and concentration of effect (MC, PE and CE components). In summary, with regard to the ethical model in section 5.1, MAGNITUDE proposes to give comprehensive consideration to learners before selecting an option.

7.3 Method

7.3.1 Participants

The participants for this study were selected from a public university in Bandung, Indonesia. 66 participants came from the different fields of studies, i.e. engineering (computer science, electrical, telecommunication), educational technology, and library. They have joined in the related humanitarian organizations such as scout, Red Cross, and adventure club. Based on the purpose of the study to evaluate the effectiveness of MAGNITUDE game, they were divided into two groups; the first group was coded as experimental group (EX), and the second group was coded as control group (CO). The EX group (n = 33) trained decision making skill using MAGNITUDE game, whereas the CO group (n = 33) instructed by simulation of disaster situation in the classroom.

7.3.2 Material

The evaluation of MAGNITUDE completed by comparing the outcome of training sessions using MAGNITUDE and the conventional way. The EX group of participants were asked to play MAGNITUDE game on the iPad. On the other hand, CO group used a training material for disaster risk management. The scenario from this material was adjusted to match to the MAGNITUDE game flow. Hence, the simulation procedure in this module was decreased and omitted some unnecessary content.

As discussed in the chapter 4, MAGNITUDE game designed to be equipped with learning analytics tool. On the second evaluation, a simple script was implemented to get the game log of learners' performance. It was collected by event-driven game rules that running in the background. As the design, MAGNITUDE emphasized the dialog between learners and NPCs to present the

ethical dilemmas. Thus, the participants were strongly requested to take into account the conversation appeared on the game events, for instance, in an occasion which learners should discuss a rescue plan with the teammate NPCs. To measure learners' performance, their engagement into the game dialog was analyzed by calculating the average time to complete the conversation and relation to the post-test score. For this aim, a certain value of spent time for conversation as the calculation reference was defined. There is also an assumption, if the learner spent a dialog time higher than reference's value, the learner might be have a sufficient concern to the dialog and vice versa. Thus, he or she would get high score in the post-test.

7.3.3 Instruments

For collecting data, a set of questionnaires was compiled that divided into three parts with the specific purpose. The followings are explanation of each questionnaire part.

- Biographic data, these questions were to gather data of the participants such as, (1) age and gender, (2) years of experienced in related humanitarian organizations, (3) how many hours per week spent for playing game. To represent their attitude's information, the close-ended questions were assembled by offering five options, i.e. less than two hours, 2-5 hours, 6-10 hours, 11-15 hours, 16-25 hours, and more than 25 hours. (4) Participants enjoyment of playing game scored by ten-scale grading. The purpose of congregating such data was to confirm that all of the participants have similar backgrounds in the humanitarian volunteering and computer game literacy.

- The pre-test questionnaire was given to both groups of the participant before they did the training, and post-test was given to the participants to measure their ethical awareness after training. The post-test questionnaire has similar form with the pre-test questionnaire, except by modifying the condition of the disaster scenario. The evaluations of validity and difficulty level of both pre-test and post-test questionnaires were done by discussion with experts during experiment preparation. The participants could select the answer for each question as follows. (a) "Would act" if the participants confident and agree to take the action. (b) "Would not act", if participants considered to avoid the action. (c) "Do not know" if participants confused whether taking or refused the action. Each pre-test and post-test instrument consisted of twenty questions. However, individual question was scored by three of measurement grades. The participants were obtained the score as follows: two-points for "would act", one-point for "would not act", and zero-point for "do not know".

- In order to study the participants' appeal of engagement of training method, a questionnaire set was constructed for obtaining the participants opinion to the

narrative and scenario of, and the goal structure of related training. However, to collect information that was not included in the definitive questions, the participants' opinions were collected through a set of open-ended questions.

- Specific for the EX group, a set of questionnaire was also constructed to measure participants opinion after using MAGNITUDE. They were used to collect the information about: (1) game quality including the audio and graphic, the dialog system, control and navigation and scoring/reward system, (2) Attracted features and aspects of MAGNITUDE game, and (3) General opinion about further MAGNITUDE development.

7.3.4 Procedure

The test and training of two groups were conducted at the different time slot. For the EX group, due to the limitation of gaming devices the schedule of the evaluation was adjusted that matched to the schedule of their courses. About four participants involved in the test session every day. Hence, the survey spent eight consecutive days to complete all tests. Figure 7.6 shows the environment of MAGNITUDE evaluation.

At the beginning, the participants were asked to fill the consent agreement for ethical concern. After the participants agreed with the consent agreement, they started to fill the biographic questionnaire and then continue to response the pre-test questionnaire. After filling it, they played the MAGNITUDE game designed to complete in 30 minutes. They continued to answer the post-test of ethical awareness and the questionnaire of opinion about training using MAGNITUDE game.

Figure 7.6 A participant who involved in second MAGNITUDE evaluation

For the CO group, the participants were congregated in a classroom to get the short session of decision-making training in disaster situation. The training subjects were delivered by simulation of disaster situation. About 33 participants involved in the session and they were divided into six groups. Every participant has different role based on the training module. The session was set approximately 30-minutes to match the duration of training using game. After simulation session, the participants were asked to response the post-test of ethical awareness and the questionnaire of training method.

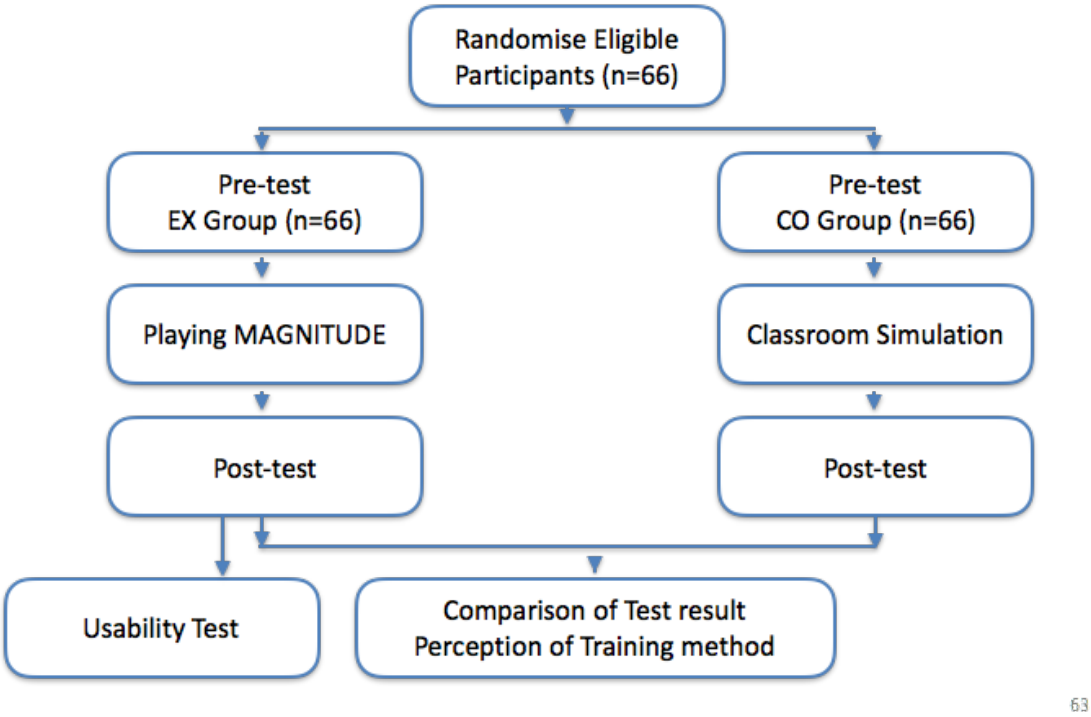

Figure 7.7 Flow of evaluation procedure

For both groups of participants, after answering the post-test and questionnaire of training method, collecting data was continued by a face-by-face discussion. The purpose of the discussion was to confirm their response to the open-ended questions and to debrief their participations. It was important to have debriefing to return the psychological condition of participants to the initial order and also to reflect their experience after playing the game (Crookall 2015) (Fanning & Gaba 2007). In the end of the experiment, each participant of both groups received a contribution salary for the effort of spending their time for the participation. However, to avoid the experiment's biases this appreciation was not informed before. In summary, for both methods of training, there was information that each participant spent 80-90 minutes to complete the test series. The structure of both evaluation steps can be seen in Figure 7.7.

7.3.5 Results

Comparison of Biographic Data

As explained in the section of research method, the participants divided into two groups. For demographic data, the evidence presents that the gender statistics of the EX group were 8 females (24%) and 25 males (76%). As shown in Table 7.2, the ranges of participants' age were between 18 to 21 years old with mean 19.3 years, and standard deviation 0.86. The demographic data also shows that gender statistics of the CO group were 11 females (33%) and 22 males (67%). The ranges of the participants' age were between 18 to 21 years old with mean 19.48 and standard deviation 0.83. The participants were responded to the question of experience joining in related disaster organizations, such as, Red Cross, Boy Scout and adventure club. Table 7.3 shows the years of participants' experience. The mean of the participants' experience from the EX group was 3.25 years (SD 0.97) and 3.23 years (SD 0.73) for the CO group. The t-test of experience difference gave the results that there is no significance difference of participants' experience joining related humanitarian organization ($t = 0.0512$, $p = 0.6038$).

Table 7.2 Age and gender statistics

Gender	EX		CO	
	Mean	SD	Mean	SD
Female	19.63	0.48	19.73	0.96
Male	19.28	1.00	19.36	0.77
Total	19.36	0.92	19.48	0.83

Table 7.3 Experience in related humanitarian organization

Gender	EX		CO	
	Mean	SD	Mean	SD
Female	3.48	1.02	3.45	0.99
Male	3.25	0.97	3.23	0.73
Total	3.42	1.03	3.30	0.84

With regard to the intention of playing game, as shown in the Table 7.4, the Mann U Whitney-test results show that there was no difference between both groups of participants on the aspect of learning ($Z = -0.9719$, $p = 0.3311$), competition ($Z = 0.5509$, $p = 0.5817$), social ($Z = -0.6730$, $p = 0.5009$), and fantasy ($Z = -1.0281$, $p = 0.3039$). It can be assumed that both groups of participant tend to use the game for learning as alternatives of just for competition, social interaction, and filling their fantasy. However, for both aspects of leisure and relaxation, there was a significant difference of both groups of the participants. In summary, from three aspects of the participants' biographic data, there is a conclusion that both groups of the participants had similar background. Hence, the evaluation of MAGNITUDE effectiveness gave meaningful results of evaluation.

Table 7.4 Intention for playing game

Intention of Playing Game	EX		CO		Mann U Whitney Test	
	Mean	SD	Mean	SD	Z	p
Leisure	7.82	1.06	7.03	1.90	-2.0059	0.0449*
Learning	7.82	1.22	7.39	1.77	-0.9719	0.3311
Relaxation	7.67	1.39	7.06	0.89	-2.0943	0.0362*
Competition	7.58	1.33	7.73	2.03	-0.5509	0.5817
Social	7.36	3.73	7.64	2.68	-0.6730	0.5009
Fantasy	7.33	1.25	7.67	1.99	-1.0281	0.3039

Note: *p < 0.05

Comparison of Decision Making Skill

From the statistical analysis of the result of both pre-test and post-test, the mean of pre-test for the EX group was of 12.18 out of 20 (SD = 1.53) and on the post-test was 15.48 out of 20 (SD = 1.37). Then the paired t-test was given the conclusion that the scores of post-test for the EX group were significantly higher than its score of pre-test (t = -10.9875, p = 0.0001). However, the mean of pre-test for CO group was 12.27 out of 20 (SD = 1.60) and on the post-test was 14.46 out of 20 (SD 1.61). The paired t-test for both scores gave the conclusion the post-test scores for the CO group was considerably higher than the pre-test score (t = -8.3001, p = 0.0001). Thus, It can be assumed that both of training method encouraged the participants to improve ethical awareness during the training session.

Subsequently, the effectiveness of MAGNITUDE was analyzed by comparing the post-test result of training using game to the post-test result of simulation in the classroom. As shown in the Table 7.5, the result of independent t-test (t = 2.2674, p =0 .0268) for the participants' score on the post-test shows that training of ethical decision making using MAGNITUDE game was significantly different. It can be concluded that training of ethical decision-making skill using serious game considerably more effective to improve the awareness of participant on ethical problems in disaster situation than the simulation in the classroom. In summary, to have a general conclusion from whole test of MAGNITUDE effectiveness, it can be added by the explanation of qualitative analysis presented in the following sections.

Table 7.5 Score of decision-making skill

Decision Making test	EX		CO		Independent t-test	
	Mean	SD	Mean	SD	t-score	p value
Pre-test	12.18	1.53	12.27	1.60	0.2325	0.8169
Post-test	15.48	1.37	14.64	1.61	2.2674	0.0268

After Training Questionnaire

After participants responded the post-test, they were asked to give their opinion about the used training methods. As shown in Table 7.6—except for statement 3: "I believe that training in disaster scenario using this method was appropriate" (Z = -0.7444, p = 0.4566)—there were significant differences in participants' responses between the EX and CO groups. The participants from the EX group gave a strong argument that the used method were boosted participants' interest (Z = -3.5550, SD 0.0004), they also expected to use this method for longer time of training session (Z = -2.0581, SD = 0.0396) and it might be used for further training schedule (Z = -2.9143, SD = 0.0036). The last rating was that the participants from the EX group believed that training using game more proper to improve their skill of how to make decision ethically (Z = -2.7511, SD = 0.0059).

Table 7.6 Opinion to the used method of training

Participants concern to the used training method	EX		CO		Mann U Whitney Test	
	Mean	SD	Mean	SD	Z	P
• I want to have further training using this method	8.62	1.06	7.86	0.94	-2.9143	0.0036**
• This training method is very interesting	8.55	1.16	7.41	0.89	-3.5550	0.0004**
• I believe that training in disaster scenario using this method is appropriate	8.38	1.40	8.10	1.42	-0.7444	0.4566
• This training method is proper for improving the ability of ethical decision making	8.34	0.92	7.72	0.74	-2.7511	0.0059**
• I want to train my skill using this method for longer time in a session	7.55	2.01	6.76	1.50	-2.0581	0.0396*

Note: *p < 0.05, **p<0.01

On the specific aspects of the EX group, most of the participants explored that the quality of graphics (M = 8.15, SD = 1.02), navigation and control (M = 7.85, SD = 1.67), game interface (M = 7.52, SD = 1.21), and audio (M = 7.29, SD = 1.19) were satisfied their expectation. Further exploration of such aspects can be found in the section of oral and written command during observation and debriefing.

The next questions asked the participants to rate some aspects of the training methods. Due to difference training media, some statements were only focused to the EX group. Table 7.7 shows the complete participants' responses. The statistic results show that there was no difference of participants' responses to the aspects of help and direction (Z = -1.0106, SD = 0.3122), realism of game environment (Z = -2.1808, SD = 0.8930), goal of training (Z = -0.1345, SD = 0.8930), and collaboration (Z = -0.3170, SD = 0.7513). However, for the narrative aspect (Z = -2.7757, SD = 0.0055), there was a significant difference between the EX and CO groups. It can be presumed that the participants from the EX group had a stronger opinion that the narrative flow of serious game more interesting than the narrative in the simulation method.

Table 7.7 Opinion to the factor of used training method

	EX		CO		Mann U Whitney Test	
	Mean	SD	Mean	SD	Z	p
Help and direction of training	6.91	1.82	6.55	1.62	-1.0106	0.3122
Realism of training environment	7.27	2.15	6.79	1.07	-2.1808	0.8930
Training goal	7.09	1.31	7.00	1.23	-0.1345	0.8930
Training Narrative	8.21	1.22	7.30	1.19	-2.7757	0.0055**

Note: *p < 0.05, **p<0.01

Questionnaire of Game Usability

The following data were specific information from the EX group. The participants were asked to give their opinion for some game aspects as shown in Table 7.8. The results show that 16 participants agreed that they felt a confused situation when playing MAGNITUDE (M = 2.85, SD = 0.93). Some of participants gave the reason during observation and debriefing that one factor of confusion was lack of game help, so they played MAGNITUDE by trial and error. All of participants' comments can be found in the next section. However, when the participant asked about the relevancy of game tasks and learning topic, most of the participants agreed that the game was relevant (M = 3.00, SD 0.70) for training subject. A number of the participants agreed that playing MAGNITUDE could increase their ethical awareness (M = 2.58, SD = 0.89). Regarding to the game accuracy, about 48% participants disagreed that MAGNITUDE has a complex game narrative (M = 2.21, SD = 0.64). Most of the participants also felt that the realism of the game is a bit far from the better game quality; hence they suggested that the game realism should be improved (3 = 3.00, SD = 0.92).

Table 7.8 Opinion to the MAGNITUDE usability

Statements	Frequency				Mean	SD
	Sa	A	D	Sd		
• I felt confused when playing MAGNITUDE	8	16	5	4	2.85	0.93
• MAGNITUDE game was relevant to the learning topics	6	22	2	2	3.00	0.70
• I felt my awareness to the ethical situation has been increased after playing MAGNITUDE game	5	13	10	4	2.58	0.89
• I believe that the MAGNITUDE game narrative have a very good complexity.	0	10	17	4	2.21	0.64
• In my opinion, the realism of game environment should be improved.	11	14	5	3	3.00	0.92
• I believe the game has good accuracy to reflect learning objectives.	16	12	2	3	3.24	0.92
• I believe that MAGNITUDE was effective to encourage me to take a decision.	5	20	2	5	2.79	0.88
• I believe that the future development of MAGNITUDE will improve my expectation in ethical decision-making skill.	6	17	2	6	2.64	1.07
• I believe that MAGNITUDE game can be used for training disaster responders.	1	18	8	4	2.48	0.74

The participants were also asked to give their opinion that MAGNITUDE would be effective to encourage them to make a good decision. The result shows that 39% of participants (M = 2.79, SD = 0.88) agreed that MAGNITUDE satisfied this expectation. A number of participants believed that the game has good accuracy to reflect learning objectives (M = 3.24, SD = 0.92). The participants also strongly agreed that if the game quality can be upgraded in the future development, it would be also improved their ethical decision making as expected (M = 2.64, SD = 1.07). In next statements, participants were asked to give their opinion regarding to MAGNITUDE purpose of training skill of making a decision. About 18 participants (M = 2.48, SD = 0.74) agreed that MAGNITUDE could be used for training disaster responders.

Written and oral comments from observation and debriefing

For gathering the information, which did not cover in the close-ended questionnaires, both groups of participants were also asked to give their opinion, about MAGNITUDE game for the EX group and about training in the classroom for the CO group. For the control group, their thoughts were collected by written questionnaire. The majority of the participants argued that disaster training by simulation more interesting that reading a textbook or classical lecture.

For the EX group, the participants' responses were collected personally during the playing session with oral questions and answer, and by written response after

debriefing. The followings are some selected comments that give the beneficial input for further MAGNITUDE development. In summary, the majority of the participants give a good appreciation. However, some of them argued that the MAGNITUDE a bit far from the ideal game.

(Q1) What is your general opinion after playing MAGNITUDE."

"This game is interesting. The unique approach to learn about disaster situation which I can play as a rescuer." (Female, 19 years).

"MAGNITUDE is potential for training of disaster response. After playing the game, I feel I can recognize some ethical issues that might be occurred in a post disaster. I can catch the important key point of the game approach in the disaster training, that is 'quick response without fault'." (Male, 20 years).

"By playing this game, I earned skill of accuracy. This game is educative and engrossed because of fun and enjoyable." (Male, 19 years).

"This game gives me an experience that we should ready to help everyone anyplace and anytime." (Female, 18 years).

"The narrative and communication within it were not present to the user interactively. The game flow was monotone. Playing goal and mission were too abstract and the appearance of necessary item objects was difficult to find and identify." (Male, 21 years).

"Graphic of the game is very good, but the game control somewhat strange." (Male, 20 years).

(Q2) What is your feeling after playing MAGNITUDE?"

"I feel happy, but confused how to complete. Because every action will determine the next steps, my adrenaline was spiked" (Female, 18 years).

"It is amazing. I faced a difficult situation that I should decide which option is the most relevant and priority" (Male, 19 years).

"I encountered a distraction because the game instruction is not clear enough" (Female, 19 years).

"The game quality is very good. It was invited me to be aware of disaster victims. But the game control is not so good, I confused how complete all tasks successfully". (Male, 19 years).

"It was passable fun, but a bit dizzy and achy if too long playing the game. But it could be used for increasing my knowledge about natural disaster rescue" (Female, 20 years).

(Q3) Please describe what you felt were the most interesting features of MAGNITUDE!

"We should take a decision by considering humanism" (Female, 19 years)

"The interesting feature is that MAGNITUDE provides cognitive aspect. As such, the game gave me new knowledge how to evacuate a disaster victim and how to take a decision in a critical condition" (Male, 20 years).

"The role-play aspect made me aware to make a decision in disaster response work" (Male, 19 years).

"Accuracy, patience and skill aspects when we should make a decision" (Male, 20 years)

(Q4) Did the game cover anything about disaster response that is important for humanitarian activist? If so please explain.

"Game narrative and learning objective are good, but the game realism is not so reflecting actual situation" (Male, 19 years)

"I am thinking that the game dialog visualized the emergency events. With this situation, a disaster responders can make the best decision in advanced to save the victims" (Female, 20 years).

(Q5) Did you learn some new things about humanitarian activities? If so, what are they?

"I joined the training of technical skill that important in the disaster response, but I never have experience how to make the decision ethically. So, after I played this game I achieved much information, especially how to consider ethical issues" (Female, 19 years).

"Playing this game gave a new perspective that training in humanitarian activities can be done using games. A game in my opinion is more effective for teaching a subject that is sometimes not so interesting in actual training. Because by playing this game, I enjoyed learning while playing" (Male, 20 years).

7.4 Learners' Performance Measurement

As discussed in the chapter 4, MAGNITUDE game designed to be equipped with learning analytics tool. In the second evaluation, a simple script was embedded to collect the game log of the learners' performance. It was done by event-driven game rules. As the design, MAGNITUDE emphasized the dialog between learners and NPCs to present the ethical dilemmas. Thus, participants were strongly requested to take into account the conversation appeared on the game events, for instance, in an occasion which learners should discuss a rescue plan with the teammate NPCs.

Table 7 .9 The dialog matrixes

Task	Conversation Name	Node count	Word count	Time Reference (Second)	
				Conversation	Task
1. Meeting with the basecamp commander	Introduction	14	400	124	124
2. Help elderly	Pre-task	7	93	36.32	46.64
	Post-task	3	18	10.32	
3. Assist the field commander	Pre-task	7	124	43.76	56.72
	Post-task	3	29	12.96	
4. Evacuation of injured boy	Pre-task	5	70	26.8	177.24
	Boy's mother	3	70	22.8	
	Doctor	3	35	14.4	
	Teammate	4	40	17.6	
	Field commander	3	22	11.28	
	Boy's mother 2	3	34	14.16	
	Doctor 2	3	20	10.8	
	Teammate 2	4	50	20	
	Field commander 2	3	21	11.04	
	Post-task	4	31	15.44	
5. Evacuation of died victim	Pre-task	3	35	14.4	111.36
	Teammate	3	52	18.48	
	Doctor	4	63	23.12	
	Nurse	4	78	26.72	
	Post-task	3	30	13.2	

To measure learners' performance, their engagement to the game dialog was analyzed by calculating the average time for completing all conversation. However, as a reference, the average time for reading non-academic article of American adults is between 250-300 words per minute (wpm)[4]. Hence, a certain

[4] http://medicine.utah.edu/learningresources/tools/reading.php

value of the spent time for conversation was defined as the calculation reference. As shown in Table 7.9, for example in task 1, learners should have a discussion with Commander which the words count for whole conversation text are 400 words distributed within 14 dialog nodes. If it refers to the average time for reading above, to have a comprehensive understanding of conversation in the first task, learners should spend their time approximately same with the time reference.

A simple linear regression was calculated to predict post-test score based on average time spent in completing all conversations. A significant regression equation was found ($F(1, 30) = 6.1035$, $p < 0.01$, with an R^2 of 0.1691. The result shows that the average time spent by learners to complete all conversations considerably significant to influent their score on the post-test. If the learners spent a total time higher than references' value, the learner might be having a sufficient concern to the dialog. Thus, they will get a high score in the post-test. Otherwise, if learners gave the least attention to the dialog, they will get a low score.

7.5 Summary

The second evaluation purpose was to count the outcome of training of disaster responders using serious games compare with the training by simulation. The evaluation of MAGNITUDE discovered that both groups of participants have progressively increased their skill after joining the evaluation program. However, from the comparison of the post-test score of EX and CO participants, the EX participants considerably tend to a bit leading than CO groups. Thus, it can be confidently claimed that training of disaster responders using MAGNITUDE was potentially more effective that the traditional training of disaster responders by simulation in the classroom.

Chapter 8
Conclusion and Further Works

8.1 Introduction

This chapter presents the conclusion and future works of the research. Section 7.2 will review the research findings as the evidence for answering the research questions that were discussed in chapter 1. The last section concludes this thesis with the discussion of further works especially the direction for the plan of MAGNITUDE design and development in the next version.

8.2 Conclusion

8.2.1 Issues in Disaster Response

Chapter 2 was discussed interviews and findings of a preliminary survey measuring ethical awareness of inexperienced disaster responders. Interview with the experts gathered a lot of useful information about disaster responders' requirements. The results of the survey indicated that there was a significant difference between experienced and inexperienced disaster responders when facing ethical dilemmas. The preliminary survey findings concluded that there is a huge opportunity to provide an alternative learning environment to improve the ability of inexperienced disaster responders for making ethical decisions. Therefore, a game-based learning to facilitate this goal has been developed. Using MAGNITUDE, learners—by means of a dialog system—would have comprehensive consideration of the impact of their action. As a virtual training environment, MAGNITUDE can give learners immediate feedback so they can repair their performances instantaneously. For example, if their actions do not meet the six components of moral intensity, they will get a negative response from the NPCs associated with the role of such NPCs, such as disaster team members, victims' families, and the community. In contrast, if the actions fulfill the moral intensity components they will collect positive rewards from the NPCs. Thus, learners will improve their awareness of ethical issues posed in the disaster response situation. Furthermore, they can select the best option for making ethical decisions in a real life disaster situation instinctively.

MAGNITUDE—which philosophically reflects the earthquake disaster scale—could improve learners' skills from novice to expert like the magnitude scale in an earthquake event. The game is expected to contribute to particular training methods for disaster responders—especially for community responders—as part of a preparedness program for disaster management.

8.2.2 Students' Viewpoint of Serious Game for Training

Chapter 3 presented a comparative survey between the HS and UN students for playing games. This contributes to the previous finding of the related surveys to examine students' game preferences, behavior and experiences and its influence of the use of game for educational setting.

Related to the after-school activities, the results of favored activities were in agreement with the factual condition. Boy scouts, Red Cross, and adventure clubs are after-school activities officially supported by most of the educational institutions, from primary education to higher-education levels. Especially for boy scouts, government supported annual competition that tiered from the district to national scope with regards to compete students' abilities in technical and non-technical skill. Collected data has been judged that the research approach to improve inexperienced disaster responders using game environment—by defining that the potential learners are students who have experience in such organizations—could be proven. Thus, the participants who select these after-school activities are prospective participants in MAGNITUDE implementation.

Regarding to the participants' reason for playing game, even though the reason of learning was placed in the second rank of the UN group, generally both groups of the participants agreed that games were motivated them for learning. This results support the expectation that the majority of the students of two educational levels in Indonesia—university and high school—had the same perception that games were potential to be used for serious purposes, i.e. for learning and training in a specific field of study. The results exhibit that the majority of the participants in the both groups believed that games could be used for training of disaster responders. It is supported by the results of the participants learning style, that biggest number participants were convergent learners. In Kolb's theory, the convergent learners can maximize their effort to grasp learning content by doing and thinking. Computer games are closely matched to these characteristics, because the game facilitates the learners to do anything related to the objective of learning. By doing specific action according to the game narrative, they can learn what is the effect of their action, and then they can analyze the possible solution with deeply thinking. The survey found that there were not differences of the participants' expectation that the games for training should have features of motivation, critical thinking and reflection. Games for training are expected to motivate the learners to engage in educational narrative. In addition, it is also necessary for the games to encourage the way of the learners thinking more critically. Some research show that there are difficulties to conduct a live practice for some training programs, for example, training of disaster responders. In addition, inexperienced learners cannot take maximum advantages from the live training due to feedback limitation where reflection from actual circumstances is

required (Caird-Daley & Harris 2008). Hence, the games for training are suitable to give feedback that the learners can reflect to the former action.

However, even though the percentage of the participants in both groups who gave positive agreement nearly same, the students at the UN level more prepared to get training of disaster responders using serious game. This thesis supported by the results of the question with regards to the popular genre of game favored by the majority of the participants. Rating for role-playing and simulation—the game genres adopted by MAGNITUDE—were placed the top three of favorite game. Both genres also give the significant differences between two groups. The results proof that the participants from the UN group could expose the actual condition that those genres—adopted by MAGNITUDE—will be suitable to the learners' preferences. The participants' interest to play such genres is the advantage for empowering the use of game for training. It is in agreement with (Prensky 2001) that RPG and Simulation would be potential to support the learning of decision-making skills. Furthermore, the expectation is also supported by the result of reason for playing game, which learning option was give a significant difference between UN and HS group. Hence, there is a conclusion that the participants from UN group more understand that game are the right way of training method.

The research finding gave the insight and empirical evidence that approach to use game for training is on the right path. Nevertheless, while I could obtain the key point of participants' viewpoint to the beneficial of game for learning, there are some limitations considering to the survey process and scope. However, first limitation is the sample size of the survey to collect the student viewpoint to the use serious game for training was considerably small. The study also has biased due to the influence of culture, demography, and way of thinking of the participants. So, the findings may have a different conclusion confronted to the similar survey in different participants background. To overcome this drawback, for further related survey, I suggest to construct the ethical questionnaires in general case that can cover a wider scope of participants not depend on such factors. In summary, the survey findings provided us the empirical evidence that UN students would more prepare to get benefits from games for training.

8.2.3 Effectiveness of Training Inexperienced Disaster Responders using Serious Game

The main difference between serious games that focus for education purposes and games for entertainment is the final outcome of serious game itself. In a regular or entertainment game, the success in game development could be measured by how popular the game among users are, and how much profit can be raised. In contrast, the success in educational games should be indicated by the magnitude of learners' learning outcome and the continuities of such game for future learning uses. According to Michael and Chen that "Serious games like every other tool of

education must be able to show that the necessary learning has occurred" (Michael & S. Chen n.d.), a serious game that feasible to be used for educational tool should stipulate an assessment framework of learners' achievement and progress tracking of their efforts. It was also reinforced by Corti that "[Serious games] will not grow as an industry unless the learning experience is definable, quantifiable and measurable," (Corti 2006).

Chapter 5 discussed the evaluation of MAGNITUDE that was carried out in two evaluations phases. According to Zagal, embedding ethical dilemmas in a game offers a chance to boost ethical thinking and reflection (Zagal 2009). In the case of the MAGNITUDE game, by analyzing the selected opinions of the participants, I can argue that embracing the six elements of moral intensity in the MAGNITUDE narrative could provide an ethical tension that motivates learners to be aware of ethical dilemmas in a disaster situation. However, most of the participants in the first phase of MAGNITUDE evaluation claimed that the game prototype is not very challenging. This might be occurred because of the uncompleted level of the game.

The first evaluation conducted on early stage of development attempted to measure what the participants' opinion to development process. I discovered that the important aspects of a game for training from the participants' viewpoint are enjoyable, easy to play and engaging. From the evaluation, I concerned to accommodate participants' inputs by redesigned the MAGNITUDE that emphasizes on the game narrative.

The second evaluation was conducted based on the survey findings of students' viewpoint to the use of serious games for training. The evaluation concerned that the UN students might have a huge potential to use serious games for training more effective than the HS students. Thus, a number of university students who actively involved in humanitarian organization were selected to engage in MAGNITUDE evaluation. The effectiveness of MAGNITUDE gauged by comparing the learning outcome of participants between EX and CO groups.

According to training method used, the oral comments also collected, especially for the reason why they taught such training approaches might be proper for training decision making. For participants who chose serious games as the best approach for training, I compiled good participants' comments that that games provide complete features necessary for exercise include immediate feedback. They believed that such feedback would encourage learners to have a sense of reflection. They also stated such feeling was very important for responders to deal with ethical issues might be appeared. However, a second ranking, participants' who selected role-play as an appropriate method for training gave arguments that role-play has characteristic to support learners to act as a responder with real-life experience. Some participants said that they could recognize the role-play rules

because it has been similar to the role-playing game genre. Other participants chose this method because he never uses serious games, and did not know what the serious game purpose is. However, simulation was in the fourth ranking, a number of participants argued that the conducted simulation of disaster situation is not so interesting due to lack of environment realism.

From the second evaluation, the result showed some participants confessed that they had difficulties in playing MAGNITUDE at the beginning. It appeared due to insufficient of experience playing this type of game. To solve similar issues in the future, the participants should have adequate time to switch from their traditional way of training to the new method of using such a training game. This can be achieved by providing an extra time to try MAGNITUDE serious game. By doing so, the learners who do not have experience playing this type of game could increase their experience using serious game. However, due to time limitation, such approach could not completely performed in second evaluation. As such, I will very concern to this finding as the foundation of game improvement and evaluation consideration in the future research works.

8.3 Contribution

This research ties to the various disciplines and techniques in three different areas include information science, education, and psychology. Thus, it has potential to give a valuable contribution in the fields. It might contribute the empirical evidence that ethical awareness is an important factor for solving most of issues appeared in the disaster, the evidence of learners intension to play game for educational context and proof that training within game approach can address some inadequacies of traditional training. The evaluation of MAGNITUDE effectiveness gave the important findings for future research phase that embedding ethical dilemmas in serious game play would encourage learners to maximize their sense of ethical consideration before taking a decision on disaster context. Another contribution is that the research result would give some benefits for establishing the research and community of serious games in Indonesia, because Even though there are many researchers in the domain of computer for education, but there is no community focused on the serious games studies.

With regard to the originality of research contribution, the state of art of SG for emergency was prompted to develop a SG for training such skill. MAGNITUDE research contributes to the field through the innovation of embedding six components of moral intensity into the gameplay. Another originality of serious game on the domain of learning analytics is also expected. By doing so, the author of MAGNITUDE game has the ability to track the learners' achievement on ethical knowledge and awareness, and also their engagement to the game play and goals.

8.4 Further works

The development of MAGNITUDE game was successfully proven in current stage. However, due to the some shortcomings of the development process, MAGNITUDE has been built with the limited game level that only focuses on the earthquake disaster. But, generally it was convinced that the game mechanics of MAGNITUDE have on the well form for reaching the main research aim. It was also satisfied to deliver an alternative of disaster training using serious game that should support the concept enjoyable while training with the appropriate feedback for improving learners' skill. To extend the existing accomplishment, it has been schedule to continue this work with further research direction as follows.

MAGNITUDE Design and Development

On the game design and development, MAGNITUDE will incorporate the location-based game concept by changing the visualization from 3D FPS style to 2D map-based game. By adopting this concept, MAGNITUDE will provide actual geographical data, which the game author or training manager has facility to define the location of predicted disaster base on the disaster mitigation data. For example, if an area has potential to get volcano eruption, training manager could compile the game data which game location can contain the specific actual area where the active volcano stay. However, to provide the flexibility how to play the game, the next MAGNITUDE version will provide two options which learners can select one of them depend on the training schedule.

The first option can be defined as the point-click mode. The learners can play this game anywhere and anytime. Learners just sitting and play using mobile devices, because it does not need learners' locations to pose the game character, instead of maximize the Google API to find the route for character movement. Another option is using global positioning system (GPS) of used mobile device to locate the character position. By implementing this mode, the MAGNITUDE game can be used as a supplement of real-location of disaster training. For example, when an official volunteering organization need to perform a training of evacuation skill, they can input the victims' data, location and evacuation procedure into MAGNITUDE gameplay. However, both game modes will have similar game mechanics with current version, which learners should complete the game levels by finishing quest by quest. The game still emphasize the ethical consideration through a dialog system, which learners can discuss such ethical issues in a conversation with NPCs. In advanced extension of MAGNITUDE gameplay, it can be combined with the mobile technology such as near field communication (NFC), and bluetooth low energy (BLE) for better interactions.

Recently, MAGNITUDE game is in the redesigning of the authoring interface according to the new features. On the next development, MAGNITUDE will

concern to build the backend of training platform. On the server, the system's database for residing game levels and users' learning analytics data will be implemented. I will also develop a client app for the game author (training manager), thus they can compile the game level configuration on Android or iOS tablets. The client app will allow the author to select the location of game components such as NPCs positions and game objects locations by tapping Google map. Then the tapped-map coordinates will be stored on the game data formatted with JSON.

Computer games are increasingly present in the lives. Hundreds of millions players around the world are entertained by game every day. However, there are demands of quality and quantity of the game content matched to the player need. Procedural content generation may address these demands by automating game content generation. Next stage of MAGNITUDE development will apply optimization of NPC behavior in using Genetic Algorithm. During its generation, the algorithm will evolve NPC behavior and resources. Each element has individual population, fitness function and codification.

Educational Aspects

On the pedagogical aspects, the next research phase is to measure the MAGNITUDE effectiveness. I consider gauging the learners' achievement on ethical awareness by conducting third phase evaluation, learners' motivation by measuring the impact of score and reward system, and calculating the learners' movement based on the Google map coordinates to examine how they engage the MAGNITUDE gameplay. I also consider measuring the usability of the authoring interface by testing the client app to the some experts or officers of related humanitarian organization.

Potential Extension of MAGNITUDE Use

As a country that has some potential disasters, Indonesia community has a less awareness to the disaster strikes. There is no official regular training or simulation conducted in the school and community in order to tackle the problem of disaster awareness. Hence, from a disaster to another once, the Indonesian community is more vulnerable from the disaster effects. In contrast, in Japan—as a leader in disaster preparation[5]—disaster training and preparation are officially conducted in a regular schedule from early level of education. Beside, some of disaster scientists also have various programs to educate Japan community. For example, Yamori developed a card game named Crossroad as an alternative of disaster

[5] http://content.time.com/time/world/article/0,8599,2058390,00.html

preparation and training for the community. As such, the Japanese community members can simply absorb the knowledge and skills of disaster from the experts that shared through this game (Yamori, 2011). Thus, when a disaster strike surrounding their environment, Japan community can quickly anticipate the huge disaster effect.

According to Japan experience for disaster preparation, Indonesia needs to follow such way. Thus, MAGNITUDE should have a role in order to tackle the lack of official of regular disaster preparation. MAGNITUDE is possible to extend its ability not only for training of disaster responders in higher educational level but also in early childhood. To meet this situation, MAGNITUDE needs to be developed in various genres and types of game beside in current serious games concept.

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Appendix A: Issues in Disaster Response

A.1 Demographic Questionnaire

Please provide your background information in the space provided

1. What is your highest level of education?
   - High School
   - Diploma
   - University/College

2. Sex
   - Male
   - Female

3. How old are you?
   - 15-17
   - 18-20
   - 21-23

4. How many years your training experience as a disaster responders?
   - 1 year
   - 1-2 years
   - More than 2 years
   - Less than 1 years

A.2 Ethical Awareness in Disaster Response (Category 1)

Please provide your best opinion for arguments below. Choose:
1. Strongly Agree:
2. Agree
3. Don't know
4. Disagree
5. Strongly disagree

1. After the earthquake, Mr. Pandu, a novice rescuer, heard a boy's weak whisper. He tried his best to scrape away the loose stones with his bare hands, and he saw the boy who was stuck under one floor slab. At the same time, Mr. Pandu found survivor(s) under another floor slab, but the number of survivor(s) was unknown. He decided to stop the rescue of the little boy and started to remove the floor slab, which covers the other survivor(s). After the successful rescue of the survivor(s), the little boy stopped breathing because of physical weaknesses.

   ☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

2. It is the first-day job for Mr. Pandu, a novice rescuer, to evacuate flooding victims. He saw that a bridge was collapsed. At the same time, he heard near this location, many people waiting rescuer to evacuate them from building roof. Before Mr. pandu decided to go into this place, he took his picture in the front of collapsed building. When he arrived in victim's location, he found one of them just died.

   ☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

3. Heavy rains almost drown South Bandung suburb. There is a collapsed bridge causing a little boy trapped and unconscious. At the same time, flooding cause the swift river currents. It can cause the victim drifted. Mr. Pandu, a novice disaster responder, desperate to cross the river without a life jacket to evacuate him. When he reached this location, he found the boy stopped breathing. After that, river current flown swiftly, and he trapped with died boy.

   ☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

4. There was a family trapped inside the house, which lay in the valley after the earthquake. The rescuers had no idea to rescue them successfully unless blowing up the hill. Destroy of the hills may cause mudslide in the future. Mr. Pandu, a rescuer, decided to blow up the hill. There was a family trapped inside the house, which lay in the valley after the earthquake.

   ☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

5. Mr. Pandu a novice disaster responder was assigned as a disaster responder for logistics in disaster location, 1000 miles from his village. In that day, he found two refugees who did not have food. Mr. Pandu knew the first refugee is a farmer; he was

with a little kid in desperate need of food. Mr. Pandu then knew that another refugee is a teacher. Due to logistics left only for one person, Mr. Pandu chose to give the food into the second refugee.

6. After a big earthquake occurred, a tsunami hit Pangandaran coastal. He got the same effect. His home was collapsed, and he lost his mother. He decided to find her. At the same time, Mr. Pandu found a family with four family members lived near Mr. Pandu home was injured. After he found his mother in medical center, he heard that one of his neighbor family members was died.

☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

A.3 Ethical Awareness in Disaster Response (Category 2)
Please provide your best opinion for arguments below. Choose:
1. Strongly Agree:
2. Agree
3. Don't know
4. Disagree
5. Strongly disagree

1. After the earthquake, Mr. Pandu, a novice rescuer, heard a boy's weak whisper. He tried his best to scrape away the loose stones with his bare hands, and he saw the boy who was stuck under one floor slab. At the same time, Mr. Pandu found survivor(s) under another floor slab, but the number of survivor(s) was unknown. He decided to stop the rescue of the little boy and started to remove the floor slab, which covers the other survivor(s). After the successful rescue of the survivor(s), the little boy stopped breathing because of physical weaknesses.

   ☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

2. It is the first-day job for Mr. Pandu, a novice rescuer, to evacuate flooding victims. He saw that a bridge was collapsed. Mr. Pandu and the other members have been difficult to check accurate information about victim's location. Killing time, he took his picture in the front of collapsed building. When he arrived in victim's location, he found one of them just died.

   ☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

3. Heavy rains almost drown South Bandung suburb. There is a bridge collapsed and causing a little boy trapped. Mr. Pandu, a novice disaster responder, desperate to cross the river without a life jacket to evacuate the victim. After that, He evacuated the boy successfully.

   ☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

4. There was a family trapped in the house, which lay in the valley after the earthquake. The rescuers had no idea to rescue them successfully unless blowing up the hill. Destroy of the hill may cause mudslide in the 20 years later. Mr. Pandu, a rescuer, decided to blow up the hill.

   ☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

5. Mr. Pandu a novice disaster responder was assigned as a disaster responder for logistics in disaster location, 1000 miles from his native village. In that day, he found two refugees who did not have food. Mr. Pandu knew the first refugee is a farmer with a little kid in desperate need of food. Mr. Pandu then knew that another refugee is a teacher with her husband. Mr. Pandu chose to give the food into the second refugee.

   ☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly

disagree

6. After a big earthquake occurred, a tsunami hit Pangandaran coastal. He got the same effect. His home was collapsed, and he lost his mother. He heard the information that his mother is dead. He decided to find his mother corpse. At the same time, Mr. Pandu found a family with four family members lived near Mr. Pandu home was injured. After he found his mother corpse, he heard that one of his neighbor family members was died.

☐ Strongly Agree ☐ Agree ☐ Don't know ☐ Disagree ☐ Strongly disagree

A.4 Ethical Awareness in Disaster Response (Category 3)

Please provide your best opinion for arguments below. Choose:
1. Would act
2. Would not act
3. Don't know

1. You have been working 36 hours straight. You feel tired, hungry, and angry. Others are still working and seem OK. Will you continue to work?

   ☐ Would act ☐ Would not act ☐ Don't know

2. You are the only caregiver for several people in emergency medical shelter. You are called to respond to a disaster.

   Is your allegiance / attention to stay with "your patients" or do you transfers your efforts to the response effort?

   ☐ Would act ☐ Would not act ☐ Don't know

3. Your Incident Commander has not had any training in ethical decision-making. She decides that you are to leave your patients at post A and report to post B to assist with care for some important local government officials.

   ☐ Would Act ☐ Would not act ☐ Don't know

4. You have responded to a disaster in a Native community. Your patient wants to talk with a traditional healer but you think action is necessary now.

   ☐ Would act ☐ Would not act ☐ Don't know

5. People who refused to evacuate now sit on the roofs of their houses surrounded by floodwaters. Resources rescue them are also needed to bring supplies and personnel to the designated staging area to care for the people who did evacuate.

   What should be the emergency health response?

   ☐ Would act ☐ Would not act ☐ Don't know

Appendix B: Questionnaire Set for Learners' Viewpoint of The Use Game for Training

Please provide your information!

1. What gender are you?
   - ☐ Male
   - ☐ Female

2. What age are you?

   ☐

3. Educational Level
   - ☐ High School
   - ☐ University

4. What type of after school activities experience?
   - ☐ Scout
   - ☐ Adventure
   - ☐ Red Crescent/Cross
   - ☐ Other

     ☐

5. Do you have any experience in disaster response?
   - ☐ Yes
   - ☐ No

6. Do you play computer games?
   - ☐ Yes
   - ☐ No

7. Do you play computer games?
   - ☐ Single player
   - ☐ Multiplayer

8. What type of games platform do you use?
   - ☐ Facebook game
   - ☐ Online game
   - ☐ Mobile game
   - ☐ Desktop game
   - ☐ Console game (PS, XBOX, PS-VITA, 3DS, Nintendo)

9. On average how many hours per week do you play computer games?
   - ☐ Less than 1 hours
   - ☐ 1-5
   - ☐ 6-10
   - ☐ 11-15

☐ 16-25
☐ More than 25 hours

10. What the reason do play a game?

☐ Learning
☐ Social Activity
☐ Fantasy
☐ Relaxation
☐ Competition
☐ Others

11. What are your preferred games?

	1	2	3	4	5	6	7	8	9	10
Strategy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Racing	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Sports	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Fighting	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Simulation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Adventure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Role-playing	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

12. Are you believed a serious game can be used for training skill of decision-making in disaster response?

☐ Believe
☐ Disbelieve

14. What skills can be obtained from serious games?

	1	2	3	4	5	6	7	8	9	10
Reflection	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Motivating	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Cooperation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Problem Solving	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Analyzing	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Critical Thinking	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Appendix C: Questionnaire Set for MAGNITUDE Evaluation

C.1 Biographic Data

1. What gender are you?
   - ☐ Male
   - ☐ Female

2. What age are you?

3. What type of after school activities experience?
   - ☐ Scout
   - ☐ Adventure
   - ☐ Red Crescent/Cross

4. Do you play computer games?
   - ☐ Yes
   - ☐ No

5. What the reason do play a game? ("1" -> weak reason, "10" -> strong reason)

	1	2	3	4	5	6	7	8	9	10
Social	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Learning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Competition	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Relaxation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Fantasy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. On average how many hours per week do you play computer games?
   - ☐ Less than1
   - ☐ 1-5
   - ☐ 6-10
   - ☐ 11-15
   - ☐ 16-25
   - ☐ More

C.2 Pre-test

1. **You are:** A rescuer

   Situation:
   A big earthquake strikes your village. There an injured boy was stacked under a pile. At the same time, you have a request to find unknown number of survivor(s) in another location. Would you do to find the survivor(s)?

   Decision:
   ☐ Would act ☐ Would not act ☐ Don't know

2. **You are:** A rescuer

   Situation:
   It is the first job you as a disaster rescuer. Your commander asked you to investigate a collapsed bridge near a village. You found that there is a trapped boy unconscious. At the same time, you got a request from elder woman to find a blanket due to bad weather. Would you find a blanket for the elder?

   Decision:
   ☐ Would act ☐ Would not act ☐ Don't know

3. **You are:** A rescuer

   Situation:
   You are asked to take the video for disaster rescue documentation. It is very important for disaster report work. At the same time, there is an unknown boy swept away by very vast river current. Would you help the boy?

   Decision:
   ☐ Would act ☐ Would not act ☐ Don't know

4. **You are:** A rescuer

   Situation:
   You are a member of the advanced disaster response group that has job to investigate the post disaster situation immediately. At the same occasion, you also had the responsibility to take care your family members including your sister and your beloved mother who were injured. Would you do your job?

   Decision:
   ☐ Would act ☐ Would not act ☐ Don't know

5. **You are:** A rescuer

   Situation:
   Your town is located in the valley. Some day, this area gets very high rainfall. It triggered a dam located in the highland almost overflowing. The mayor of your home town have a limited time to investigate the exact condition, however an expert gives him an opinion that you and your group should blow the levee near a village—there are hundred of inhabitants—, so the water will not hit the town. There is no enough time to

evacuate them. Would you follow the advice?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

6. **You are:** A rescuer

Situation:
A volcano was erupted in your village. Central commander informed you that the eruption column predicted to strike this area in a short time. You are the only responder stay in this area. As a spontaneous disaster responder you found that there are two victims in a house, i.e. a conscious boy and an injured elder, so he cannot walk. Would you leave the injured elder?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

7. **You are:** A rescuer

Situation:
You and your teammate were inside a house that there is an injured toddler squashed by a pile. However, to remove the pile, your team needs heavy equipment, but it will take time to get it. On the other hand, your team needs to evacuate the boy ASAP to save his life. Please analyze carefully the following discussion with regard to the rescue action.

Teammate 1 (Rescuer): We should evacuate him now. But there is a pillar trapping his leg. We need to get rid of that first. Hurry up! He is bleeding too much.
Teammate 2 (Rescuer): Huh… we need heavy equipment to do it. So… just wait until the equipment arrives.
Basecamp Commander: Sorry… there is a problem with sending equipment.
Boy's Mother: please save him. He is my only son.

Decision:
☐ Would act ☐ Would not act ☐ Don't know

8. **You are:** A rescuer

Situation:
Two men come to your basecamp to request logistic. One of them is your elementary school teacher from neighbor village; another is an elder with his grandson. However, the logistic is very limited only for a refugee. Would you give the elder his need?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

9. **You are:** A rescuer

Situation:
After a big earthquake occurred, Your home was collapsed, and you lost your mother. You decided to find her, but at the same time, you found a family with four family members lived near your home was injured. Would you decide to search your mother?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

10. **You are:** A rescuer

Situation:
Flooding hit your village, and there is a collapsed bridge with unknown boy trapped behind with. The weather information center predicted that the river current would flow swiftly soon, so the boy will be vulnerable. However, you don't use life jacket. Would you take a responsibility to evacuate the boy?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

C.3 Post-test

1. **You are:** A rescuer

   Situation:
   A big earthquake strikes your village. There is an injured boy was stacked under a pile. At the same time, you have a request to find unknown number of survivor(s) in another location. Would you do to find the survivor(s)?

   Decision:
   ☐ Would act ☐ Would not act ☐ Don't know

2. **You are:** A rescuer

   Situation:
   It is the first job you as a disaster rescuer. Your commander asked you to investigate a collapsed bridge near a village. You found that there is a trapped boy unconscious. At the same time, you got a request from elder woman to find a blanket due to bad weather. Would you find a blanket for the elder?

   Decision:
   ☐ Would act ☐ Would not act ☐ Don't know

3. **You are:** A rescuer

   Situation:
   You are asked to take the video for disaster rescue documentation. It is very important for disaster report work. At the same time, there is an unknown boy swept away by very vast river current. Would you help the boy?

   Decision:
   ☐ Would act ☐ Would not act ☐ Don't know

4. **You are:** A rescuer

   Situation:
   You are a member of the advanced disaster response group that has job to investigate the post disaster situation immediately. At the same occasion, you also had the responsibility to take care your family members including your sister and your beloved mother who were injured. Would you do your job?

   Decision:
   ☐ Would act ☐ Would not act ☐ Don't know

5. **You are:** A rescuer

   Situation:
   Your town is located in the valley. Some day, this area gets very high rainfall. It triggered a dam located in the highland almost overflowing. The mayor of your home town have a limited time to investigate the exact condition, however an expert gives him an opinion that you and your group should blow the levee near a village—there are hundred of inhabitants—, so the water will not hit the town. There is no enough time to

evacuate them. Would you follow the advice?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

6. **You are:** A rescuer

Situation:
A volcano was erupted in your village. Central commander informed you that the eruption column predicted to strike this area in a short time. You are the only responder stay in this area. As a spontaneous disaster responder you found that there are two victims in a house, i.e. a conscious boy and an injured elder, so he cannot walk. Would you leave the injured elder?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

7. **You are:** A rescuer

Situation:
You and your teammate were inside a house that there is an injured toddler squashed by a pile. However, to remove the pile, your team needs heavy equipment, but it will take time to get it. On the other hand, your team needs to evacuate the boy ASAP to save his life. Please analyze carefully the following discussion with regard to the rescue action.

Teammate 1 (Rescuer): We should evacuate him now. But there is a pillar trapping his leg. We need to get rid of that first. Hurry up! He is bleeding too much.
Teammate 2 (Rescuer): Huh… we need heavy equipment to do it. So… just wait until the equipment arrives.
Basecamp Commander: Sorry… there is a problem with sending equipment.
Boy's Mother: please save him. He is my only son.

Decision:
☐ Would act ☐ Would not act ☐ Don't know

8. **You are:** A rescuer

Situation:
Two men come to your basecamp to request logistic. One of them is your elementary school teacher from neighbor village; another is an elder with his grandson. However, the logistic is very limited only for a refugee. Would you give the elder his need?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

9. **You are:** A rescuer

Situation:
After a big earthquake occurred, Your home was collapsed, and you lost your mother. You decided to find her, but at the same time, you found a family with four family members lived near your home was injured. Would you decide to search your mother?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

10. **You are:** A rescuer

Situation:
Flooding hit your village, and there is a collapsed bridge with unknown boy trapped behind with. The weather information center predicted that the river current would flow swiftly soon, so the boy will be vulnerable. However, you don't use life jacket. Would you take a responsibility to evacuate the boy?

Decision:
☐ Would act ☐ Would not act ☐ Don't know

C.4 [Post Test] Preference and Motivations about Training Methods

1. Please give rating for the following statements related to the used method of training of disaster responders

	1	2	3	4	5	6	7	8	9	10
I want to have further training using this method	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
This training method is very interesting	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I believe that training in disaster scenario using this method is appropriate	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
This training method is proper for improving the ability of ethical decision making	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I want to train my skill using this method for longer time in a session	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2.

	1	2	3	4	5	6	7	8	9	10
Help and direction	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Realism of training environment	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Training goal	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Training Narrative	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

C.5 Questionnaire for Game Usability [Special for Experimental Group]

1. Please rate following opinions after playing MAGNITUDE!

	1	2	3	4	5	6	7	8	9	10
I felt confused when playing MAGNITUDE	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
MAGNITUDE game was relevant to the learning topics	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I felt my awareness to the ethical situation has been increased after playing MAGNITUDE game	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I believe that the MAGNITUDE game narrative have a very good complexity.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
In my opinion, the realism of game environment should be improved.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I believe the game has good accuracy to reflect learning objectives.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I believe that MAGNITUDE was effective to encourage me to take a decision.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I believe that the future development of MAGNITUDE will improve my expectation in ethical decision-making skill.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I believe that MAGNITUDE game can be used for training disaster responders.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
I felt confused when playing MAGNITUDE	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. Please give your rating for the aspects of training do you attended as follows!

	1	2	3	4	5	6	7	8	9	10
Graphics	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Navigation and control	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Game interface	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Audio	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. As a review, in your own words, what was game activity all about?

4. How did you feel after the game?

5. Please list what you felt were the most negative aspects of the game:

6. Did the game cover anything about disaster response that is important for humanitarian activist? If so please explain.

7. Did you learn some new things about humanitarian activities? If so, what are they?