THE EXPERIENCES OF GAMER AND NON-GAMER MINING ENGINEERING
STUDENTS IN PLAYING SIMULATION GAME FOR EDUCATIONAL
PURPOSES: A PHENOMENOLOGICAL STUDY

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ABSTRACT

THE EXPERIENCES OF GAMER AND NON-GAMER MINING ENGINEERING STUDENTS IN PLAYING SIMULATION GAME FOR EDUCATIONAL PURPOSES: A PHENOMENOLOGICAL STUDY

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Games can be an effective educational tool which increases the engagement and motivation of the students while they are having fun. But, how these games should be adapted for education in engineering department remains a challenge. In the literature, there are few studies that investigate the effectiveness of simulation games in engineering education. However, these studies did not reveal the experience of students in game based learning environment in details. The purpose of this phenomenological study is to investigate of gamer and non-gamer mining engineering students' experiences of using simulation games for educational purpose. It investigates how they perceive and describe their experience in detail and seek the essence of their experience. To achieve this, three non-gamer and three gamer participants were requested to play a game related with mining. Their opinions about the usage of games in educational settings, the strength and weakness of the game used in this study, the motivational elements in the game environment and their suggestions to improve the effectiveness of the game were investigated. The

participants were selected by criterion sampling method and the data was collect through in-depth phenomenological interviews, focus group interview and observation. This study showed that participants enjoyed their experiences and supported the integration of these kinds of games to the educational settings. Visualization, learning by doing and motivation were the common themes given by the participants for the benefits of the game usage in educational settings. The non-gamers focused on the strengths of the game whereas gamers focused on weaknesses. All the participants were affected by similar motivational elements especially challenge, curiosity and control and similar constructs shaped their experiences namely information seeking, observation, assessment, hypothesis building and decision making but their effects changed based on personal characteristics and interest of the students. The findings of this study might help educational researchers to gain insight about how the learning opportunities provided by games helps the learners from the learners' perspectives. In addition, this study might inform the educational game designers about what they should consider to create effective educational games specifically for mining engineering education. Finally, it may help instructors to reconsider appropriateness of usage of simulation games in their courses especially in mining engineering department.

Keyword: Games, Simulation Games, Mining Engineering Education, Phenomenological Research

ÖZ

OYUN OYNAYAN VE OYNAMAYAN MADEN MÜHENDİSLİĞİ BÖLÜMÜ ÖĞRENCİLERİNİN EĞİTSEL AMAÇLI SİMÜLASYON OYUNU OYNAMA DENEYİMLERİ: BİR OLGU ÇALIŞMASI

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Oyunların öğrenciler eğlenirken onların katılımını ve motivasyonunu artırdığı için etkili bir eğitim aracı olma potansiyeli vardır fakat bu oyunların mühendislik bölümündeki eğitime nasıl adapte edilmesi gerektiği bir sorun olmaya devam etmektedir. Alanyazında mühendislik alanında simülasyon oyunlarının etkinliğini araştıran az sayıda çalışma vardır ancak bu çalışmalar oyun tabanlı öğrenme ortamında öğrencilerin deneyimini ayrıntılı olarak ortaya koymamaktadır. Bu olgu çalışmasının amacı oyun oynayan ve oynamayan maden mühendisliği bölümü öğrencilerinin simülasyon oyunlarını eğitsel amaçla kullanımı deneyimlerini araştırmaktır. Bu çalışma, öğrencilerin bu deneyimlerini nasıl algıladıkları ve tanımladıklarını incelemekte, bu deneyimin özünü araştırmaktadır. Bu amaçla, bu çalışmada üç oyun oynayan ve üç oyun oynamayan öğrencilerden maden ile ilgili bir oyunu oynamaları istenmiştir. Öğrencilerin oyunların eğitsel ortamlarda kullanılması hakkındaki görüşleri, bu çalışmada kullanılan oyunun güçlü ve zayıf yanları, kullanılan oyunda bulunan motivasyonel öğeler ve öğrencilerin oyunun etkinliğinin

artırılması için verdikleri tavsiyeler araştırılmıştır. Katılımcılar ölçüt örnekleme yöntemiyle belirlenmiş ve araştırma verileri ayrıntılı görüşme, odak grup görüşmesi ve gözlem yoluyla toplanmıştır. Bu çalışmanın sonucunda katılımcıların deneyimlerinden memnun kaldıkları ve eğitim ortamlarına bu tür oyunların kullanımını destekledikleri görülmüştür. Görselleştirme, yaparak öğrenme, motivasyon oyunun eğitsel ortamlarda kullanımının yararları olarak öğrenciler tarafından verilen ana temalardır. Oyun oynamayan katılımcıların kullanılan oyunun güçlü yönlerine, oyuncu katılımcılar ise zayıflıklarına odaklandığı bulunmuştur. Tüm katılımcıların oyun oynama sırasında benzer motivasyonel öğelerden özellikle zorluk, merak ve kontrol öğelerinden etkilendiği ve benzer yapıların, bilgi araştırma, gözlem, değerlendirme, hipotez geliştirme ve karar verme, deneyimlerini şekillendirdiği görülmüş fakat bunların etkilerinin oyuncunun kişisel özellikleri ve ilgi alanlarına göre değiştiği bulunmuştur. Bu çalışmanın sonuçları, eğitimcilere oyunun sağladığı öğrenme olanaklarının öğrencilere nasıl yardımcı olduğunu öğrencinin bakış açısıyla gösterecektir. Ayrıca, bu çalışma eğitsel oyun tasarımcılarına özellikle maden mühendisliği bölümü için etkili oyun tasarlamak için neleri göz önünde bulundurmaları gerektiği hakkında bilgilendirecektir. Son olarak, bu çalışma eğitimcilere derslerde özellikle maden mühendisliğini eğitiminde simülasyon oyununun kullanımının uygunluğunu tekrar düşünmelerinde katkıda bulunacaktır.

Anahtar Kelimeler: Oyun, Simülasyon Oyunu, Maden Mühendisliği Eğitimi, Olgu Çalışması

"This dissertation is dedicated to my family and M."

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

In recent years, digital games take an important place in the lives of people. Millions of people around the world are captivated by these games. For example, people spend three billion hours per week playing online multiplayer games (McGonigal, 2010). In addition, the statistics shows that in 2011 in USA 72% of people play computer and video games (Association, 2011).

People play digital games due to the several reasons. According to Prensky (2003) people play games because they are fun and give the player enjoyment and pleasure. They require intense and passionate involvement. They are structured and have rules and goals that motivate players to play. Games are interactive and adaptive. They have outcomes and feedback so players learn while playing. They allow players to win so they help players to ego gratification. Games help the player to excrete adrenaline by proposing conflict/ competition/ challenge/opposition. They pose a problem to solve so that they develop creativity of players. Finally they have interaction to form social groups, representation and story that give players emotion (Prensky, 2003). In addition to the statements of Prensky (2003), there are additional explanations about why people play games. According to Hostetter (2002), it decreases the stress level of the people and raises emotions. Today, high technology has made digital games visually more realistic. In other words, the boundaries with virtual environment and real life have been blurred. Games provide opportunities for people to experience impossible things such as flying or driving a car carelessly in the real life settings. Moreover, while playing digital games, they develop a sense of immersion; temporarily loose the sense of time and awareness of self (Harvey,

1998). Playing digital games helps the players to pass the time, escape from doing other things and enjoy themselves (Griffiths & Hunt, 1998).

Digital games not only provide people to have fun but also teach them. Especially computer games provide powerful learning environment (Hong, Cheng, Hwang, Lee, & Chang, 2009; Struppert, 2010) Games teach new skills, knowledge, insights, attitude, behaviors and challenge the players to think, explore and respond (Lieberman, 2006), support active learning, experiential learning and problem-based learning (Oblinger, 2004), help young people to understand complex systems through experimentation (Prensky, 2003; Garris, Ahlers, & Driskell, 2002), support the activation of prior knowledge of the players to achieve a specific goal or performing a task, provide immediate feedback that helps players to learn from their actions and test their hypothesis (Oblinger, 2004), enhance learning process by visualization, experimentation, and creativity of play (Betz, 1995), develops critical thinking skills by providing situations in which player analyses and evaluates the information and comes to concrete conclusions (Amory, Naicker, Vincent & Adams, 1999) and help players to develop collaboration skills and learn new concepts and synthesize new information (Colella, 2000). According to Prensky (2003), in every second, or fraction there is a learning opportunity in modern computer and digital games. He states that on the surface, game players learn to do things such as flying airplanes or driving fast cars. And, on the deeper level, they learn how to take in information from many sources and make decisions quickly; how to find the best strategy for overcoming obstacles. Therefore; educators have decided to integrate games to the educational settings and researchers have conducted game studies support the integration of simulations and games in educational settings. Struppert (2010) claims that these technologies match the lifestyles and learning styles of learners better. Hence, some of the commercial games such as Civilization III, SimCity and The Sims have been integrated to education to teach History and Social Studies (Struppert, 2010). In addition to commercial games, to achieve the specific goals, educators develop their own games and named them as educational games or serious games. Educational games are software that includes game characteristics in order to teach a specific topic or help students to develop problem solving skills

(Demirel, Seferoğlu and Yağcı, 2003). They have two dimensions in terms of fun and teaching. In other words, they teach while players are having fun simultaneously (Bayırtepe and Tüzün, 2007).

The promising effects of the games are also recognized by the researchers and educators in higher education. These games have integrated in higher education to increase motivation and engagement of the learners towards the subjects and enhance learning outcomes (Chaudhary, 2008; Gros, 2007). As stated by Deshpande and Huang (2008), simulation games have great potential in engineering education and several simulation games were developed for engineering education such as computer, civil engineering, industrial engineering. These studies showed that simulation games could help the students to learn various skills related with their field and enhance deep understanding of the subject (Deshpande and Huang, 2008). Nevertheless, when the literature is examined it is seen that there are limited examples of game usage in university level (Ozcelik, Cagiltay, & Ozcelik, 2013) especially in the mining engineering department. Similarly, these studies generally focused on the development of the game or the general opinions of students regarding with the game. These studies do not attempt to identify the experiences of students in game playing, their motivations, opinions, suggestions in detail. Although games are one of the most investigated topics in the educational literature, there are still many questions that need to be analyzed in order to integrate the games to higher education effectively. As indicated by Annetta, Minogue, Holmes, and Cheng (2009) many studies have reported the potential of games for engaging students and helping them to learn difficult concepts. But according to them, still in the literature there is lack of empirical data to support or refute these theoretical claims. For this reason, they suggest that video games are needed to be evaluated by researchers and teachers from an educational perspective in order to understand whether they can be integrated to teaching practices. In addition, the usage of games for education is also needed to be investigated from the learners' view. Since they are considered to the main user of the game and aimed to learn or develop skills by using game, their perspectives and their learning process is very important for educators to identify how they can be embedded in their education.

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1.2 Statement of the Problem

Games have a potential to be an effective educational tool that motivate the students and teach them while they are having fun. But, the studies about the game conducted so far still have not shown how these games should be used in educational setting. Susi, Johannesson and Backlund (2007) stress that many people still think that the benefits of games are questionable. Those people think that games are toys and there is lack of evidence about their usefulness in education. Hence, they believe that researchers need to concentrate on investigating why games are engaging and effective and how they should be integrated to learning process to maximize learning potential.

The opportunities game provided to the learners are very valuable for enhancing the learning experience of them. Especially, simulation games help students to connect theory and practice to increase their learning (Deshpande & Huang, 2008). But, how these games should be adapted for engineering education remains a challenge (Deshpande & Huang, 2008). In the literature, there are fewer studies that investigate the effectiveness of simulation games in engineering education especially mining engineering education (ex: Ebner & Holzinger, 2007; Nikolic 2011; Cox & Walker, 2004; Wu & Chen, 2009). Moreover, these studies did not reveal what students go through on these environments. In other words, these studies did not reveal the experience of students in game based learning environment in detail. Without identifying what learners go through while playing games, it is difficult to design affective games and find a general framework on the integration of these games to the educational setting effectively. Hence, in depth analysis of the students' perspectives, attitudes and experience, motivation are needed to provide insights for essential design and development elements of educational games and their usage in higher education.

1.3 Purpose of the Study

The purpose of this study is to investigate mining engineering university students' experiences in using simulation games for educational purpose. In this study, how non-gamer and gamer students experience the phenomena is investigated deeply. This study investigates how non-gamer and gamer students perceive and

describe their learning experience through simulation games, and seek essence of their experiences. Moreover, it describes the strength and weaknesses of simulation games used in this study, and search for its motivational elements.

1.4 Research Questions

The research questions of this study is

- How do gamer and non-gamer mining engineering students perceive and describe the phenomenon of using simulation games for educational purpose?

To answer this research question, the sub research questions are identified. The sub research questions of this study are;

- o How does this experience affect gamer and non-gamer mining engineering students' opinions about the usage of simulation games for educational purpose?
- o How do gamer and non-gamer mining engineering students identify the strengths and weaknesses of simulation game used in this study?
- o What are the motivational elements in simulation games identified by gamer and non-gamer mining engineering students based on their experience?
- o What do they suggest to improve the effectiveness of the simulation game they used?

1.5 Significance of the Study

This study aims to identify the gamer and non-gamer mining engineering students' experience of using simulation games for educational purpose. Although the literature includes several researchers related with simulations and simulation games, there is lack of studies about the experiences of students in game playing. As stated by Cilesiz (2010), understanding this kind of experience and its essence may provide an additional dimension to the debates about digital games and its appropriateness to the integration of educational settings. Moreover, this study shows educational researchers about how the learning opportunities provided by games help the learners from the learners' perspectives. Finally, understanding this experience of both non-gamer and gamer students contributes to identify how games should be used in educational settings and what the educator should consider in integration

process. Therefore, the findings of this study contribute to the literature in that respect.

This study aims to identify and reveal the effectiveness of simulation games from the learners' perspectives. It investigates what gamer and non-gamer mining engineering students experience, how their opinions related with simulation games are changed during the usage of simulation game. Moreover, their opinions about the strengths and weaknesses of those games are identified. Thus, the findings of this study may contribute to discover the essential design and development elements of simulation games. For this reason, this study may help the educational game designers about what they should consider to create effective, motivated educational games specifically for mining engineering education.

Finally, this study contributes to mining engineering education. As stated by Feisel and Rosa (2005), engineering is a practicing profession. They stated that "the overall goal of engineering education is to prepare students to practice engineering and, in particular, to deal with the forces and materials of nature" (p. 121). According to Hitch (2011), mining engineers have to develop variety of skills in order to be successful in their profession and he believes that the only way to develop these necessary skills is practicing. But, due to safety problems it is difficult for mining engineering students to practice their knowledge and skills. Mallett and Orr (2008) suggest that new methods and technologies should be integrated to the education in mining field. They claim that realistic simulations such as computer-based virtual environments can be solution for those problems. However, how these technologies can solve the problems that mining engineering students face have not been investigated deeply. Understanding the experience of these students for the usage of simulation games for educational purpose may help educators reconsider the use of simulation games in this department and the appropriateness of usage of simulation games to practice the necessary skills of them.

1.6 Definition of Terms

Simulation Games: It is a form of game which simulates variety of activities in real life settings for various purposes such as training, prediction, analysis

Epoché: It is an ancient Greek term which defines a moment where all opinions and judgments about the existence of external world is suspended.

Phenomena: Greek word which means "to show oneself" or "to appear".

Phenomenological study: It describes the meaning of the lived experiences of a concept or phenomenon of several individuals (Creswell, 2007).

Ore: It is a naturally occurring solid material that includes metal or valuable material which can be extracted for profit.

Quarry: An industrial site in which nonmetallic resources and materials are extracted and processed

Quarrying: Extraction of stones or minerals deposits from the crust of Earth

CHAPTER 2

LITERATURE

2.1 Definition of Games

There are various definitions of games in the literature. Huizinga (1955) gives a long description of game in his book "Homo Ludens a Study of the Play-Element in Culture ". According to him, game is "a free activity standing quite consciously outside "ordinary" life as being "not serious", but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social grouping which tend to surround themselves with secrecy and to stress their difference from the common world by disguise or other means (p.13). On the other hand, Kraer (2000) defines game as "objects which consist of components and rules". According to him, game has certain criteria in terms of common experience, equality, freedom, activity and diving into the world of the game. Salen and Zimmerman (2004) define game as "a system which players engage in an artificial conflict, defined by rules that result in a quantifiable outcome". Finally, Juul (2003) describes game as "A game is a rule-based formal system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels attached to the outcome, and the consequences of the activity are optional and negotiable".

Games are different than simulations. Egenfeldt-Nielsen (2003) discusses about these differences. According to him the main difference is the goals. He states that games have specific goals whereas simulations do not have any specific goals. If goal is added to simulation, simulation will be altered to games (Egenfeldt-Nielsen, 2003). Dorn (1989) identifies simulation game as a representation of reality and it

includes the basic characteristics of games and simulations (Dorn, Simulation Games: One More Tool on the Pedagogical Shelf, 1989). Lastly, Galvao, Martins, and Gomes (2000) states that simulation game is the mix feature of game and simulation. It includes game features such as competition, cooperation, participants, rules and simulation features such as the representation of reality. They emphasize that simulation games are general games for educational purpose and if it is designed for a company, specific organizational aims can be seen.

2.2 Theoretical Bases

2.2.1 Motivation in Games

They conducted several works and design several computer games to come up with taxonomy of motivations for learning. Based on their works, Malone and Lepper (1987) identified many motivating factors in two main categories; intrinsic and interpersonal motivation. According to them, these factors are essential to create good and engaging games regardless of their educational qualities.

Malone and Lepper (1987) gave special emphasis to the intrinsic motivators. According to them intrinsically motivated learning is "learning that occurs in a situation in which the most narrowly defined activity from which the learning occurs would be done without any external reward or punishment." (p.229). They believe that intrinsic motivations is desired by all the educators because intrinsically motivated students are tended to be more successful since they are interested in subjects, study for their good and want to increase their competence and knowledge. They identify challenge, curiosity, control and fantasy as intrinsic motivators in the game environment.

Challenge: According to Malone and Lepper (1987) people seek and enjoy activities that pose some level of challenge to them but this challenge should be optimum level. Otherwise if the challenge level is too high or too low, it causes little intrinsic motivations for performers. In order to create a challenging activity, Malone and Lepper (1987) give several strategies to the designers. According to them, to make a challenging activity, there should be defined goals. In addition, the players should be provided feedback about his or her performance. The activity also should enhance self-esteem of the performers. Finally, there should be uncertain outcomes

that may be produced using variable difficulty levels, multiple levels of goals, hidden information and/or randomness (Malone & Lepper, 1987). In addition to these strategies, Rittterfeld and Weber (2006) state that challenge can be created by time constraints, making players to compete with other players, agents or his/her previous results.

Curiosity: Malone and Lepper (1988) states that curiosity is the most direct intrinsic motivation for learning and it should be optimum level. In other words, the learning environment should not be too simple or complicated compared to the pre-knowledge of the learners. Malone and Lepper (1988) divide curiosity into two categories; sensory curiosity and cognitive curiosity. Sensory curiosity involves attention-attracting value of variation. Changing sound, light, smell etc. causes sensory curiosity. On the other hand, cognitive curiosity is provided by modifying higher-level cognitive structures like inconsistency or incomplete of existed knowledge (Malone & Lepper, 1987).

Control: According to Malone and Lepper (1987), computer games provide a sense of control which makes people to play. Thus, they believe that control is also an important intrinsic motivator for learning. They identify three features of the game which are contingency, choice and power.

Fantasy: According to Malone and Lepper (1987), fantasy environment is the environment that contains mental images of physical or emotional situations that are not present. They divide fantasy in two categories, endogenous and exogenous fantasies. In endogenous fantasies, the fantasy and the skills that players learns are depended each other whereas in exogenous fantasies, fantasy depends on the skills being learned (Malone & Lepper, 1987).

Malone and Lepper (1987) differentiate intrinsic and interpersonal motivators by stating that interpersonal motivators depend on existence of other people whereas intrinsic motivators depend on player himself. These interpersonal motivators are cooperation, competition, and recognition. Both cooperation and competition are divided into two categories; endogenous and exogenous. For example, combining scores of different people is exogenous cooperation and it is weak form of motivation. If the overall tasks are broken into dependent tasks and students work

together to finish the overall task such as jigsaw method, than this form of cooperation is named as endogenous cooperation. By providing independent tasks and allowing the students to compare their performance each other cause exogenous competition. On the other hand, if people have conflicting goals and they are working on dependent tasks, endogenous competition is aroused (Malone & Lepper, 1987).

In addition, based on the work of Malone and Lepper (1987), Garris, Ahers and Driskell (2002) come up with six dimensions which are necessary characteristics of instructional games. They are; fantasy – fictional characters or contexts; rules and goals- well defined rules, goals and appropriate feedback; sensory stimuli – both auditory and visual; challenge – optimal difficulty level and uncertainty of goal achievement; mystery –optimal complexity level of information; and control– active learner control.

2.2.2 Flow Theory

Mihaly Csikszentmihalyi (1990) measures the qualities of enjoyable activities in daily life and proposes flow theory. According to him (1990), flow is the involvement of an activity completely. In flow state, a person loses sense of time, his/her ego and uses his/her skills to the highest level.

Csikszentmihalyi (1990) states that pleasure is important in the lives of people, but it does not always make an individual happy. People do ordinary activities such as eating, sleeping to maintain the order of their life. But for the enjoyment, people should go beyond what they are programmed to do and achieve an unexpected task. If the challenge of task and the skill levels of individuals are match, they experience flow. However, if the challenge level of the task is higher than the skills of the participants, he feels anxiety and if the challenge level is too low, he feels boredom.

Csikzentmihalyi (1990) identifies eight dimensions of flow experience which are;

1. Clearly defined goals and immediate feedback,
2. Match of personal skills and challenge level,
3. Merge of action and awareness,

4. Focus on the task,

5. Sense of control,

6. Losing of self-consciousness,

7. Altered sense of time and

8. Autotelic experience.

2.2.3 Constructivism

Constructivism can be considered as "philosophical explanation about the nature of learning" (Schunk, 2012 pg.230). According to constructivism, people create their own meaning instead of acquiring it. It views knowledge as working hypothesis instead of truth and assumes that people do not get knowledge from outside, they form it by themselves. Hence it claims that the knowledge of one person is true for that person and it does not necessarily true for other people (Schunk, 2012). It admits the existence of the real world; however, it proposes that what people know of the world is gathered from their own interpretations of their experience. Thus, according to this view, both learner and environmental factors are critical because their interaction creates knowledge (Ertmer& Newby, 1993). Constructivism emphasizes that since all knowledge is constructed by individuals based on their beliefs and experiences, it is tentative, subjective and personal (Airasian & Walsh, 1997).

Cobb (1994 cited in Bonk & Cunningham, 1998) identifies two major trends in constructivism; individual cognitive approach and sociocultural approach.

Individual Cultural Approach: It is rooted to Piagetian theory and it stresses the individuals' constructivist activities while he tries to make sense of the world. It stresses that people construct their knowledge by interacting with the environment. According to this approach, learning occurs when there is a mismatch between what is expected and what is encountered. Individuals construct his/her knowledge to resolve this conflict. In addition, they construct themselves and their world by accommodating their experience. Thus, this perspective give importance to teachers and other students as a source of puzzlements that creates conflict in students' mind. In this approach, the main focus is on the individual within the group. Cognition occurs in the individual's head. For all of these reasons, cognitive

constructivist educators seek to make learning process more relevant to the learner experience. They build the learning on prior knowledge of the students and address misconnections.

Sociocultural Approach: This approach is based on Vygotsky ideas and it focuses on knowledge construction in the sociocultural context that all people are immersed. According to this approach, acculturation causes learning. For this reason, it gives importance to human dialogue, interaction, negotiation, and collaboration among the individuals.

Duffy and Cunningham (1996) states that there are seven pedagogical goals in constructivist learning environments. These environments;

- Provide experiences for the students during knowledge construction process
- Supply multiple perspectives
- Enable multiple modes of representation
- Supply relevant and realistic contexts
- Support ownership in learning
- Provide social experience for learning
- Promote self-awareness in knowledge construction process.

In addition, Jonassen (1994) mentions that there are six main characteristics of constructivist learning environments. First of all, it provides multiple representations of reality so that it shows the complexity of the real world. Moreover, it fosters knowledge construction rather than knowledge reproduction. It presents authentic tasks in a meaningful context not out of context. These constructivist learning environments do not include predetermined sequence of instruction. Unlike the traditional learning environments, they are based on real-world settings or case-based learning. Finally, constructivist learning environments encourage students to reflect on their experience and construct context and content dependent knowledge.

Finally, Lebow (1993) states that five principles are needed in the constructivist learning environment. It should balance the learners and the potentially damaging effects of instructional practices. The students should be provided a context that supports their autonomy and relatedness. In addition, students should be informed about the reasons of learning in the learning activity. It should support self-

regulating learning by promoting skills and attitudes of the learner and it should motivate the learner to engage in intentional learning processes.

2.2.3.1 Experiential Learning

Experiential learning theory is related to and congruent with constructivism (Thanasoulas, n.d). It emphasizes that experience play a central role in the learning process. Thus, it distinguishes from other learning theories. It includes Dewey's philosophical pragmatism, Lewin's social psychology, and Piaget's cognitive-developmental genetic epistemology and provides a unique perspective on learning and development (Kolb, Boyatzis & Mainemelis, 2000).

According to experiential learning theory, learning is "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience (Kolb 1984, p.41). Rogers and Freiberg (1994), express the qualities of experiential learning as personal involvement, learner-initiation, learner evaluation and pervasive effects on learner. Kolb (1984) points out the correlation between concrete experience and abstract conceptualization and believes that this correlation is the center of learning. In addition, he presents a cyclical model of learning. This model consist four stages which are concrete experience (or "DO"), reflective observation (or "OBSERVE"), abstract conceptualization (or "THINK") and active experimentation (or "PLAN"). Kolb (1984) states that learner can start at any stage but must follow each other in linear sequence.

- *Concrete experience* (CE): Learner directly practices an activity.
- *Reflective observation* (RO): Learner consciously reflects on that practice.
- *Abstract conceptualization* (AC): Learner develops a theory or model bases on his observation.
- *Active experimentation* (AE): Learner plans and tests a model or theory.

Boud, Keogh and Walker (1985) believe that reflection can be the main factor in the determination of the students who learns from the experience effectively. For this reason, in experiential learning theory, great emphasis is given on reflection.

According to Boud, Keogh and Walker (1985), during the reflection people reconsider think and evaluate the experience, so it is an important step for creativity.

Although, the model formed by Kolb is one of the well-known models and it is used in many learning and training events, there are many criticisms about the model (Denholm, Protopsaltis and de Freitas, 2013). For instance, the learning style described in the model are found too simple and accused of not considering the ways of learning other than experiential (Forrest, 2004). In addition, it is blamed not to give sufficient attention to the reflection process (Boud, Keogh and Walker, 1985). Tennat (1997) states that assuming four different learning styles are extreme and it does not consider cultural conditions and differences. He also states that the model is not empirically supported. But despite the criticism about the model of Kolb, Rogers (1996) thinks that its contribution on the educational field should not be underestimated. According to him, the model has helped to shift the attention from the instructor to the learner. Besides, by this model, experience becomes the topic of discussion again.

2.2.4 Case-Based Instruction and Learning by Doing

2.2.4.1 Case-Based Instruction

Case-based instruction is firstly used in business, medical and law schools and later in undergraduate level (Herreid, 1998). Yadav and Beckerman (2009) state that the usage of case-based instruction in undergraduate science education helps students to develop their problem-solving and critical thinking skills. According to them, the cases can be problem-based or dilemma based and can include representative scenarios related with the domain and/or illustrate critical issues about the domain. Cases can provide a supportive environment in which students can apply their theoretical knowledge to the practical situations without worrying about the impact of their actions (Yadav, Shaver & Meckl, 2010). Herreid (1998) states that case-based instruction enhances the active participation of the students and encourages them to construct their own learning in classroom settings. In case-based instruction, students analyze the cases and finds out solutions for them. Thus, their teamwork abilities and higher thinking skills are increased (Herreid, 1998).

Dori and Herscovitz (1999) believe that case-based learning increase the motivation of students since it displays the importance of the issue via real life situations. It creates opportunities for students to experience real life situations and enhances their interest and enjoyment toward learning (Mayo, 2002; Naumes & Naumes, 2006). According to Jones (2003), case-based instruction increases critical thinking, problem-solving, communication and decision-making skills of the students by allowing them to practice in real life situations. The literature includes many studies about the effectiveness of case-based instruction. For instance, Yadav and Beckerman (2009) conducted an experimental research in undergraduate level in order to investigate whether case-based instruction affect the problem solving and critical thinking skills of students in plant pathology courses. They found that case-based instruction increase the problem solving and critical thinking skills of the students significantly by actively engaging them to the course content compared to traditional teaching methods. In addition, they found that students had positive attitudes towards case-based instruction. Hoag, Lillie, and Hoppe (2005) conducted a study with undergraduate students and found that although the performance of students on critical thinking questions was not improved statistically, cases made the content easier to remember, helped to create more enjoyable classroom and so increased the attendance of the students. In another study, Bergland, Lundeberg, Klyczek, Sweet, Emmons, Martin, Werner, and Jarvis-Uetz (2006) found that case-based instructions have a positive effect on the students. They used a software case-based multimedia called "Case It!" which was developed for high school and introductory college biology students. Their study showed that the interest of students and their higher order thinking skills was increased due to the usage of the case-based multimedia program in the course.

According to Fuchs (1970), cases should be used in engineering education because they bring reality into the classrooms. He believed that creating outside reality in classroom environment allow students to gain kinds of experiences which they can gain in the workplace so it increases their motivation to learn the contents they need in engineering disciplines. Cases show what engineers deal with by providing engineering experience. In other words, it helps the students to gain an

idea about what engineers do and motivates them to learn the basic concepts and problem-solving skills (Henderson, Bellman, & Furman, 1983). Case studies help students to link what they learn to real world situations as well as make the learning more motivating and interesting (Yadav, Shaver & Meckl, 2010). According to Yadav, Shaver and Meckl (2010) generally the problems that engineers work on do not have clear-cut solutions. This forces engineers to make complex decisions regarding with the problems. They believe that cases hold a great value to show the complex nature of engineering. Cases can create realistic context and want students to solve problems that they can encounter in their career (Yadav, Shaver & Meckl, 2010).

Richards, Gorman, Scherer and Landel (1995) point out that studying and reflecting on the experience of others is another way of learning. According to them, these experiences can be given in cases. Cases allow active learning by forcing students to take the roles of participants in decision making process. They also serve as a vehicle for pointing out the business issues and human resources which are not considered in traditional engineering courses. According to Richards, Gorman, Scherer and Landel (1995), engineering in real word includes ethical issues, impact assessment, uncertainty and risks, priorities and tradeoffs and human elements. Cases can show these open-ended and ill-defined problems that students can face in their future engineering career. Richards, Gorman, Scherer and Landel (1995) state that the usage of cases in engineering education help the students to link the curriculum to reality and integrate their prior experience. Moreover, they can help students to combine what they learnt from the other courses as well as make them to be motivated and active during the learning process (Richards, Gorman, Scherer & Landel, 1995).

Yadav, Shaver and Meckl (2010) investigated the effect of case-based instruction on the conceptual understanding of students and their attitudes with 73 students in undergraduate mechanical engineering. They found that students' attitudes were positive to this method. The majority of the participants thought the usage of cases was engaging and added realism to the classroom environment. They also made the content relevant to students. The researchers concluded that case-based

instruction could help students by encouraging them to actively engage to the course and allowing to see the application of engineering to the real world. But, their study revealed that there were no significant differences on the conceptual understanding of students. According to the researchers, this indifference showed the importance of implementation of case studies. As stated by Gallucci (2007), case studies provide positive and engaging experience to students but if it is not implemented carefully, it may not enhance the conceptual understanding of the content.

2.2.4.2 Learning by Doing

Schank, Berman, Macpherson (1999) claim that life forces students to do more than to know in order to function. For this reason, they believe that students should be taught how to perform useful tasks by letting them to do. They stress that letting someone to do something is the most effective way to teach how to do it. Bot, Gossiaux, Rauch and Tabiou (2005) state that knowledge and know-how cannot be separated in technical and scientific process. Thus, if this is considered in teaching of science in higher education, it can help the students to develop skills in autonomy, innovation, creativity and self-learning. To achieve this, Schank, Berman, Macpherson (1999) come up with a simulation called goal-based scenario. They explain that a goal-based scenario (GBS) is a learn by doing simulation that students try to teach goal by using necessary content knowledge and skills. It aims to create a model in which the goal for the students is learning "how to" instead of "know that". They mention that students generally learn in decontextualized way. They do not understand the importance of the new knowledge because they are not meaningful and relevant to them. But, with the help of GBS, students learn the necessary content and skills to achieve a goal which is important, interesting and relevant to them.

Schank, Berman, Macpherson (1999) develops an instructional model called case based reasoning (CBR) which explains how to remember and use memories to solve new problems. According to them, it is effective to develop a skill and help people to become experts and how they relate the problems to their domains of expertise. They believe that experts have many memories related with their domain of expertise. To call the related memories when they need, a nonconscious process is

occurred. In this process, experts "index" their memories by "labeling" each of them with a "title" and "fill" them in the appropriate place in the memory.

Schank, Berman, Macpherson (1999) identify the elements of the case based learning and reasoning as goals, plans, expectations, failure and explanations. Students set goals to attain and to achieve the goal they come up with several plans. They also make expectations of the plans. But, when they see that the plans do not work as they want, they experience failure and they find explanations that explain the reasons of the failure.

According to Schank, Berman, Macpherson (1999), in GBS it is important to create sensible and motivating context in which they will study the target skills because the role of the learners and the goal aims to help students to understand the relevance of the skill they are practicing. Thus, GBS includes seven essential components which are the learning goals, the mission, the cover story, the role, the scenario operations, the resources and the feedback including coaches and experts.

The first step in GBS is finding a goal or mission that will be appealing for the students. Schank, Berman, Macpherson (1999) suggest that the goal should allow students to achieve the learning goals. It should demand the knowledge and skills that students are wanted to gain in order to complete the missions successfully. Moreover, it needs to be motivational and realistic. If it is fantastic, students might not realize the real-life applications of the skills they are practicing. In addition to mission, the cover story should be provided to the students. Cover story is the background story line that informs the students about the need of mission completion. Schank, Berman, Macpherson (1999) gives several suggestions about the cover story. According to them, it should be motivating and interesting. Also, it should force the students to search the information or to practice skills that students are wanted to learn. And to complete the mission, students should be given roles. The role also should be motivating, exciting and realistic as well as it should allow students to practice the necessary skills. Thirdly, the scenario operations should be considered in GBS. Schank, Berman, Macpherson (1999) define the scenario operations as the activities that students have to do to complete the mission. They need to be closely link to the learning goals and the mission. Also, the operations that

students do should affect the success or failure of the students. In GBS, there must be many operations students should do to achieve the mission and the scenario must include much information to manipulate. In addition, students should not be requested to do more than is necessary for the learning goals. In GBS, students should be given resources. Schank, Berman, Macpherson (1999) explain that resources in GBS should provide necessary information for students to achieve the mission. They should be well-organized and easily accessible. Finally, feedback should be given in GBS. Schank, Berman, Macpherson (1999) state that feedback can be given in three ways. It can be given through the consequences of students' actions. Moreover, online coaches can be provided to the students. During the GBS, online coach can inform the students about their performance and offer help when needed. Finally, the GBS can give feedback by domain experts telling stories related with similar experiences.

2.3 Serious Games and Game Based Learning

Susi, Johannesson and Backlund (2007) define serious game as the digital games that are used for purposes other than just entertainment. According to Zyda (2005) it is "a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives" (p.26). Finally, Corti states that goal based learning and serious games refer to the same types of games that "is all about leveraging the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills" (p.1). Zyda (2005) distinguish the serious games from other types of game by stating that serious games include not only story, art and software but also pedagogy. Pedagogy makes the game serious. In other words, serious games include activities that instruct and educate players so players build new knowledge or develop or gain skills (Zyda, 2005). However, Zyda argues that entertainment component must come first in serious games and pedagogy must be subordinate to story. In addition to Zyda, Susi, Johannesson and Backlund (2007) compare the serious games and entertainment game. Table 1 explains these differences identified by these authors.

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Table 1 *Differences between Entertainment Games and Serious Games*

	Serious Games	**Entertainment Games**
Tasks	Focus on problem solving	Preference of rich experiences
Focus	Learning or practicing necessary skills	Having fun
Simulations	Assumptions necessary for workable simulations	Simplified simulation Processes
Communication	Should reflect natural Communication	Often perfect

Serious game is considered to be effective in educational area. Kirriemuir (2004) states that there are two main reasons for the development of games for education;

1. To benefit from motivational power of games for making learning fun
2. Belief that games are powerful learning tool since they create opportunities for "learning by doing".

Games support various skills that are important for humankind such as strategic thinking, planning, communication, application of numbers, negotiating skills, group decision-making and data-handling (Kirriemuir & McFarlane, 2004). They can help the development of logical thinking and problem solving skills of players since it poses obstacles and challenges to players to overcome by using try and error approach (Higgins, 2000). They allow players to play out a particular strategy or adopt certain approach by allowing the players to repeat the same level or modified level (Corti, 2006). Hence, games take the players' attention for a long time and they are adaptable to almost any subject (Annetta, Minogue, Holmes, & Cheng, 2009). They are effective tools to teach cause-and-effect relationships and the knowledge gained from games tends to be durable due to the interactive nature of the learning experience (The new Media Consortium [NMC], 2005). Video games provide opportunities and foster students to explore beyond the boundaries of a given material. Thus, they foster students to be proactive and exploratory and make them

self-reliant learner (Taradi, Taradi, Radic, & Pokrajac, 2005). They simulates the environment that students experience in the real world or creates the one students cannot experience directly (Winn, 2002).

The opportunities provided by simulation games are especially valuable for education. Simulation games include many properties that can help players in their learning process. First of all, they can be designed to give immediate feedback about the consequences of players' actions. Secondly, game controller or designer can modify the game by adding, removing or adjusting various factors in the game. Finally, the usage of simulation games are cheaper compared to real-world training and it enables players to carry out dangerous tasks in safety environment (Kirriemuir & McFarlane, 2004). They offer players to experience something that is too costly, too risky or physically impossible to achieve in real world (Corti, 2006). According to Galvao, Matins and Gomes, simulation games are mostly applied to education and learning since they can be affective for teaching facts, concepts and principles or to teach specific skills. Mintzberg (1973) state that simulations are appropriate for experiential learning since it includes practicing skills in a realistic context and performance analysis in detail. Students are actively experience the learning process and are provided opportunities to test their hypothesis and different implications of concepts in real life settings (Galvao, Martins, & Gomes, 2000).

The studies also show positive influence of simulation games on learning process. Lee (1999) analyzed the 19 studies that targeted different subject level from K12 level to college level. He analyzed the studies in which the moderator variables such as presentation or practice and guided or unguided simulations. The meta-analysis shows that there is a positive impact of simulation games on students' learning. They are affective for both presentation and practice when used with other instructional methods and science is appropriate subject for simulation type of learning. But Lee also shows that there is negative impact of this technology on the attitudes of the students and the performances of the students are increased when guidance is given in practice mode. Vogel, Cannon-Bower, Bowers, Muse and Wright (2006) examined the variables gender, learner control, realism, age and learner collaboration on the learning of the students and found that the performance

of the students were increased when they controlled their navigation in virtual learning environment rather than teacher control it. Moreover they found that when the sequence of the program was controlled by the computer, students in traditional learning environments had higher performance than the students who use simulations and games. The meta-analysis conducted by Sitzmann (2011) was focused on how the games and simulation affects work-related skills and knowledge. He examined some variables like access level, instruction mode, the value of entertainment, the quality of methodology, type of control group treatment. The results showed that simulations could increase the learning of work related skills and knowledge. He found that students who used simulation games had 20% higher scores in self-efficacy, 11% in declarative knowledge, 14% in procedural knowledge and 9% in retention than the students in comparison groups. Moreover, he found that when students used the simulation games as many times as they wanted and when the game covered the course topics actively instead of passively and when the game was used with other instructional methods instead of stand-alone instructions, they learnt more than the students who did not use games. Merchant, Goetz, Cifuentes, Keeney-Kennicutt and Davis (2014) conducted a meta-analysis of 67 studies to investigate the effectiveness of simulations, games and virtual worlds in both K12 and higher education level. They looked at the variables such as testing conditions (transfer, immediate, repetitive and delayed), instructional mode, feedback, types of measure and research design quality and control group treatment. Their meta-analysis revealed that students who used games showed more learning gains than the ones used simulations or virtual worlds. They also found that in simulation studies, for declarative tasks elaborate explanation of feedback was appropriate whereas for procedural tasks knowledge of correct response was better. Although Vogel et al. (2009) found no significant difference between group and individual game play, Merchant, Goetz, Cifuentes, Keeney-Kennicutt and Davis (2014) that the performance of the students were increased when they played the game individually rather than the group. They also found that the number of treatment sessions had negative effects on learning outcomes in game-based learning. Similarly, in virtual worlds, the repeatedly measurement of the students decreased the learning outcome

of the students. They revealed that game was found to be more effective than virtual worlds or simulations. Games and virtual worlds were appropriate for abilities-based, knowledge-based and skill-based learning outcomes. There was not significant difference between the students in game-based learning environments who measured immediately or after a period of time which indicated that games promoted long-term learning. Like Sitzman (2011), Merchant, Goetz, Cifuentes, Keeney-Kennicutt and Davis (2014) found that when students used simulations for practice, they displayed more learning outcomes.

Serious games are also criticized by the researchers. Charsky (2010) states that many instructional computer games are lacking in sophistication, depth of learning and game play. According to him, they generally teach lower order thinking skills, facts, concepts and procedures of the specific field. Although the goal of most serious games are to facilitate learning high order thinking skills, they do not teach students how to apply and analyze their knowledge, synthesize their perceptions, or evaluate their learning (Charsky, 2010). Besides, most computer-based educational games were linear by design and lacked sustainability as educational tool (Annetta, Minogue, Holmes, & Cheng, 2009).

2.4 Serious Games and Simulations in Higher Education

Although students in higher education want to use simulations and games in their lessons (Cagiltay, 2007; Tao, Cheng, & Sun, 2009), there are not many examples of serious games and simulations in higher education. Also, the studies are generally focused on computer engineering department (for example, Wang, 2005; Chua, 2005; Veronese, Barros & Werner, 2005; Eagle & Barnes, 2009; Liu, Cheng & Huang, 2011; Ozcelik, Cagiltay & Ozcelik, 2013) and the guidelines that help the researchers and educators to develop such games are limited (Ozcelik, Cagiltay and Ozcelik, 2013).

Deshpande and Huang (2008) summarizes the simulation games in higher education under four categories; drill-based, exercise-based, problem-based and mini case. They define drill-based games as the straightforward plug-and-crank games which include particular process or phenomenon. In those games, they claim that students can observe the non-critical and critical factors that affect the particular

process. In exercise-based categories, there are games which require players to choose the appropriate technique to solve a specific problem. These games guide the students during decision making process in a multidimensional environment. In problem-based games students tries several approaches based on the assumptions made. Finally, in mini case games, students are wanted to identify the appropriate opportunity or need. They are given scenarios with suitable cover story and wanted to find a solution that meet the given constraints.

Peixoto, Possa, Resende, and Pádua (2011) examine the design characteristics of the simulation games used in Software Engineering and found five main characteristics in those games. These characteristics can also be considered as important for the simulation games in other engineering disciplines. These characteristics are clear goals and rules, feedback, virtual worlds, adaptability and game features.

Clear Goals and Rules: According to Peixoto, Possa, Resende, and Pádua (2011), the game should provide clear specific goals and rules to the players. They help players to see discrepancies about their target. Therefore, they take the attention of the players, force them to put more effort in the game environment and motivate and engage them.

Feedback: Peixoto, Possa, Resende, and Pádua (2011) consider feedback as a critical element in the game environment. They state that it support the decision of the players and gives information to the players during their learning process. They identify two kinds of feedback in the game environment, informative feedback and performance feedback. In informative feedback, players are provided information to maintain their interest and curiosity whereas in performance feedback the players are informed about their performance to achieve the predetermined goals.

Virtual Worlds: In simulation games, there is a particular reality in which players are given roles in particular situation. The role of players and their educational profile, the settings and learning goals play an important role in the determination of virtual world where gaming takes place.

Adaptability: Adaptability is an important feature to determine the quality of educational system. It helps the learning environment to meet the needs of the

students who have different learning styles, different levels of initial knowledge and different goals and expectations. According to the Peixoto, Possa, Resende, and Pádua (2011), this can be achieved by two ways, either providing different level of challenge or providing different simulation models parallel to learning goals.

Game Features: Finally, Peixoto, Possa, Resende, and Pádua (2011) state that in simulation games, it is important to integrate some features that cannot be found in real world such as score in order to encourage the players' learning process.

Although the number of studies related with the usage of games in higher education is limited, the literature contains several studies that prove the benefits of games for higher education students. For instance, in 2006, Blunt conducted causal-comparative explanatory study in order to identify the difference in academic achievement between students who used video game in learning and students who did not based on gender, ethnicity or age. He examined historical test scores of 3rd year business students from nationally known university in Arlington, VA and found that students who used games had significantly higher test scores than students who did not. There were no significant differences between males and females and between ethnic groups. Both of them who used games have higher test scores compared to others who did not use games. Finally, he found that students who were 40-year-old or younger significantly gained higher scores with game play than the ones who were 41-year-old or older. On the other hand, in 2011, Gale conducted an experimental research to determine the effectiveness of serious games as an instructional technique. He selected eight classes that contained 340 undergraduate college students in public four-year Research University located in the southeastern region of the United States in 2010 and gave the lecture in three instructional techniques: audio lecture, text reading, or serious game. He used pre-test and post-test and performed descriptive statistics, *t*-tests, and multiple repeated-measures ANOVAs in order to understand which instructional technique helped the students in the knowledge acquisition. He found that serious games increased the students' performance but when it compared with other instructional technique students using simulation games performed significantly poorer score on the post test. In other words, simulation games increased students' knowledge at a lower rate than

traditional lecture methods, audio lecture and textual reading. This study showed that serious game was statistically less effective method than other traditional lecture methods in knowledge acquisition.

In another study, Winter and Wiemeyer (2012) investigated what students thought about the game named Virtual Sport Teacher with 7 volunteer students ranging from 22 to 26 years old and 5 to 7 semester in the department. The game was by Kliem, Wendel, Winter, Wiemeyer and Göbel (2012) for pre-service physical education teachers in order to help them to practice the procedure of a typical sport lesson, the treatment to the students and arrangement of different sport exercises. Students played the game approximately 30 to 60 minutes and observed during game play. After the game play, they were delivered game experience questionnaire which contained 42 items related with seven dimensions (Immersion, Challenge, Tension, Flow, Competence, Positive Affect and Negative Affect) and interviewed. The study showed that students perceived the game as a "normal" computer game rather than learning software. Moreover, students seemed to have enjoyable game experience. They did not get bored and feel angry during game play. Finally, students thought that their game experience was interesting and they believed that the game could be an opportunity to fill the gap between education in the department and practical applications.

Denholm, Protopsaltis and de Freitas (2013) conducted a survey study with 80 students who attended Project Management or a related subject at Warwick University in order to reveal the value they give to the team-based mixed-reality games they used in their courses. They found that students generally found these games exciting and majority of them believed that "their team winning" and "showing their personal competence" were important. 70% of the participants stated that working in teams was one of the strongest elements that affected the value of the game and 60% of them indicated conflict was also important. 75% of them said that their "working in teams" skill was improved. The participants rated the value of feedback highly and stated that it increased motivation. Over 60% of the participants indicated that playing games about a specific topic were more useful than participating to the lectures. Students in the study mentioned that feedback was the

main contributor to affective learning process. Especially they valued tutor feedback important. Students also mentioned that team based mixed reality games were helpful for acquiring both theoretical and practical knowledge and increased their motivation.

Ozcelik, Cagiltay and Ozcelik, (2013) investigated the effect of uncertainty on the learning achievement of the students in the department of computer engineering, software engineering and information system engineering. They developed a game like learning tool in order to teach database concept and 140 undergraduate students were attended to their experimental study. They found that uncertainty enhances both learning and motivation. They concluded that uncertainty affected the motivation of the students positively and motivation causes students to spend more time on questions and to have higher accuracy in questions. According to them the combination of high motivation, accuracy, uncertainty and response time caused students to gain higher scores in the posttest.

Ebner and Holzinger (2007) conducted an experimental study with 121 seventh semester student in Master's level. They developed an online game named Internal Force Master which aims to help civil engineering students to carefully identify the correct internal forces among the wrong solutions within a short time. They found that students who played games showed equal achievement with students who used traditional learning methods. Moreover, students enjoyed the usage of games for learning. For these reasons, they believed that games could be useful method in the education of Civil Engineering Master level students. Based on their findings, the researchers gave suggestions about the game design. They recommended that players had to be motivated to play. Thus, they believed that useful games should be created for the target group. In addition, they stated that the game had to be simple and played in short time, available anytime and anywhere and encourage competition. Related with civil engineering, Nikolic (2011) developed and implemented a simulation game called Virtual Construction Simulator 3 in order to provide active learning experiences to the construction engineering students and increase their decision making process as well as their knowledge about construction project planning and management. She assessed the game with 97 students at Penn

State. She found that VCS3 helped the students to form more holistic views of construction scheduling and to deal with management challenges. It also increased the motivation and interest of students in learning about construction process and time and cost tradeoffs. Finally, she found that immediate feedback and goal-driven exploration helped the students to be active learners instead of passive learner and they created opportunities to find more questions and enhance more in-class discussions.

In one study, Philpot, Hubing, Hall, Flori, Oglesby and Yellamraju (2003) used two games named Q-tile and The Mohr's Circle Game in used both in mechanics of material and the statics courses in mechanical engineering department. The games were assigned as homework and students were wanted to gain the score of 90% or higher. In their study, it was found that students enjoyed the games and generally get near-perfect scores. Moreover, the games provided more in-class discussions. Moreover, the instructors stated that the game appeared to increase the performance of the students in the target topics. In another experimental study in mechanical engineering, Coller and Scott (2009) used a game in numerical method course. All the learning experiences and assignments were anchored in the game. Students used the content of the lessons to race a car. The researchers found that students who played games spent approximately twice as much time as on the course outside the classroom compared to the students attended to textbook-based course. They also gave higher rates to the importance of the course than the students in traditional classroom. In addition, students in game-based classroom showed deeper learning in concept mapping exercise than the students in textbook-based course.

In 1995, Bringelson, Lyth, Reck and Landeros (1995) developed a game named National Consortium for Technology in Business (NCTB) and integrated this game to the department of industrial engineering and business students. In this game, students were required to required students to make a series of decisions related with production, marketing, purchasing and quality control. During the semester, students played the game and at the end of the semester, they were asked to identify the strengths and weaknesses of the game. The researchers found that students enjoyed their experiences and understood the nature and complexity of decision making

process in manufacturing environment. According to the students in the study, working with students with different perspectives in a team was strength of the game. Moreover, the game helped them to understand the contents of the course and their real world applications. As weakness, students pointed out the difficulty of arranging the meeting with teammates, spending much time on the learning of the software and the market at the beginning and their need for more detailed feedback related with their decisions and the impact of the decisions. Similarly, Cox and Walker (2004) developed a non-computerized Socratic Dice and Penny game in order to help the students to understand the concepts of planning, balancing and control. The game was played by 39 undergraduate students and 28 MBA students. The results of the survey data and commends of the students showed that students had positive attitudes towards the game and enjoyed their game experience. Moreover, they believed that the game was an effective method to understand these line design, production planning and control concepts. In 2004, also Hirose, Sugiura and Shimomoto developed Industrial Waste game related with environmental engineering and searched for its effectiveness in environmental education. 213 undergraduate students attend social psychology course participated in the study. The students were asked to fill the questionnaire related with industrial waste issue before and after game play in order to estimate the educational effect of the game on students. The results showed that the awareness of the students related with industrial waste problems was increased. Students stated that they gain interesting experience by playing the game and attending post-game discussions and their motivations to learn more related with the issue were increased. Moreover, Arunachalam and Sadeh (2005) reported a web based multi-agent simulation game named The Supply Chain Management Trading agent competition (TAC-SCM) related with industrial engineering. The game was developed at the Carnegie Mellon University and it simulated typical supply chain under realistic conditions. The game was played with 20 teams around the world and all teams were competed each other. The researchers believed that the game and 2003 tournament showed that the game offered new visions to the supply chain trading technologies. Moreover, according to the

researchers the high number of players in the tournament showed the interest of people to the game.

2.4.1 Serious Games and Simulations in Mining Field

Because of the high rate of injury and fatality, training is highly important in the mining field (Kizil, Kerridge and Hancock, 2004). Hence, researchers have investigated the alternative ways for educating miners effectively. Especially, virtual reality simulations have taken the interest of the researchers in mining field and a wide variety of applications have been developed. Kızıl and Joy (2001) find that VR is used in many areas in the field such as data visualization, risk analysis, accident reconstructions, hazard awareness and training of operators and drivers. Tichon and Burgess-Limerick (2009) state that simulations and simulation games generally used in four main categories; mining equipment operation, mining equipment safety, mining hazard identification, mines safety training. According to Kızıl and Joy (2001), there are various reasons for this interest. They state that the combination of high quality graphics in three dimensions, sounds and high interaction in virtual reality help the trainees to gain a unique experience. Thus, they believe that virtual reality can contribute to the improvement of minerals industry. They point out that it has capacity not only to enhance productivity and better utilization of time but also increase safety awareness and so decrease incidents in the field. According to them, virtual reality technologies have the potential to save the lives and increase the safety records in mining field.

The literature provides several implementations of simulations in mining field. For instance, the researchers working in National Institute for Occupational Safety and Health (NIOSH) in U.S. develops many virtual reality applications in order to educate both mine workers and rescue personnel. With the help of the game graphic engine in the applications, trainees can navigate in the mine environment and they can both identify and avoid the hazards (Filigenzi, Orr & Ruff, 2000). In addition, mining technology unit (HATCH) and MIRARCO of Laurentian University in CANADA design virtual reality application for safety education including accident recreation, enhancement of operator visibility while using drivers in underground mines and equipment design for particular working environments

(Delabbio, Dunn, Iturregui and Hitchcock, 2003). The researchers in School of Mining Engineering at the University of New South Wales in Australia design a virtual simulation which simulates mining work environment. In this mine environment, the users are presented problem-based learning exercises in order to develop their problem solving skills and prepare them for their career (Stothard, Galvin and Fowler, 2004). Shafrik, Karmis and Agioutantis (2003) develop VR application which simulates haulage truck incidents in surface mining. By this application, users can investigate the causes of accidents by altering actions. Fei and Anbi (2011) develop a virtual mine specifically for metal mines. The application includes four main parts; mine roaming, mining process simulation, mine accident simulation and mine equipment manipulation. Finally, The University of Pretoria (UP) in Africa build a virtual reality center in which the students and the workers in the mining field can be educated safely in a simulated mining environment (Buthelezi, 2012). Especially undergraduate mining students can implement a range of mining functions such as mineral extraction methods, planning and designing of mine and mining systems etc. (Buthelezi, 2012).

Several studies show that the virtual reality technologies can be an effective tool in the education of both workers and students in mining field. For instance, Squelch (2001) conducted an experimental research related with the usage of virtual reality in mine workers training in South Africa with 30 workers. A virtual reality application about mine safety was developed for the study. The participants were divided into two groups. One group received VR-based training program whereas the others was given video-based training. The participants were given 5 point scale in order to evaluate the ease of visual material to understand the mine safety. The findings of the study showed that both VR group (81%) and video group (94%) rated the video and VR as "easy to understand". According to the study, although the participants had little or no computer experience, VR was useful for education of miners. The participants did not need to have high level of computer skills or literacy to benefit from VR Technologies. He found that both VR group (77%) and video group (94%) thought there was a good level of realism in the materials. According to the researcher, this showed that VR had potential to present materials realistically as

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much as videos. None of the participants showed fear of the equipment. Moreover, the open-ended questions showed that their self-esteem and opinions about mine management were increased due to the usage of VR. Although 94% of the participants in video group satisfied with their learning experience and preferred to be trained via video than other materials excluding VR, by analyzing the video training period, it was seen that 22% was asleeping during the video, 28% was not pay attention to the video. According to the study, this was an important finding which showed the advantage of VR over the video for the education of workers in mining field. He explained that participants in video-based training were passive whereas participants in VR groups had to be active. VR provided hands-on interaction so that trainees in VR group could not asleeping during the training. The researcher concluded that virtual reality applications could be an effective educational tool in the mine hazard training field especially in South African mining industry.

Mallett and Orr (2008) conducted a study with a game developed by the researchers at National Institute for Occupational Safety and Health (NIOSH). The game simulated an underground coal mine in order to teach how to read mine maps to the miners. The players were given tasks that force them to find predetermined locations using mine maps. The game was tested in three training locations with 135 miners ranged from 18 to 54 years old. Although the participants played the game together in the class and only one person used keyboard or mouse to perform the actions decided by the miners together, the interviews with the participants showed that 99% of the enjoyed the game and their learning experiences and 92% of the participants wanted to attend training that included computer based sessions in the future. Moreover, 52% of the participants found the game realistic and 23% gave positive feedback related with engagement. 5% of the participants emphasized the part in which they lost. According to them, this part showed them what they should expect and do when they lost in mine. Finally, when participants were asked related with negative parts of their training, 41% of the participants stated that they did not have any negative comments and 9% stated that the game should be more challenging.

Brnich, Mallett, Reinke and Vaught (2004) conducted another study with emergency command center personnel using Mine Emergency Response Interactive Training Simulation (MERITS). MERITS was a simulation that aimed to teach emergency command center personnel how to manage an underground mine fire effectively. It simulated an underground coal mine. Users were informed about the problems occurred in the simulated mine and asked for the actions to overcome the problems. By using MERITS, the personnel in command center could practice some of the necessary skill for their job such as information gathering, decision-making, and coordination skill and situation assessment in safe environment. The scenario of the simulation was shaped by the decision and emergency response plans of the users. The simulation was tested in four different locations in U.S.A by 49 participants who have more than 15 years working experience in mining field. The participants were given 5 Likert type questionnaire in order to reveal their opinions regarding with MERITS. All the participants in the study enjoyed their experiences and stated the simulation was not bored and help them to learn how to be prepared and handle a real emergency better. Moreover, majority of the participants (95.7 %) found the storyline of the simulation realistic. Based on the positive results gathered from the participants who were experts and had familiarity with the skills and performances in management of mine emergency, the author concluded that MERITS could be a useful tool to teach how to respond to mine emergency.

Wu and Chen (2009) implemented a research in mining engineering department. For their research, a virtual reality simulation system was developed by using OpenGL and VS2005 platform. It simulated development and transportation system and the transportation scheduling process of underground tramcars in three dimensions. They stated that by the help of virtual reality simulation, students could be introduced to virtual scene of mine and they could both interact with scenes and be assisted in the planning, designing and management of mine. Although the number of students who used the simulation was not given by the researchers, it was reported that many students said that their self-confidence and their interest to professional knowledge is increased by the simulation. In the study the instructors were also surveyed in order to estimate the performance of students who used

simulation under the guidance of instructor. The instructors stated that the ability of students to solve the practical problems in mining engineering and their research ability was increased when they used simulation under their guidance.

CHAPTER 3

METHOD

In this chapter the detailed design of the study is covered. The overall design of the study, the justification of methodology, participants of the study, data collection instruments, data collection and analysis procedures are explained in detail.

3.1. Research Problem and Research Questions

The purpose of this study is to examine the experience of mining engineering students using simulation games for educational purpose thereby making contribution to the literature in designing, developing and evaluating games for educational environment. It seeks how non-gamer and gamer students describe their experiences in detail. In accordance with this research problem, the following research questions were investigated.

- How do gamer and non-gamer mining engineering students perceive and describe the phenomenon of using simulation games for educational purpose?

The sub research questions of this study are;

- o How does this experience affect gamer and non-gamer mining engineering students' opinions about the usage of simulation games for educational purpose?
- o How do gamer and non-gamer mining engineering students identify the strengths and weaknesses of simulation game used in this study?
- o What are the motivational elements in simulation games identified by gamer and non-gamer mining engineering students based on their experience?
- o What do they suggest to improve the effectiveness of the simulation game they used?

3.2 Design of the Study

To answer these research questions stated above, qualitative research design was implemented. More specifically, in this study phenomenological research was carried out. Phenomenological research is a qualitative research technique that seeks to "make explicit the implicit structure and meaning of human experience "(Sanders, 1982). It refers to the totality of lived experiences that belong to a single person (Giorgi, 1997). It aims to determine "what an experience means for people who have had the experience and are able to provide a comprehensive description of it" (Moustakas, 1994). Thus, phenomenological framework and methodology is appropriate for the purpose of this study.

Phenomenology is a study that describes the meaning of several individuals' lived experiences of a concept or phenomenon (Creswell, 2007). "Phenomena" is a Greek word that means "to show oneself" or "to appear" (Sanders, 1982). Phenomenology studies how the experience presents itself in conscious subject. In other words, it studies conscious phenomena (Sanders, 1982). Moustakas (1994) defines phenomenological study as scientific study of the appearance of the experience in the conscious. Sander (1982) states that phenomenology seeks for essence that cannot be identified by ordinary observation. In addition, he states that it does not concentrate on the subject of experience or the object of experience. Instead, it focuses on the point in which "being and consciousness meet" (Sanders, 1982).

Phenomenological study aims to obtain descriptions of experience. It does not focus on what cause the experience or whether the description of the experience belongs to independent reality. It does not aim to do generalization, identify the functional relationship or develop a theory. Instead, it tries to generate insights so that people contact with phenomena (Cilesiz, 2010). The phenomenological researcher avoids from making assumptions and focuses on a specific phenomenon freshly and naively. He identifies a research question or a problem that guides the study and come up with findings that will lead to further research and reflection (Moustakas, 1994).

In phenomenological research, there are two interrelated dimension in every experience; noesis and noema. Manen (1990) describes noesis as "denotes that to

which we orient ourselves; it is the object referent of noesis" and noema as "the interpretative act directed to an intentional object, the noema" (pg. 183). The correlation between the object as perceived (noema) and the subjective apprehension (noesis) of that object in consciousness are intentionally analyzed in order to find the essence of the experience (Sanders, 1982). The term "intentionality" is used by Husserl in order to describe the correlation between conscious subject and their object (Cilesiz, 2010). According to Husserl (1982), it describes total meaning of the object, which is more than what is given in the perception of a single profile or perspective (cited in Sanders, 1982). In addition, every experience includes textures and structures. Texture is outside appearance of the experience whereas structure is what might account for or underline the textures. The essence of the experience is investigated by identifying the textures and structures underlying the textures and focusing on commonalities of the nature of the experience (Cilesiz, 2010). The phenomenological researcher use specific method named "imaginative variation" which helps to establish essential intuitions along his disciplinary lines while identifying the essence of experience (Giorgi, 1997).

In phenomenological research, the beliefs, attitudes, and assumptions of the researcher affect the researcher while she focuses on the experience of the individual. Thus, researchers need to temporary suspend all her beliefs, attitudes, assumptions about the experience that is being investigated in order to understand what the pure vision; the "essence" of the experience is (Sanders, 1982). The suspension process is called "epoché".

Creswell (2007) defines the philosophical arguments of phenomenological study. According to him, these philosophical arguments are;

- The study of persons' lived experiences,
- The view that these are consciousness experiences,
- The identification these essences descriptions not their explanations or analyses.

In phenomenological research, Sanders (1982) states that researcher performs eidetic reduction process in which he abstracts the essences from consciousness experience. The researcher goes beyond the pattern of conventional structures or

thoughts and actions with the aim of determining their common grounds. He accomplishes this by using intuition and reflection. For this reason, phenomenological studies are blamed as being "subjective". But, Husserl objects to this accusation (cited in Sanders, 1982). He indicated that "the objective is the manifest presence of what appears and can be recognized only subjectively by the person who perceiving it" (cited in Moustakas, 1994). Thus, phenomenological researcher opposes to separation of subject and object. Instead, in phenomenological studies, it is believed that there is a relationship between external perception of natural objects and internal perceptions, memories and judgments about that object (Moustakas, 1994). Thus, according to Husserl, researchers use subjectivity to go beyond the object appearances. For this reason, there is empirical subjectivity in phenomenological research (cited in Sanders, 1982).

3.3 Participants of the Study

This study aimed to identify the gamer and non-gamer mining engineering students' experiences of using simulation games for educational purpose and six mining engineering students attended to the study. Since phenomenological research seeks to identify the experience of individuals and determine the essence of the experience through the eyes of the participants, participants should have the ability to reflect on and to provide full descriptions of their lived experiences (Creswell, 2007; Cilesiz, 2010). Therefore, it is suggested that the number of the participants does not need to be high, few participants (3-10 participants) are considered to be appropriate for phenomenological studies (Creswell, 2007; Cilesiz, 2010).

Two homogenous groups which were gamer and non-gamer were formed in this study, since this study aimed to investigate how each group experience the phenomenon. In each group, three mining engineering students were participated.

The participant pool was comprised of mining engineering students in one of the well-known public university in Ankara, Turkey. To form two homogenous groups (gamer group and non-gamer group), some criteria were identified. First of all, to create the phenomena participants should not have had any educational game playing experience before. In addition, all of the participants were wanted to have summer practice experience in order to compare their game and summer practice

experiences. To be more specific, for gamer group, the participants of this study were;

- Students of mining engineering department who were interested in playing games for entertainment
- Volunteer to participate in the study,
- Attended to summer practice,
- In the third year of their department and
- Did not have any experience of playing educational games.

For non-gamer group, the participants of this study were;

- Students of mining engineering department who were not interested in playing games for entertainment
- Volunteer to participate in the study,
- Attended to summer practice,
- In the third year of their department and
- Did not have any experience of playing educational games.

In order to find the participants who met the criteria defined at the beginning of the study, students in third year of the mining engineering department were given a survey and asked to complete it. The survey was prepared by the researcher in order to gain demographic data of the participant pool and three experts in the Department of Computer Education and Instructional Technology checked its appropriateness. At the end, 43 students filled out the questionnaire (See Appendix A). In Table 2, the details about the participant pool were given in detail.

Table 2 *Details of Participant Pool*

Variable		Frequencies	Percentages
Gender			
	Female	19	44.2 %
	Male	23	53.5 %
C.GPA			
	Less than 2.00	8	18.5 %
	2.01-3.00	18	65.2 %
	3.01-4.00	4	9.2 %
Computer Ownership			
	Yes	41	95.3 %
	No	2	4.7 %
Computer Usage			
	4-10 years	19	44.2 %
	More than 10 years	20	46.5 %
Game Playing			
	Yes	33	76.7%
	No	9	20.9%
Game Type			
	Action	22	51.2%
	Adventure	12	27.9%
	Fight	8	18.6%
	Puzzle	15	34.9%
	Role Playing	8	18.6%
	Simulation	13	30.2%
	Sport	17	39.5%
	Strategy	22	51.2%
Educational Game Experience			
	Yes	8	18.6%
	No	34	78.6%
Voluntariness			
	Yes	17	39.5%
	No	22	51.2%

In this study, criterion and purposeful sampling method was used. In addition to the criteria defined at the beginning of the study, the C.PGA score of the students in participant pool were analyzed and found that majority of students in participant pool

had C.GPA score between 2.01 and 3.00. Hence, from the participant pool, the participants who met the criteria and had C.GPA between 2.01 and 3.00 were identified. At the end, six mining engineering students (three for gamer group, three for non-gamer group) were invited to participate to the study. In Table 3 the details of the participants in this study were given in detail. The participants in this study were between 22 and 25 years of age whose cumulative GPA scores were in the range of 2.00 and 2.72. All of the participants had computers and used it at least four years. Similarly, all of the participants did not have any educational game experiences.

Table 3 *Details of the Participants*

	Kim	Manny	Johnson	Claire	Michael	David
Age	22	22	25	21	21	22
C.GPA	2.21	2.33	2.00	2.21	2.60	2.72
Computer Ownership						
	Yes	Yes	Yes	Yes	Yes	Yes
Computer Usage						
	4 years	6 years	> 10 years	> 10 years	6 years	> 10 years
Game Playing						
	No	No	No	7 years	12 years	12 years
Game Type						
	No	No	No	Puzzle Simulation	Action Simulation Role-Playing	Action Adventure Simulation Sport
Educational Game Experience						
	No	No	No	No	No	No

3.4 Data Collection Instruments

In this study, interviews and observations were used to collect data. First of all, for this study, an interview protocol was prepared for participants in order to identify their experiences in using the simulation game for educational purpose (See Appendix B). Giorgi (1997) pointed out that in phenomenological research, what is sought is a concrete, detailed description of individual experiences so he he suggested that the questions in the interview should be broad and open ended. To

achieve this, in this study, the interview protocol was divided in two parts. In first part, their general opinions related with their department, their summer practices, their profession, game playing and game usage in educational settings were gathered. By these questions, the researcher in this study aimed to gain detailed information about the participants and about their pre-opinions related with games and their usage for education. In the second part, the questions that aimed to reveal their experiences and how their opinions related with the usage of games in educational settings were changed based on their experiences were identified. The interview protocol was used for both phenomenological interview and focus group interviews.

The interview protocol of this study was prepared by the researcher. At the beginning of the study, the interview protocol was checked by three experts in the Department of Computer Education and Instructional Technology. Based on their suggestions, the protocol was revised. Two questions were omitted and three questions were rewritten. In addition to expert check, the appropriateness of interview protocol was controlled with three students in pilot study. Based on the feedback from the students, one question related with the strengths and weaknesses of the game were added. In the first part of the interview protocol, there were totally 10 questions. There were 5 main questions related with their general opinions of students about their department, 1 question about their summer practices, 2 questions about their profession, 1 question about game playing and 1 question game usage in educational settings. Moreover, in the second part of the interview there were totally 16 questions that addressed the research questions. There were 3 questions about the opinions of the participants related with game usage in educational settings, 4 questions about the strengths and weaknesses of the game used in this study, 7 questions about motivational elements in the game and 2 questions about the suggestions of students to increase the benefits of the game.

In addition to interview protocol, an observation schedule was prepared for this study for triangulation. The observation schedule was prepared by the researcher and was checked by one expert in the Department of Educational Sciences. The observation data was collected in order to support the findings of interview data. During the game playing sessions, participants were observed while they were

playing. The main concern of the observation was identifying the actions and reactions of the students, their needs in game environment and their experiences. The researcher focused on what participants in the study faced and how they reacted in the game environment and took notes. The observation data and the interview data were analyzed and the observation data was discussed with participants for helping them to express their experience in detail.

In observation process, two video cameras were used. One camera recorded face expression of the participants while the other recorded the actions of the participants in the game environment.

3.5 Data Collection Process

In this phenomenological research, qualitative data collection method was carried out. Merriam (2009) states that in qualitative study the researcher is the main instrument of data collection and analysis. For this reason, Merriam (2009) identifies the characteristics that a qualitative researcher should have. According to her, a qualitative researcher should be tolerant for ambiguity, sensitive and develop good communication, listening and writing skills (Merriam, 1998). The researcher have taken a course "Qualitative Research Methods in Education" so she has gained the necessary skills mentioned by Merriam (2009) to conduct a qualitative study. In qualitative research, there are two main data collection techniques. These methods are interviews and observations (Bogdan & Biklen, 2007; Marshall & Rossman, 2006). For this reason, those two methods was used in order to collect data. The data were collected by semi-structured interviews, focus interview and observations. In phenomenological study, three open interviews should be conducted for each participant. The first interview establishes the context of the participants' experience. Second one allows the participant to reconstruct the experience in detailed way. Finally, the last one encourages the participants to reflect on the experience they had (Cilesiz, 2010). Hence, in this study three semi-structured interviews with the participants were conducted one by one. In addition, at the end a focus group interview was conducted with all the participants together in order to share their experiences. All the interviews were recorded with digital voice recorder. This study

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was include three liner phases. In Table 4, data collection process in this study was given in detail.

First phase (Reflection of the Researcher): In the first phase of the research, the researcher wrote her experience about learning from simulation games. By this technique, she tried to separate her attitudes, beliefs from the findings of the study. In other words, she tried to focus on the participants' experience by isolating her experience about the phenomena "using simulation games for educational purpose".

Second Phase (Game Assessment): In the second phase, the simulation game used in this study was analyzed in order to determine its appropriateness for the mining engineering department. One expert in the mining field and one mining engineer and one graduate student who had master's degree in mining engineering were asked to play the game and assessed its realism and its educational value in detail.

Third Phase (Students Implementation): In the third phase, the data was gathered from the participants.

Intervention 1 (Orientation): The participants were conducted a semi-structured interview one by one. In those interviews, their attitudes towards the simulation games, their department, their profession, the education in their department was investigated. The interviews with each participant took approximately 20 minutes. Then, they were asked to play the first level of the simulation game for a week in order to get them used to the simulation game used in this study.

Intervention 2 (Game Experience): After one week, the participants were invited to play the second level of the game for an hour in a laboratory near the researcher one by one. The laboratory was called Technology Enhanced Learning Research and Applications Lab and allocated for the special studies in graduate level. The laboratory was equipped with technology such as LED TV, projector, cameras, eye-tracking machine. Moreover, the laboratory was designed as living room and included sofa sets and a table in order to make the users to feel comfortable during studies.

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During Intervention: The participants were observed during the game period for between 46 and 108 minutes, their face expressions and their actions in the game environment were recorded by two video cameras.

After Intervention: The participants were interviewed in order to identify their experience during the game playing session in detail. The interviews took between 35 and 45 minutes for each participant. The data obtained by video cameras was used to support of the data obtained from observation and was discussed with participant for allowing the participants express himself/herself better. Participants were also asked to continue to play the game and finish the level at their home.

Intervention 3 (Game Experience): After a week, the participants were invited to play the next level of the game in the same laboratory again.

During Intervention: The participants were observed during the game period for 61 and 103 minutes, their face expressions and their actions in the game environment were recorded by two video cameras.

After Intervention: The participants were interviewed in order to identify their experience during the game playing session in detail. The interviews took between 35-45 minutes for each participant. The data obtained by video cameras were used to support the data obtained from observation and was discussed with participant for allowing the participants express himself/herself better. They were also asked to compare their game play with the previous one. Participants were also asked to continue to play the game and finish the level at their home.

Intervention 4 (Group Discussion): Finally, the participants were invited to focus group interview to share their experiences and attitudes towards the simulation game. All the participants attended the focus group interview and it took 40 minutes.

Table 4 *Data Collection Process*

Phases in the Study		Duration
Phase 1: Reflection of the Researcher		
Time	2nd week of March	
Participants	Researcher	
Data Collection	Reflection paper	
Phase 2: Game Assessment		
Time	3rd week of March	
Intervention	Game Play	
Participants	Expert, Mining Engineer,	10-40 min.
	Graduate Mining Engineering Student	
Data Collection	Interview	
Phase 3: Students Implementation		
Intervention 1: Orientation		
Time	4th week of March	
Intervention	Game Play	
Participants	Mining Engineering Students	
Data Collection	Interview	20 min.
Intervention 2: Game Experience		
Time	1st week of April	
Intervention	Game Play	
Participants	Mining Engineering Students	
Data Collection	Observation, Interview	46-108 min,
		35-45 min.
Intervention 3: Game Experience		
Time	2nd week of April	
Intervention	Game Play	
Participants	Mining Engineering Students	
Data Collection	Observation, Interview	61-103 min,
		35-45 min.
Intervention 4: Group Discussion		
Time	3rd week of April	
Intervention	Discussion	
Participants	Participants	
Data Collection	Focus Group Interview	40 min.

In addition, the time each participant spent on missions in interventions were given in Table 5. Table 5 showed that in intervention 2, one participant completed only one mission in 60 minutes. On the other hand, the other participants completed at least two missions in the game environment in intervention 2. However in intervention 3, all of the participants finished at least two missions during the observation.

Table 5 *Times the Participant Spent on Each Mission*

	Intervention 2			Intervention 3			
Missions	**1.**	**2.**	**3.**	**1.**	**2.**	**3.**	**4.**
Manny	49 min.	18 min	-	8 min	26 min	32 min	18 min
Kim	60 min	-	-	38 min	40 min	25 min	-
Johnson	48 min	50 min	-	20 min	30 min	32 min	-
Claire	7 min	45 min	-	50 min	30 min	-	-
Michael	30 min	7 min	9 min	13 min	36 min	32 min	12 min
David	24 min	26 min	8 min	3 min	23 min	15 min	20 min

3.6 Data Analysis

Data was analyzed based on the suggestions of Giorgi. Giorgi (1997) explains the phenomenological analysis of data in four steps;

1. *Reading of the data*

   As indicated by Giorgi (1997), the researcher should read the whole data before analyzing the data and Cilesiz (2011) suggested that the researcher read the data multiple times and gives equal value to the all statements related with the phenomena. Hence, the data obtained in this study was transcribed, read, reread and related statements were given equal value by the researcher.

2. *Breaking of the data into some kind of parts*

   The data obtained in this study was divided into "meaning units". Giorgi (1997) indicates that the researcher identifies the meaning units by splitting statements when the meaning is changed. The transcribed data was divided into the meaning units by organizing the statements of the participants by the researcher.

3. *Organization and expression of the data from a disciplinary perspective*

   After the meaning units are identified, Girogi (1997) states that the researcher should express these units in his or her discipline in order to help the audience to understand the phenomena better. The researcher analyzed the meaning units and identified themes that could helped the reader to understand individual textual descriptions of the experiences of each participants. Then, she elaborated on the individual textual

descriptions to arrive at the underlying structures of the experience, asking what could possibly account for the experience.

4. *Synthesis or summary of the data for purposes of communication to the scholarly community*

The individual textual and structural descriptions of the experience of the participants were identified and combined.

3.7 Trustworthiness of the Study

Merriam (2009) explains that in qualitative research, validity refers to trustworthiness of the data interpretation. It confirms that the findings of the qualitative study are gathered from the properly implementation of the research methods. Guba (1985) states that trustworthiness contains four aspects which are credibility, transferability, dependability and confirmability. In qualitative research, the term credibility is used for internal validity, transferability used for of external validity, dependability used for reliability and confirmability used for objectivity (Yildirim & Simsek, 2006).

Merriam (2009) describes credibility as "deals with the question of how research findings match reality" (p. 213). In addition, Merriam (2009) suggests several strategies to enhance the findings credibility such as methods, data source, investigator and theory triangulation, member check, peer examination and adequate engagement in data collection. In this study, the data was collected with multiple methods (interview and observation). Moreover, the process and findings were discussed and reviewed with peer reviewer in order to estimate their appropriateness. Also, the findings were discussed with the participants of this study to investigate whether they represented the opinions and experience of each participant.

According to Merriam (2009), transferability is "concerned with the extent to which the findings of one study can be applied to other situations" (p. 223). She suggests thick description to increase transferability. To increase the transferability of the study, the characteristics of the participants and description of the study were given in detail.

Merriam (2009) states that replicating the qualitative research will not produce the same results since human behavior is not static. Thus, she explains that if

the findings are consistent with the data, the study is dependable. To increase dependability of this study, the findings were checked with both the participants and a graduate student in order to estimate the appropriateness of the findings based on the data.

Finally, to ensure the confirmability (objectivity) of the study, the researcher used triangulation and engaged bracketing process to avoid personal judgments. Moreover, she wrote her opinions regarding with the usage of games for education to be aware of her own prejudgements and avoid her biases in data analysis process. She made her co-workers and participants to be aware of her opinions and asked them whether the findings obtained from the data were affected by these prejudgements.

3.8 Simulation Game

Simulation game that was used in this study is a commercial game. This game simulated a mine environment. In the game environment, players owned a quarry and they were supposed to produce several rocks and minerals by using numerous vehicles such as wheel loaders and dump trucks etc. During the game play, several customers asked the player to produce specific rocks. The players were informed about the demand of the customer and the money the customer would pay for the mission and they decided whether to accept the mission or not. The game provided three levels to the players. In each level, different stone quarry was (marble, limestone, granite) was given to the players and they were requested to produce several rocks and minerals.

Since quarrying is one type of the mining, this game is appropriate for mining engineering education. This simulation game provided an opportunity to explore a fieldwork and learn the usage of several vehicles and equipment, their capabilities in realistic mining context. The game not only allowed the players to see the main mining operations such as drilling, blasting, loading and hauling but also helped them to apply these operations in game environment. The player should consider many things in order to produce the ore and crush it. For instance, they had to determine the vehicles and equipment so it helped them to gain insight about the importance of the vehicle and equipment selection in mining. Also, they could

experience the difficulty to use the vehicles in mining environment. Since they did everything in the game environment, they could experience how the distance between the mine site and the crusher plant affected the production. Finally, they could see the relation between the vehicles and bench height. In Table 6, the benefits of the game for mining engineering education are given in detailed.

Table 6 *The Benefits of the Game Used in this Study*

Necessary Skills and Knowledge in Mining Engineering	Benefits of the Game used in this Study
Students should know the basics of an open pit environment and be able to design open pit environment.	Game simulates three different open pit environments in 3D which allows students to explore realistic quarrying environments and determine the necessary elements in quarrying.
Students should know the main operational stages and relationships between them in quarrying.	Game allows students to learn and experience the mining operations by forcing them to do all the stages themselves. Also, it allows students to see these operations as a whole and comprehend them deeply.
Students should know the equipment used in drilling and be able to solve the problems that can be seen in drilling processes.	Games allow students to drill by using drilling equipment and experience the possible problems in 3D environment.
Students should know the blasting pattern design.	Students can implement blasting pattern design in game environment.
Students should know the equipment used in loading and their effects on production.	Games allow students to use several equipment used in loading and help them to understand their relationship in realistic environment.
Students should know the relationship between the equipment and the design of the quarrying.	Students used equipment in the game environment and they experience the relationship between the design of the quarrying such as bench geometry and equipment properties.

Table 6 (Continued)

Students should know the elements that affect the transportation.	Students can experience the transportation process and investigate what affects transportation and how in game environment.
Students should know the importance of mine design and the effects of design on production	Students run a quarry and explore the importance of design and their effects on production in 3D environment.
Students should know the role of crushing grinding plant in the end product production.	Students can experience the crushing grinding plant role by producing products in quarrying.
Students should know the mining equipment and their relations.	Game allows students to see the relationship between mine equipment by performing mining operations and help them to understand the importance of selecting the proper equipment in quarrying. Moreover, they experience the possible problems in using these vehicles in quarrying.
Students should be aware of the problems that can be seen in quarrying and be able to solve these problems.	Students run a quarry, experience the possible problems in quarrying and try to solve them.
Students should know the mineral economics.	Students are demanded to produce several products for money. Hence, they evaluate the value of mineral and its production cost in game environment.
Students should know the quarry products obtained in open pit environment and their value hierarchy.	Students can produce several products such as limestone, rail blast in quarrying so they get information about these products. Also, they sell the products so they gain information about their value in market.

The simulation game meets the assumptions of constructivism. According to Ertmer, Peggy, Newby and Timothy (1993), there are five assumptions in constructivism. First of all, constructivism emphases on the identification of the

context in which learners learn and apply the necessary skills. The simulation game that was used in this study simulated a mining field in which students could apply the necessary skills for their working life. In constructivism, learners control the learning process and they are provided opportunities to manipulate the information and use what they learn. In the game, students were requested to produce several rocks. To accomplish this, they were provided machines and vehicles that could be seen in mining field. They could make hypothesis and could test their knowledge by using those vehicles and machines. They could apply what they learnt and accommodated their knowledge based on what they experienced in the game environment. Moreover, in constructivist environments, information is presented in different ways such as learners revisit the content at different times for different purpose and from different context. Since the game provides three levels, students revisited the content at different levels and from different context. It supported the development of problem solving skills of the learners and fostered them to go beyond the given information. In the game, students developed their problem solving skills while they were producing, carrying and crushing ore. They performed variety of activities such as deciding where to drill, which vehicle they should use, how they could produce the necessary stone etc. Finally, the students were assessed whether they transferred their knowledge and skills to different context. Game assessed the students by their skills. If the students performed the necessary activities and earn enough money, they were allowed to play the next level.

In addition to constructivism, the game was also appropriate to the experimental learning theory. Dorn (1989) states that simulation games are based on experiential learning theory and includes four stages. In first stage, students practice an activity. In the second stage, they observe the effects of their behavior and decisions, what happens after they practice an activity. In stage three, they try to understand the general principles and develop theory or models based on their observations. In the last stage, they apply their theory or models to a new context. The game provided environment in which students performed activities in order to produce demanded stones using several vehicles and equipment such trucks or dynamites etc. They could observe the consequences of their actions or decisions.

Since they performed the activities many times, students may develop a theory or model in order to do activities effectively and efficiently. Finally, since they were provided different levels, they were given opportunities to plan and test their theories or models.

3.9 The Researcher

3.9.1 Subjectivity Statement

Literature about the usage of simulation games for education in engineering education especially in mining engineering is not deep enough. The researcher in this study believed that more researches were needed to clearly understand their effect on the students in the engineering education. She thought that the engineering was difficult job and the education in the engineering department was important for the success of the students in their future career. In addition, she thought that practicing was necessary for being experienced engineer. However, especially in mining field, it was difficult to create a realistic context in which students could apply their knowledge. She believed that games could be helpful for the students to practice their knowledge. The unique attributes of the game might help to increase the effectiveness of education in mining field. The researcher believed that investigating what students experienced during the game could help educators to develop more beneficial games which met the needs of the students. With this beliefs and background, she analyzed the experience of mining engineering students using simulation games for educational purpose. In order to be objective, she tried to bracket these beliefs during the study. However, she warned the readers to consider this subjectivity statement when analyzing the findings of this study.

3.9.2 The Role of the Researcher

The role of the researcher in qualitative study is different than the researcher in quantitative study. In quantitative research, the researcher tires to be objective during the study. But, in qualitative research, "the researcher is the primary instrument for data collection and procedures" (Merriam, 2009, pg. 15). Hence, in qualitative research, the researcher should define her biases and role in detail.

The first role of the researcher in this qualitative study was the facilitator. She tried to make the participants comfortable during the study. She tried to make them

aware of their role and status in this study. She explained how they fit into the aim of the research and how their contribution was valuable for her. Moreover, she tried to create a comfortable environment in which they feel free to say whatever they wanted.

The second role of the researcher included encouraging the participants to be open and share their experience in detail. She asked them to play the game near her and explain what they did and why. In addition, she wanted them to tell her what they thought while they were playing. Finally, during the study, she set aside her prejudgements, biases in order to reveal out the experience of participants from their viewpoint.

3.10 Limitation of the study

The first limitation of this study is selection of the participants. The aim of this study is exploring the experiences of two different group; gamer and non-gamer students. Hence, it was intended to obtain the groups that fitted the aim of the study. Although the criteria of selecting the participants were identified before starting the study, it was difficult to find students who met the criteria. The participants in this study were volunteer students who attended to the department of Mining Engineering in one of the well-known public university in Ankara, Turkey. Most of the students in the department did not volunteer to attend because of the fear that the study might take most of their time. Hence, the participants in this study were selected among limited mining engineering students who wanted to attend the study voluntarily.

Secondly, the interviews in this study were conducted in Turkish in order to make the students feel comfortable while they were sharing their experiences. Thus, the interview data was needed to be translated in English. Although, the interviews of each participant were translated to English and checked by second person, it might not reflect the opinions of the participants word by word.

CHAPTER 4

RESULTS

In this chapter, the findings of this study are given in detail. This chapter includes both textural and structural descriptions of non-gamer and gamer participants. In addition, a composite textural description and a composite structural description representing the non-gamer and gamer participants as a whole are written in order to explain the essence of the experience of using simulation games for educational purposes.

4.1 Textural Description of Experiences of Non-gamer Participants

There were three non-gamer participants, Kim, Manny and Johnson, in this study. In this part, the textural descriptions of each player's experience are given briefly.

4.1.1 Opinions of Non-gamer Participants about the Usage of Simulation Games for Education (Research Question 1)

Table 7 shows the pre and post opinions of novice participants regarding with the usage of simulation games for education. The themes extracted from the interviews for pre and posts opinions are organized under benefits and problems. The findings showed that before attending this study, novice participants thought that visualization, learning by doing and motivational attributes of the games could be benefits of games for education. Additionally, Johnson expressed that while students at K-12 level could benefit more from educational games, games were not beneficial for university level students. In regard to problems, only one novice game player, Manny, indicated that game usage in educational setting could cause a problem, addiction. After game play experience, the opinions of non-gamer participants were changed positively. All non-gamer participants listed similar benefits of usage of games for education. The themes, visualization, learning by doing, motivation were mentioned by all three non-gamer participants in this study. In addition, self-

confidence was mentioned by two participants, Manny and David and fun was listed by Manny. Finally, it was revealed that non-gamer participants'opinions regarding with the negative effects of games was changed. It was found that addiction was not considered as a problem anymore whereas time management and underestimation was listed by one participant, Manny.

Table 7 *Opinions of Non-gamer Participants about the Usage of Simulation Games for Education*

Opinions	Kim	Manny	Johnson
Pre-opinions			
Benefits			
	Visualization	Visualization	
	Learning by Doing		
		Motivation	
			K12 Level
Problems			
		Addiction	
Post-Opinions			
Benefits			
	Visualization	Visualization	Visualization
	Learning by Doing	Learning by Doing	Learning by Doing
	Motivation	Motivation	Motivation
		Self-Confidence	Self-Confidence
		Fun	
Problems			
	Time Management		
	Underestimation		

4.1.1.1 Pre-opinions of Kim about the Usage of Simulation Games for Education

Kim was the first non-gamer participants participated in this study. Although, she was non-gamer participant, she enjoyed her experience of using simulation games for educational purpose. Before playing the simulation game, she was asked what she taught about using games in education in order to reveal her pre-opinions. The interview results showed that she supported the usage of games in educational settings and believed that these kinds of games needed to be integrated into educational settings due to two main constructs, visualization and learning by doing.

Visualization: Before playing the simulation game, she stated that one of the main problems she faced in her department was the limited usage of visual materials in the courses. She explained that it was difficult for her to visualize the concepts and terms while they were discussed in the lectures. She needed and sought additional materials that could help her to visualize the contents of the courses. She stated;

> *"I have difficulties in the lessons. For example, if instructors show pictures or videos and explain the content with them, we will understand better I think.... At my summer practice, I understood many things better. In there, since you see what is explained in the courses, you understand more easily."*

> *"Ben zorlanıyorum derslerde. Mesela hocalar resim ya da video falan gösterseler onlarla anlatsalar konuyu, daha iyi anlarız bence.... Stajımda daha iyi anladım birçok şeyi. Orada derste anlatılan şeyleri gördüğün için daha rahat anlıyorsun."*

Learning by Doing: At the beginning of the study, Kim believed that educational games could help the students to learn the content more easily. According to her, students including her generally memorized everything such as theorems, rules when they were studying. So, they forgot most of the information they gathered in the courses. To overcome this problem, she believed that she needed to understand the logic behind the theorems and rules. According to her, students could understand them more accurately by applying them. According to her, games;

> *"Helps to remember. You remember something more easily if you understand its logic instead of memorizing. Otherwise, you just memorize and then you forget. For this, you need to apply what you learn I think. When you do, you understand why it is in this way, it becomes more durable."*

> *"Hatırlamasına yardımcı olur. Ezberlemek yerine, mantığını anlayınca daha kolay hatırlıyorsun bir şeyi. Öbür türlü sadece ezberliyorsun ve sonra unutuyorsun. Bunun için de öğrendiğini uygulaman gerekiyor bence. Yapınca neden öyle olduğunu anlıyorsun, daha kalıcı oluyor."*

However, she stated that they had limited chance to apply what they learnt in the courses. The only chance they got is the lab sessions of the courses. But, in the lab, they did not do whatever they wanted to do due to safety problems. She stated that educational game could help the students at this point. For her, the game could

create a safety environment where the students could apply the information they gathered through the courses and saw what happened. In addition, the game could guide the student and gave necessary information at appropriate times. By these, she believed that students could easily learn the contents and remember the necessary information in the future. She illustrated this by stating;

> *"Ok there are Lab courses, in there you cannot do everything….The game can provide this….Eventually, the game guides you…….. It also gives information at appropriate times….. When you are hired, you may recall the mistakes you did in the game and their consequences."*

> *"Tamam Lab dersleri var da, orada da her şeyi yapamıyorsun ki…. Oyun bunu sağlayabilir….. Sonuçta seni yönlendirecek oyun… Bilgi de verecek uygun zamanlarda…. Bir yere girdiğinde oyunda yaptın bir yanlışı, sonuçlarını, verilen bilgiyi hatırlayabilirsin."*

4.1.1.2 Post-opinions of Kim about the Usage of Simulation Games for Education

After attending this study, it was found that the opinions of Kim about the benefits of game in educational settings remained similar. She gave visualization, learning by doing and motivation as the benefits of the game. However, she listed two problems -time management and underestimation- that may be aroused when the simulation games were integrated to educational settings although she did not mention any before game play.

Visualization: After playing the game, Kim agreed that the game really could help students to visualize the concepts, processes discussed in the courses. As stated above, Kim believed that it was difficult to understand the contents of the lessons due to the visualization problem. She could not imagine the process or the concepts while the instructors were explaining. Thus, she needed additional sources that helped her to visualize them and to transform abstract knowledge to concrete knowledge. To achieve this, she got help from the videos. She sought videos related with her department. However, these videos did not help her as she needed. She stated that videos that she watched were generally in English so she faced difficulties to understand the video content accurately. Moreover, it showed the processes from pre-defined angle of view in two dimensions. She taught that game eliminated these

kinds of problems thus it increased learning. She believed game fulfilled the visualization need of the student since;

> *"I did not visualize anything when I learnt at the first time. I look at videos and pictures to understand… Generally, the videos I find are in English, I do not understand what they are saying. Moreover, they are filmed from fixed location, two dimensions….In the game, you can adjust everything…. Besides in three dimensions…. Even you do not say it gives much more information, it teaches much better, it helps you to visualize at first place."*

> *"Hiçbir şeyi zaten canlandıramamıştım ilk öğrendiğimde. Videolara resimlere bakmıştım anlamak için… Genelde bulduğum videolar İngilizce oluyor, anlayamıyorum ne dediklerini. Bir de sabit bir yerden çekiliyorlar, iki boyutlu….. Oyunda sen ayarlayabiliyorsun her şeyi… hem üç boyutlu…. Çok fazla bilgi verdi, çok iyi öğretti falan demesen bile canlandırmana yardımcı olur en başta."*

She suggested that in the first lesson of the course students could play the educational game designed for the course instead of reading the syllabus of the course. By this, students could understand what they were going to learn in the course. Moreover, she added that the students could play the same game at the end of the course. By this, they could estimate their performance in the course and understood what they needed to study more accurately. She suggested;

> *"I think, in the first lesson instead of looking the syllabus, the game related with that course can be played. Looking the syllabus does not ring the bell to you. Something is written but you do not understand what it is about. Even, it comes to my mind now; the same game can be played at the end of the semester. You can see how much you learned etc."*

> *"Bence ilk ders syllabus a bakmak yerine o dersle ilgili oyun oynanabilir… Syllabus a bakmak sana bir şey ifade etmiyor ki. Bir şeyler yazıyor ama ne ile alakalı anlamıyorsun. Hatta bak şimdi aklıma geldi aynı oyun dönem sonunda da oynanabilir. Ne kadar öğrendin falan onu görebilirsin."*

Learning by Doing: According to Kim, learning by doing was another reason why games should be integrated to her department. She emphasized that she prefered to learn by doing instead of just reading textbooks or listening the instructors. She understood and remembered the contents more easily by doing them. She stated that game provided this opportunity for her. She stated;

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"I understand better when I do. Otherwise, something is told, you just listen, it does not stay on your mind, you forget. When you apply what is explained, you learn better"

"Ben yapınca daha iyi anlıyorum. Öbür türlü bir şeyler anlatılıyor, sen sadece dinliyorsun aklında kalmıyor, unutuyorsun. Anlatılanları uyguladığında daha iyi öğreniyorsun."

She also compared games with videos. She believed that one of the big disadvantages of the videos was the lack of interaction. She said that she just watched the videos. Something happened in the video but she could not interfere anything in them. However, unlike the video, games provided high interaction between the gamer and the environment simulated in the game. Games created opportunities for gamers to manipulate the environment and to see what happened when they did something. Thus, she believed that games could increase the learning for all of these reasons. She believed that;

"You watch the video…. You do not do anything just watch. But, in the game you can change something and look what will happen. I think it is very important."

"Video izliyorsun…..Hiçbir şey yapmıyorsun sadece izliyorsun. Ama oyunda bir şeyleri değiştirip neler olacak diye bakıyorsun. Bence bu çok önemli."

Motivation: Kim stated that game might also effect the motivation of the students. For her, it could increase the motivation of the students to learn the contents. She stated that games could help students to estimate what else they should know, what they should study. For instance, after playing the game she recognized that she forgot most of the information related with quarrying. She stated that the difficulties she had faced in the game motivated her to study quarrying again. According to her, game could;

"Absolutely increases motivation. Because, you see what you know, what you do not know. For example, I recognize that I forget most of the things related with quarrying. I get angry, I go home and study it"

"Motivasyonu kesinlikle artırır. Çünkü görüyorsun neyi biliyorsun, neyi bilmiyorsun. Mesela fark ettim ki ben birçok şeyi unutmuşum quarrying ile ilgili. Sinir oldum eve gidip çalışacağım."

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In her opinion, although game provided great opportunities for learners, the integration of it to their department might also bring two main problems which were time management and underestimation.

Time Management: Kim thought that time management issue would be the biggest problem students might face if the game used in education. Based on her experiences, she stated that playing games required much time. Especially for non-gamer learners, getting used to the game took a long time. However, students in their department did not have much time for such kind of things. She said that, studying their lessons took a great amount of their time so they might not allocate their time to play educational games. Accordin to her;

> *"It cannot be done once a week….. Studying our lessons take lots of our time… But even one time can be helpful to visualize I think, at least to understand what it is."*

> *"Haftada bir yapılabilecek bir şey değil.. Derslere çalışmak çok zamanımızı alıyor… Ama bir kere bile olsa bence yardımcı olur canlandırmaya en azından nasıl bir şey olduğunu anlamaya."*

Underestimation: Kim stated underestimation might also be a problem when games were used in their department. She said that games were generally used for entertainment. Thus, students might not take educational games seriously. They might think that they were just playing games so they might not be attentive to the game. Consequently, they might not benefit from the game as desired. She thought that;

> *"Some of the students may say that this is just a game and may not take it serious."*

> *"Bazı öğrenciler bu sadece bir oyun diyerek ciddiye almayabilirler."*

4.1.1.3 Pre-opinions of Manny about the Usage of Simulation Games for Education

At the beginning of this study, Manny was interviewed about her opinions of using simulation games for educational purpose. The results showed that she defended the usage of educational games in educational settings especially in her department due to the two main constructs, visualization and motivation.

Visualization: Like Kim, Manny also pointed out the limited usage of visual elements in the courses in mining engineering department. She stated that it was a bit difficult to understand the concepts and processes that were discussed in the courses. To overcome this difficulty, she tried to watch videos related with the concepts of her lessons. However, this solution was not enough for her. She stated that she might not find related videos about a topic she searched. She said that they needed visual materials and game might help them to visualize and understand the concepts more easily and effectively. She explained;

> *"Instructors in the courses, only shows pictures to us, they rarely show videos… If they show, it will stay in people's mind more… The things we are explained are too abstract. Simulations and games can make them more concrete… they affect people more….. I watch video about the concepts I do not visualize. I said that visuality was important, it can be supplied by games I think… .Everything is abstract in your mind, it makes them more concrete…. I think it makes theory more practical."*

> *"Hocalar derste sadece resim gösterebiliyorlar bize çok nadir video gösteriyorlar…. Bu tarz bir şey gösterirlerse insanların akıllarında daha da kalır…. Anlatılan şeyler çok soyut. Simülasyonlar, oyunlar bunları daha somut yapabilir.. insanı daha çok etkiler… Canlandıramadığım konularla ilgili video izliyorum. Görsellik önemli demiştim dijital oyunlarla bu sağlanabilir….. Her şey soyut senin kafanda bunları daha somutlaştırıyor… Bence teoriyi daha pratikleştirecektir."*

Motivation: Before attending this study, Manny thought that games could have an effect on the motivation of the students. According to her, it could increase the motivation of the students towards the courses. She stated that games were different than traditional learning materials such as books. Thus, it could take the attention of the students and motivated them to study. She believed that;

"Absolutely games positively affect the motivation… By using these kinds of things additionally when you think like students; they are more interested in these kinds of things. For this reason, these kinds of things are the things that can take their interest… This take their attention thus the motivation would increase. It increases their attention to the subject."

"Kesinlikle oyun olumlu etkiler motivasyonu…. Bu tarz şeyler kullanılarak bir de öğrenci açısından düşünülünce öğrenciler bu tarz şeylere daha da ilgilidir. O yüzden bu tarz şeyler onların ilgisini çekebilecek şeyler… Bu ilgilerini çekecektir, motivasyonu arttırır o yüzden. Konuya ilgilerini arttırır."

Moreover, she believed that games could help students to transform their theoretical knowledge to practical one so their motivation would increase. According to her;

"Absolutely, theoretical thing become practical thing. After showing in the lessons, teachers can show the game. At that time students both do more practical things and they gain information before summer practice."

"Kesinlikle teorik bir şey pratik bir şey oluyor. Derste gösterdikten sonra hocalar oyunu gösterebilirler. O zaman öğrenci hem daha pratik şeyler yapabilecek hem stajdan önce bilgi kazanabilecekler."

Despite the benefits of the game, Manny had a concern about its usage in educational settings at the beginning of the study. She taught that game might cause addiction.

Addiction: At the beginning of this study she taught that students might become addicted to the game. They might play the game hours for hours to finish it. Addiction might be a problem among the students since;

"Some students may go crazy… All the time they might try to play the game to finish it."

"Bazı öğrenciler sapıtabilir … Sürekli bitene kadar oynamaya çalışabilir."

4.1.1.4 Post-Opinions of Manny about the Usage of Simulation Games for Education

After each of game playing sessions, Manny was asked whether her opinions of integrating games to educational settings especially for her department were changed or not. The interview results showed that her opinions were not changed

dramatically but she listed several more constructs about the benefits of simulation games usage in education. Moreover, it was seen that her concerns about its usage was changed. She did not believe that these kinds of games might cause any problems. She stated that she enjoyed her experience and advised that these kinds of games should be used in educational settings especially in her department.

Visualization: She stated that the first benefit of game usage in her department was visualization. As written above, Manny faced difficulties to imagine the concepts and processes discussed in the courses in her department. She stated that in her department they had learnt things that they had ever known or seen in their lives. Thus, the information they learnt were too abstract for them. In addition, she said that the language of the courses was English. This also increased the difficulty to understand and visualize the content.She said;

> *"You learn the things that you have ever known… I talk because I have difficulties additionally the courses is in English. This is also a disadvantage thus in my mind I cannot visualize actually."*

> *"Hiç bilmediğin şeyler öğreniyorsun… Ben çok zorlandığım için konuşuyorum bir de ders eğitim İngilizce. O da bir dezavantaj o yüzden kafamda ben canlandıramıyorum açıkçası."*

Although she tried to find videos to understand the contents and processes, she needed additional materials to fill this gab. For her, game could help her to fill this gab. She said that the game she played represented the reality and made her feel that she was really working in mine. The game simulated mine environment in three dimensions and allowed her to change the perspective of the screen as she desired. The game could fulfill her needs about visual elements in the courses since;

> *"But with games, I see everything in 3 dimensions. I can see from the angle I want. I think it is very beneficial"*

> *"Ama oyunla 3 boyutlu olarak görüyorum her şeyi. İstediğim açıdan bakabiliyorum. Bence oldukça yararlı."*

Learning by Doing: The second construct identified by Manny was learning by doing. She thought that game could increase learning since it allowed students to learn by doing and allowed them to practice their knowledge in safety environment.

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She stressed the importance of applying their knowledge. She stated that since their job was very dangerous, they could not have much chance to apply and practice their knowledge. She stated that in their summer practices, they were not allowed to be active and take decisions. Instead, they were observers and watched what the other mining engineers and workers were doing in mine. She stated that just observing the workers in mine neither helped her to develop her necessary skills to be a mine engineer nor expanded her knowledge. She needed to apply what she learnt to be a good mine engineer. Thus, learning by doing method was the best method to learn for her. She needed to practice what she knew by doing them. She said that practicing information help her to retrieve them easily when she needed. And, she believed that the game provided this chance. It created opportunities for her to do whatever she wanted and applied what she learnt in safety environment. She said that the player had to be active doing game playing sessions. In the game, players were the main decision maker and had to perform all their decisions by themselves. So, they could apply and practice what they knew, saw the consequences of their decisions and built their knowledge based on their experiences. According to her;

> *"Experiences are said to be very important I think it is very true… It is important to apply what you know; so when you graduate, you should know how to do it…You can apply everything you use in the courses in here… For example, we learn stagger blasting patterns but what is this stagger blasting design, square design? In here you apply this... You turn a lot of things to practical knowledge... In summer practice, I just see how the blasting design is applied, the blasting holes…. But eventually you do not apply that in there. When we become mining engineer, we do not do that, we say people to do that. Thus, in here you have a chance to do that. So, I think it is very important."*

> *"Tecrübe çok önemli diyorlar bence bu çok doğru.. Bildiklerini pratiğe dökebilmek önemli bu yüzden mezun olabildiğinde nasıl yapılabileceğini bilmen gerekiyor.. Derste öğrendiğim şeyleri burada yapabiliyorsun…. Mesela biz öğreniyoruz şeşbeş dizayn ama şeş beş dizayn ne kare dizayn ne? Burada bunu uyguluyorsun.. Bir çok şeyi pratiğe dönüştürebiliyorsu… Stajda sadece görüyorum nasıl bir dizayn oluşturmuşlar patlatma deliklerini… Ama sonuçta sen oluşturmuyorsun orda. Biz mühendis olduğumuzda biz bunu yapmayacağız, insanlara yap diyeceğiz o yüzden burada senin kendi yapma imkânın oluyor o yüzden bence çok önemli."*

Motivation: Another construct identified by Manny as the benefits of the game was the motivation. Based on her experiences Manny thought that games could increase the motivation of the students to learn. She stated that when she learnt new things in the courses, she became more interested to the contents of the courses and wanted to learn more. She thought that this was also true for all the students. She believed that when students understood the content of the courses and became successful, they became more interested to the courses. Since games helped the students to learn, they could increase their motivation towards the content of the courses. According to her;

> *"When I learn something, I want to do it more; I become more interested in it. Similarly, the tiny things you learn from there [games] can make you more interested into the course. Or, the course included visual things may take students' interest much."*

> *"Bir şeyi öğrendiğim zaman daha çok yapmak istiyorum daha çok ilgileniyorum. Ayni şekilde orda öğrendiğin en ufak bir şey senin o dersteki ilgili arttırabilir. Ya da görsel şeyler içeren bir ders öğrencilerin ilgisini daha çok çekebilir."*

Self-Confidence: Manny also thought that games could affect the self-confidence of the students. According to her, it could increase students' self-confidence. She thought that since players did everything by themselves in the game environment, they got used to processes in mine. So, when they saw anything or was given any duty in mine environment, they might remember the things they had done in the game. Hence, they might be more confident while they were doing anything in the mine. She stated that games;

> *"Also affect the self-confidence, why, because eventually in there you are everyone, every operator. When you go to mine, you can say aaa, I know that……You can remember the things you see and say aa I saw that, I did that in that way. Thus, it affects positively."*

> *"Özgüveni de etkiler, niye, çünkü sonuçta sensin orda ki her şey tüm operatörler sensin. Madene gittiğinde aa ben bunu biliyorum diyebilirsin..... Gördüğün şeyleri hatırlayıp aaa bunu görmüştüm, bunu böyle yapmıştım diyebilirsin. O yüzden çok olumlu etkiler."*

Fun: Kim thought that game was a fun way to study. She stated that studying from the books was boring. Students could easily get bored while they were studying from the books. Based on her experience, she believed that by playing games, students could get fun while they were learning. She believed that;

> *"I think it is very funny. You do and see everything. It is absolutely funnier compared to studying from the book."*

> *"Bence çok eğlenceliydi. Her şeyi sen yapıyorsun ve görüyorsun. Kitaptan çalışmaktan daha eğlenceli olduğu kesin."*

4.1.1.5 Pre-opinions of Johnson about the Usage of Simulation games for Education

Like the other participants in this study, Johnson was also asked what he taught about educational games in order to gain his pre-opinions about educational games. Johnson had conflicts about the usage of games in educational settings. For Johnson, these games were needed to be used in K12 level rather than university.

K12 Level: He stated that educational games could help K12 students to improve their skills and increase their motivation. But, these games did not useful for university students because;

> *"It can be affective on primary school, secondary school students.. Can stay on mind more. Students can play the game more eagerly.. But for university students I do not know whether this is affective. For me, probably it may not be affective."*

> *"Etkili olabilir ilkokul, ortaokul öğrencileri üzerinde... Daha çok akılda kalabilir. Öğrenci de daha çok hevesle oynar.. Ama üniversite öğrencileri için bu etkili olabilir mi bilmiyorum. Benim için etkili olmaz herhalde."*

He believed that it was too late for university students to learn from educational games. He justified his belief by stating that the contents that university students were learnt were so difficult and complex. He thought that no game could cover the topics the university students had to learn thus;

> *"The game cannot be used for university students. The contents are very difficult, they cannot teach with the games."*

> *"Üniversite öğrencileri için kullanılamaz oyun. Konular çok zor ki öğretilemez oyunla."*

4.1.1.6 Post-Opinions of Johnson about the Usage of Simulation Games for Education

After attending the study, the opinions of Johnson about educational games were changed. He thinks that educational games could also be used by university students in their lessons. He came up with three benefits of the game usage in educational settings which were visualization, motivation, self-confidence and learning by doing.

Visualization: Visualization was the first construct stated by Johnson. He stated that educational games could help the university students especially mine engineering students by providing visualization. He said that in the courses most of his friends including him needed additional materials which could help them to visualize the concepts discussed in the lessons. According to him, he learnt better by seeing or visualizing than just listening. The visuals were not used enough in their courses however;

> *"I think the things discussed in the courses should be seen in order to understand them better. The game can be used in that way."*

> *"Bence derste anlatılan o şeylerin daha iyi anlaşılabilmesi için gözle görülmesi gerekir. Oyunda bu yönde kullanılabilir."*

He stated that in the first and second years in the department, he and his friends could not imagine what a mine looked like. They were curious about mine environment and asked each other how it might be. He stated that if these kinds of games use in their department, at least the students could imagine how a mine environment looked like and what processes were happened in there. According to him;

> *"These kinds of games should be used in the department. At least, the students can see mine environment before summer practice…. How the environment is not known before summer practice… I think that kind of information should be given before summer practice… The game can show this environment to the students."*

> *"Bu tür oyunlar kullanılmalı bölümde. En azından öğrenciler maden ortamı görürdü stajdan önce… Nasıl bir ortam olduğu stajdan önce bilinmiyor… Bence böyle bir bilginin stajdan önce verilmesi gerekiyor….. Oyun bu ortamı gösterebilir öğrencilere."*

Learning by Doing: Secondly, Johnson mentioned that learning by doing was also the benefit of the game. He stated that game created opportunity for students to learn the contents of the lessons by doing them. He said that in these kinds of games, students were forced to do several things and observed the consequences. He believed that students could apply what they learnt in the game environment so they could learn the content more easily. He justified his beliefs by stating;

> *"Sometimes, it is not enough to learn by just listening the instructor. But, if you learn something by doing, you can remember it easily in the future. The game provides this to you."*

> *"Sadece hocayı dinleyerek öğrenmeye çalıştığınızda bazen yeterli olmuyor. Ama böyle bir şeyi yaparak öğrendiğinizde, ileride daha kolay hatırlayabiliyorsunuz. Oyunda size bunu sağlıyor."*

Motivation: Acording to Johnson, motivation of the students could be affected by the game. He stated that educational games could increase the motivation of university students to learn because;

> *"The motivation will be increased of course, you might like the environment in there and it might motivate you to study more. Since it takes your attention, you want to study."*

> *"Motivasyon artar tabi, oradaki ortam senin hoşuna gidebilir ve seni daha çok çalışmaya motive edebilir. İlgini çektiği için çalışmak istersin."*

Moreover, he stated that if the game was divided into the branches like surface or underground mining, the students might decide in which branch they wanted to work more accurately. He believed that;

> *"If there are parts related with surface or underground mining, the students can decide what they want and study it a lot."*

> *"Yer üstü veya yer altı madenciliğini ile ilgili kısımlar olsa öğrenciler neyi istediklerine karar verebilir ve ona daha çok çalışabilir."*

Self-confidence: Finally, Johnson believed that the usage of games in educational settings could affect the self-confidence of the students. It could increase their self-confidence. He stated that these games showed the players what they were

capable of so it might cause the players to feel that they could do the same things in reality. According to him;

> *"Of course it affects the self-confidence. At least, you do in here [game], your self-confidence will increase. In real life, for example you can say I did it in the game I did in that way and it worked, in here it is also work. You feel more confident when you are doing."*

> *"Özgüvene tabi etkisi olur. En azından burada yapıyorsun özgüvenin artar. Gerçek hayatta da mesela şey diyebilirsin ben bunu oyunda yaptım şöyle yaptım oluyordu burada da olur. Kendini daha rahat hissedersin yaparken."*

4.1.2 The Strengths and Weaknesses of Simulation Game Used in this Study (Research Question 2)

In Table 8, the opinions of non-gamer participants related with the strengths and weaknesses of the game used in this study are given. It was found that non-gamer participants thought in similar way related with the game. Realism in the design and visualization were the common themes given by all three non-gamer players as strength of the game. Additionally, the themes missions, learning by doing, role of the players, lack of guidance and hints were also told by participants. For the weaknesses, it was found that all three non-gamer participants listed mild punishment. Similar missions, lack of guidance, limited technical information and less feedback were the themes that the participants also listed under the category of weaknesses of the game.

Table 8 *Opinions of Non-gamer Participants about the Strengths and Weaknesses of Simulation Game Used in this Study*

Opinions	Kim	Manny	Johnson
Strengths			
	Realism in the Design	Realism in the Design	Realism in the Design
	Visualization	Visualization	Visualization
	Missions	Missions	
	Learning By Doing	Learning By Doing	
	Roles of the Player		Roles of the Player
		Lack of Guidance & Hints	
Weaknesses			
	Mild Punishment	Mild Punishment	Mild Punishment
	Lack of Guidance		
		Similar Missions	Similar Missions
			Limited Technical Information
		Feedback	

4.1.2.1 The Opinions of Kim about the Strengths and Weaknesses of Simulation Game Used in this Study

Kim identified five main strengths of the game used in this study which were realism in the design, visualization, missions, learning by doing and roles of the player.

Realism in the Design: Kim stated that one of the biggest strengths of the game she played in this study was its realism. She thought that simulation games were needed to represent the reality if it aimed to teach. Thus, she gave great importance on realism of the game. She found that especially mine design and processes in the game environment were realistic. According to her;

> *"If the game is used in education, it is necessary to be appropriate to reality. It should be realistic so you can remember what this is, how this is when you start to work."*

> *"Eğer oyun eğitimde kullanılacaksa, gerçeğe uygun olması gerekir. Gerçeğe uygun olsun ki sen de ileride çalışamaya başladığında bu neydi nasıldı diye hatırlayabilesin."*

Mine Design: She stated that in the game, mine was well simulated. For example, the height of the benches and the design of the mine were simulated appropriate to real life. Thus, although the player did not see any mine, this game could help the player to have opinions about the mine environments in her belief. She stated;

> *"I think the game is realistic, the heights, vehicles etc."*

> *"Bence gerçekçi oyun, yükseklikler, araçlar falan."*

In addition, Kim stated that the designers also designed the vehicles and equipment in the game environment realistically. Their graphics of them were good. Even, special audio effects of these vehicles and equipment were added. In the game, the vehicles such as wheel loader or dumper produced a warning signal when they went backwards. In her opinion, this increased the realism of the game and made the players to think that they really drove the vehicles. She thought that;

> *"The vehicles make sounds etc. Besides, if it does not make sounds, it will be ridiculous."*

> *"Araçlar ses çıkarıyor falan. Zaten ses çıkarmasa saçma olurdu. Madende durmadan o sesi duyuluyor çok fazla araç çalıştığı için."*

Processes: According to Kim, the processes players conducted in quarry such as hauling, drilling was realistic and increased the realism of the game. She stated that the players could have an idea about the processes in quarrying while they were completing the missions so it was strength of the game. But she added that in the game the weaher was changed from time to time. However, this was not affected the processes in the game environment and it descreased the realism of the game. According to her, although sometimes the weather in the game was raining, the conditions did not change. She said that when it was raining, the road became mud and it was more difficult to drive the vehicles. But for her, there was no difference in the game when it was raining. For this reason, she stated that rain was meaningless in the game and should be excluded or the conditions should be redesigned for the rain in order to increase the realism. She mentioned that;

"The works done are also realistic, that loading, transporting etc…. thing is nice, well it gives you a mission, you see what is done in quarry by the mission, that was good….The rain is unnecessary. Because when it is raining, the road does not become mud. It does not affect the angle of my vision. It does not affect anything. If it affects anything, it should rain."

"Yapılan işler de gerçekçiydi, o yükleme, taşıma falan…. Şey güzeldi işte sana görev veriyor, sen görev sayesinde görüyorsun neler yapılıyor taş ocağında, o iyiydi.Yağmur çok gereksiz. Çünkü yağmur yağınca yol çamur olmuyor. Görüşümü engellemiyor. Herhangi bir şeyi etkilemiyor. Bir şeyi etkileyecekse, yağmur yağsın."

Visualization: According to Kim visualization was also strength of the game used in this study. In the interviews, she stressed the difficulties she faced in visualization of the concepts and processes discussed in the courses. She believed that the game provided visuals to the students to some extent. For her, students could see a realistic mine environment and some of the processes such as hauling, transportation in quarrying. Thus, the game could fulfill some of the visual needs of the students. According to her;

"As I said before, I cannot visualize in the courses.. If you do not visualize in your head, you do not understand what the instructor says exactly. But in here, there is visuality, it shows you a mine, the vehicles, transporting etc. at least, something is built in your head.. If something is explained via that, you can guess what they are… The game provides this, this can be given as advantage."

"Dediğim gibi hayal edemiyorum derslerde.. Hoca bir şeyler anlatıyor ama kafanda canlandıramayınca ne dediğini anlamıyorsun tam olarak. Ama burada görsellik var, sana madeni göstermiş, araçları, taşımayı falan göstermiş. En azından kafanda bir şeyler oluşuyor… Üzerine bir şeyler anlatılsa onları ne olduğunu tahmin edebilirsin… Oyun bunu sağlıyor."

Missions: Kim also listed missions as one of the strengths of the game due to two main reasons. Firstly, the missions in the game forced the players to produce something. According to her, this was how a useful game supposed to be. She believed that players should be given missions but these missions should cause players to produce something. In other words, games should force the gamers to perform actions in order to produce something. Hence, she did not like war or race

games and thought that they were useless. Because in those kinds of games, players just killed the others or raced with each other instead of producing something according to her. She believed that those games did not contribute anything to the players so they were useless. But, unlike these kinds of games, the game used in this study gave missions to the players. It wanted players to produce several rocks or minerals to supply the customers' demand. She stated that she did activities and produced what the customers wanted in the game. This made her to feel that she did something worthful and did not waste her time. In her opinions, it made the game useful since;

> "I should do something, I should produce something… I think nothing happens when you just kill people or drive a car. There are no benefits of these games; they also do not contribute anything to you. Nothing happens at the end…. If I play a game, something should be produced or I should find something. In here, you produce something, for example you produce rocks at the end. For this, I think this game is very good."

> "Bir şeyler yapmam lazım, bir şey üretmem lazım… Bence sadece insanları öldürdüğünde ya da araba yarışı yaptığında hiçbir şey olmuyor. O oyunların bir yararı yok, sana kattıkları bir şey de yok. Sonunda bir şey olmuyor…. Oyun oynayacaksam bir şey ortaya çıkmalı ya da bir şey bulmalıyım. Burada da bir şey üretiyordun mesela taş üretiyordun sonunda. O yüzden bence bu oyun gayet iyiydi."

Secondly, she believed that the missions in the game also contributed to the learning process of the students. She stated that she learnt better by doing. By assigning missions, the game provided opportunities for her to perform specific activities. While doing the activities, she felt that she expanded her knowledge related with quarrying. She sheded light on this by giving example. She stated that missions helped her to understand the transportation in the mine more accurately. The missions forced her to produce ore, transport and crush them. To achieve it, she needed to use some vehicles such as wheel loader and dumper track. She needed to load the fragmented rocks into the dumper track by using wheel loader. Thus, she was given opportunities to find best method to transform the fragmented rocks by using specific vehicles. So, she stated that she could find out how she could load the wheel loader by many rocks and how she should park the vehicles to load them more

easily. She made hypothesis related with transportation and tested them. Consequently, for all of these reasons, she believed that the missions could help the players to learn more effectively. According to her;

> *"The missions also help to learn… I learn how the transportation should be, I understand better. For example, I produced ore, transported, crushed them… I thought how I should carry them, I tested how I carried. The missions helped you to understand better I think."*

> *"Görevler öğrenmeye de yardımcı oluyor… Transportation nasıl olmalı onu öğrendim, daha iyi anladım…. Mesela ore ürettim, taşıdım, parçaladım…. Onları nasıl taşısam diye düşündüm ,nasıl taşıyacağımı denedim. Görevler daha iyi anlamanı sağlıyor bence."*

Learning by Doing: According to Kim, the last strength of the game was learning by doing. She stated that game was designed for single player not for multiple players. This forced the players to be active during the game and do everthing by themselves. According to her beliefs, in multiple player games, one player might become the leader and leaded the others. The leader might control and decide everthing. In those situations, the others might not learn due to the obedience to the leader. This possibility decreased the educational value of the game. To prevent this, she suggested that students needed to play alone and asked to do everthing by themselves at the begining. This caused them to learn more effectively because;

> *"It cannot be played with multiple players. This is educational game so; you need to be alone I think. You need to do something alone otherwise, at that time someone tells do this in this way, in that way, at that time you cannot learn. You just apply what he knows."*

> *"Oynanmaz çok oyucu ile. Eğitici bir oyun bu yani tek başına olman gerekiyor bence. Tek başına bir şeyleri yapman gerekiyor yoksa o zaman birisi şöyle yap böyle yap diye söyleyecek o zaman öğrenemezsin ki. Onun bildiklerini uygularsın sadece."*

Roles of the Player: As said by Kim, the roles assigned to the players by the game were also strength of the game. She stated that in this game, players were given many roles such as operators, workers, mining engineers etc. And, she liked the idea of working in different roles. She said that instead of giving orders to other avatars in

the game, she did everything and this allowed her to learn by doing. Especially, she liked to work as an operator. She stated that in her summer practice, she gained huge amount of information from the operators in the mine. For her, experienced operators built great knowledge because they performed the same activities over and over in different conditions so they learnt many things from their experiences. Therefore, she thought that being assigned to different roles in the game was more educative thus it was strength of the game. She stated that;

> *"In here, I am both operator and mining engineer, it is nice… Besides, you learn what you will learn from operators. I saw it at summer practice. They become experts by doing the same thing over and over. I learnt many things from them. Thus, also in here being an operator is nice. "*

> *"Burada ben hem operatörüm hem maden mühendisi, güzeldi… Zaten operatörlerden öğrenirsin ne öğreneceksen. Ben stajda bunu gördüm. Onlar uzman olmuşlar artık aynı şeyleri yapa yapa. Onlardan çok şey öğrendim ben. O yüzden burada da operatör olmak güzeldi."*

Kim also specified two weaknesses of the simulation game she played which were mild punishment and lack of guidance.

Mild Punishment: Kim complained about the mild punishment in the game environment. She believed that there had to be severe punishment for mistakes in educational games it it was designed for their department. She stated that their job required full attention and carefulness. In reality, if they made a tiny mistake, this might cause severe injuries or high costs. Thus, they got used to be careful and be able to implement safety rules. For her, severe punishment helped them to achieve this. She stated that if the players did not punish severely for their mistakes, they might underestimate the importance of being careful in mine and might violate the safety rules. This would cause them to act neglectfully in the mine in the future. She complained that;

> *"In the game, I made an accident but nothing happens. I lose some money but that is all. I am a careful person but now, I am thinking the players, I think the penalties should be heavy. It should be heavy so you do not do again, be careful. Otherwise, they can say that it does not matter and continue to make mistakes."*

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"Oyunda kaza yapıyorum ama bir şey olmuyor. Biraz param kaybediyorum o kadar. Ben dikkatli biriyim ama şimdi oyuncuları düşünüyorum da bence cezalar ağır olmalı. Ağır olsun ki bir daha yapma, dikkat et. Yoksa önemli değil deyip hata yapmaya devam edebilirler."

But, she added that the designers of the game should be careful about punishment in the game. She warned that non-gamer players were generally stressful. They needed time and practice to get used to the game and be successful. Based on her experiences, she said that non-gamer students generally made many mistakes and had many accidents when they were playing. If this costed them a lot, their stress would be increased. They might become overexcited and demotivated to play. So she suggested that the severe punishment should be applied to upper levels of the game. Firstly, the non-gamer students should be prepared to be careful by mild punishment with warnings. After gaining experience, the players should be punished severely for their mistakes. For instance, players could pay huge amount of money to repair the vehicles they damaged or was forced to buy new ones. This made them to be careful and prepared them to their future career. She believed that;

> *"I made a lot of accident. I am thinking, severe punishment made me demoralized, I quitted. According to me, at the beginning there should not be severe, only the warning can be. For example it can say do not do, be careful etc. But at the next levels, it should be. Therefore, you can learn to be more careful."*

> *"Oynarken çok kaza yaptım. Düşünüyorum, ağır cezalar moralimi bozardı, bırakırdım. Bence ilk başlarda yeni oynayanlar için ağır ceza olmamalı sadece uyarı olabilir. Mesela yapma dikkatli ol falan diyebilir. ama sonraki seviyelerde olmalı. Böylece daha dikkatli olmayı öğrenirsin."*

Lack of Guidance: Kim said that lack of guidance was another weakness of the game. She stated that she had some difficulties in making decisions such as deciding in which place she should start to drill or how. In these situations, she needed to be guided. She wanted to receive hints all the time before doing anything. According to her, these hints could be anything such as a question, technical information and it should guide her about what she should consider or do while she was playing. In her belief, educational game should guide the players if it aimed to teach. And the guidance should be given based on the activities the students were

going to do. Otherwise, a player might not be certain about their decisions and may lose their way in the game. She suggested that;

> "Sometimes tips etc. should be appeared. For instance, I cut the stone, before cutting it should guide where to cut… There should be hint, there should be information that appears occasionally. At that time, it will be more educative… It should not appear all the time; it should appear based on the task. In other words, if I decide to do it, it should appear at that time. It should say me how I drill etc. Or, for instance when I hold the drill, at that time it can give information about drill."

> "Arada sırada tipler falan çıksın. Mesela taşı kesiyorum, kesmeden önce nerden kesilecek diye yönlendirsin.. Hintler olmalı, arada çıkan bilgiler olmalı. O zaman daha öğretici olur… Her seferinde çıkmasın, göreve göre çıksın. Yani eğer ben patlatmaya karar verdiysem o zaman çıksın. Bana söylesin nasıl deliğim diye. Ya da mesela drill i elime aldığım zaman orada drill hakkında bilgi verebilir."

In addition, she advised that these hints should be appeared at the beginning of the game. At later stages, they should be dissepared. Otherwise, according to her, students got boring at later stages because;

> "However, appearance of the information all the time is ridiculous. You cannot progress, at that time. The game speeds down, you get bored. It should be given at the first level; in upper levels it should not be given."

> "Ama sürekli olarak çıkması da saçma olacak. İlerleyemezsin o zaman. Oyun yavaşlar, sıkılırsın. İlk seviyede çıkmalı, daha sonraki seviyelerde ise çıkmasın."

4.1.2.2 The Opinions of Manny about the Strengths and Weaknesses of Simulation Game Used in this Study

Based on her experience, Manny identified realism in the design, visualization, missions, learning by doing, lack of guidance and hints as the strengths of the game used in this study.

Realism in Design: Manny stated that realism was one of the biggest strengths of the game. She stated that especially the graphics and special audio effects increased the realism of the game. She liked the graphics used in the game. She said that the graphics were realistic and so;

"I liked it. Maybe because I did not play a game like that, eventually there are a lot of very advanced games, but I do not know that was really enjoyable and good for me. It was realistic, I think this is important."

"Ben beğendim. Belki böyle bir oyun hiç oynamadığım içindir, sonuçta çok fazla gelişmiş çok fazla oyun var ama bilmiyorum bana bu gayet eğlenceli ve güzel geldi. Gerçekçiydi, bence bu önemli."

Mine Design: Manny thought that the mine design in the game was appropriate to the real ones. She believed that students could gain the idea of how a mine was with the help of the game so it was strength of the game. She stated;

"I think a student who play this can see how a mine is."

"Bence bunu oynayan bir öğrenci maden nasıl bir ortammış görebilir."

For Manny, specifically the graphics of the vehicles were well designed. She stated that the vehicles in the game were similar to the ones she saw in her summer practice. Thus, when she was playing the game she felt that she was really worked in mine and used the vehicles. Moreover, Manny said that special audio effects were also considered in the game. She thought that the special audio effects used in the vehicles increased the reality of the game. She stated that in the game the vehicles made a warning sound when they went backwards. According to her, this detail was very important in mine environment. She told;

"It was good; the truck's voice etc. was very good. I always say that I enjoy the sounds of reversing gear very much. I feel like I am in mine due to this reversing gear voice. That was good because in mine this voice always grates on your ears."

"İyiydi kamyonun sesi falan gayet iyiydi. Zaten hep soyluyorum o geri vites sesi benim çok hoşuma gidiyor gerçekten kendimi madende hissediyorum o geri vites sesinden dolayı. Çünkü madende sürekli o sesler böyle kulağını tırmalıyor o yönden iyiydi."

Processes: Manny also found the processes realistic. She believed that the processes such as hauling, transporting were realistic in the game so she identified them they were strength of the game. She stated;

"They were also realistic, I like them."

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"Onlar da gerçekçiydi, ben beğendim."

Visualization: As stated in previous part, Manny faced difficulties to visualize the concepts and processes discussed in the lessons. In the interviews, she gave an example to clarify these difficulties. She stated that before summer practice, she had not understood the actual size of each vehicle while she had been learning. She had not understood quantitative characteristics of them. But when she saw the vehicles at summer practice at a distance and compared its size by something she knew like an average human height, she understood its actual size more accurately. She believed that the game provided this opportunity. She stated that the students could compare the size of the vehicles with the avatar and they could see the height of the vehicles more precisely. According to her;

> *"For example, in the lectures it was explained that the height of dragline was this etc., but it did not mean anything to me. When I saw at summer practice I understood how big it was. Instead of saying verbally, if they compares with the things we know, we can understand better. In the game this is happen, the man went to near the vehicle and I understood how big the vehicle was. It may seem very simple but it is very important."*

> *"Mesela derslerde anlatılıyordu dragline yüksekliği şudur falan ama bana bir şey ifade etmiyordu. Stajda görünce anladım ne kadar büyük olduğunu. Sözel olarak söylemek yerine hocalar bildiğimiz bir şeyle kıyaslasa, daha kolay anlarız. Oyunda bu oluyordu adam aracın yanına gitti ve anladım aracın ne kadar büyük olduğunu. Çok basit gözükebilir ama önemli bir şey bu."*

Missions: Manny thought that providing missions to the players was also strength of the game. She liked to be given a job and worked to finish it. She stated that in mine environment, people with different backgrounds were working. And, they were given missions to do something in a certain time. She thought that by given the missions, the game showed the students how a mine environment was in reality so;

> *"Given missions is very good. Eventually, in mine a lot of people are working and they are wanted to do something… Also in here, it is the same, the missions are coming, you do."*

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"Görevlerin verilmesi çok iyiydi. Sonuçta madende birçok insan çalışıyor ve onlardan bir şey yapılması isteniyor…Burada da aynı şey, görevler geliyor sen de yapıyorsun."

Learning by Doing: Manny stated that doing everything by herself is also strength of the game. She liked to do everthing and gave all the decisions by herself in the game environment. She stated that learning by doing gave a chance to her to use her knowledge and saw the consequences of her decisions and actions. She believed that since she gave all decisions by herself, this allowed her to see what she remembered and what she needed to study to expand her knowledge. Like Kim, Manny stated that doing everything by herself helped her to gain experiences directly. She could understand what an operator might experience while doing specific tasks. According to her, this helped her to see the possible problems an operator could face in mine environment directly. This would help her to give better decisions when they would be working in mine in the future. Hence, she believed that doing everything by herself was more educative than telling avatars what to do. According to her;

> *"Doing everything by yourself is more educative of course… In there you work as an operator, you understand how it is like, what they are doing, what difficulties an operator faces, what may happen etc… You understand the importance of experienced operator…. In the future, when deciding something in mine, it will absolutely help you."*

> *"Her şeyi senin yapman daha eğitici tabi… Orada sen operatör gibi iş yapınca anlıyorsun nasılmış, ne yapıyormuş operatör nasıl sorunlarla karşılaşıyormuş, neler olabilirmiş falan….. Deneyimli operatörlerin önemini anlıyorsun böylece….. İleride madende bir şeylere karar verirken kesinlikle sana yardım edecektir."*

Lack of Guidance & Hints: Manny had different idea than Kim related with guidance and hits. She thought that lack of guidance and hints was the strength of the game not weakness. She liked to take full control in the game environment and to give all the decisions by herself. By this, she thought that she was forced to consider all the possibilities by herself and saw the consequences of her decisions. She said

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that trying to find the best decisions and seeing the consequences of them were more instructive than being given hints. She suggested;

> *"It should not give hints to me… It does not say when I cannot do for example, if in there I cannot load the dumper; it should not give me hints about how I can load, I should find it. I should find it so I can learn."*

> *"Bana hint vermemeli.. Ben yapamayınca söylemesin mesela ben orda kamyonu dolduramazsam bana nasıl dolduracağımın ipucunu vermesin onu ben bulayım. Ben bulayım ki bir şeyleri öğreneyim."*

Manny believed that in the future she had to take all the control while she was working as mining engineer. She thought that nobody would guide her in the future. So she stated that lack of guidance and hints would help her to be prepared for her future career.

> *"When we star to work, we will decide on everything ourselves. In some places, only one mine engineers might work, you cannot ask anyone in such kind of place."*

> *"Çalışmaya başladığımızda her şeye kendimiz karar vereceğiz. Bazı yerlerde sadece bir maden mühendisi çalışabiliyor kimseye soramazsın ki öyle bir yerde."*

In addition to strengths, Manny also identified the weaknesses of the game used in this study which were similar missions, mild punishment and feedback.

Mild Punishment: Mild punishment in the game was another thing that Manny complained about. Although Manny was a non-gamer participant, she wanted to be severely punished when she made a mistake in the game. She said that mining engineers were responsible for everything in the mine environment. People had to be very careful in mine because any small mistake might cause big problems or hurt someone. Thus she believed that since educational games were aimed to help them to prepare their future career; severe punishment forced them to consider all possible problems and caused them to be very careful while they were working in mine. She stated;

> *"You are responsible of everything in mine. Even a tiny mistake can cause big accidents… If the game helps us, if it shows what will be in the future, there should be severe punishment."*

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"Madende her şeyden sen sorumlusun. En ufak bir hata bile büyük kazalara yol açabiliyor... Eğer oyun bize yardım edecekse, gelecekte olacakları gösterecekse, ağır cezalar olmalı."

Similar Missions: Manny stated that although she liked to be given a mission, the game provided similar missions in all levels. For her, at the beginning it was fun to complete the missions but after a while doing similar missions over and over made her get bored. In later levels, she preferred to do different missions instead of doing similar missions over and over. Thus, similar missions were listed as a weakness of the game by her. She stated that;

"At first it was enjoyable but after a while similar missions are given, that is boring... I would like something like the car is broken; I go to the repair-shop, have it repaired etc. something like that can be happened. Those also can be given as mission."

"İlk zamanlar eğlenceliydi ama bir süre sonra hep aynı görevler geliyor, o sıkıcı oluyor... Ben şey isterdim araba bozulsun tamirhaneye gideyim, araba tamir edilsin falan o tarz şeyler olabilir. Onlar da görev olarak verilebilir."

Feedback: Feedback was the last contructs that Manny complained. She stated that although game showed the consequences of her actions, only seeing the consequences were not enough for her to estimate her performance. She said that the game should inform her about her actions in detail. She thought that this would be more educative. She suggested that;

"But if I make a mistake, it should say it to me so that I learn. It should give information about the consequences of my action in detail. "
"Ama yanlış yaptıysam bana bunu söylesin ki ben öğreneyim..... Hareketlerimin sonucu hakkında ayrıntılı bilgi vermeli."

4.1.2.3 The Opinions of Johnson about the Strengths and Weaknesses of Simulation Game Used in this Study

According to Johnson, realism in the design, visualization, and role of the player were strengths of the game.

Realism in the Design: According to Johnson, the game was realistic and its realism was strength of the game. He stated that the game especially mine design and processes were appropriate to reality.

Mine Design: Johnson believed that the mine design in the game environment was realistic. The mine environment in the game looked like the one he had gone for his summer practice. He said that he remembered the days in his summer practice while playing the game. He added that especially vehicles were realistic in the game environment. The vehicles included special audio effects. This increased the reality of the game and helped him to feel that he really worked in mine environment. According to him;

> *"The game was very close to reality. The mine in the game resembled the mine I worked for summer practice. When I was playing, those days flooded back to my mind. In the vehicles for example when dumper track went backward, warning beeps was heard. This increases the reality of the game."*

> *"Oyun baya gerçeğe yakındı. Oyundaki maden benim staj için çalıştığım madene çok benziyordu. Oyun oynarken o günler geldi aklıma. Araçlarda mesela kamyon geri giderken uyarı sesi duyuluyordu. Bu oyunun gerçekçiliğini artırmış."*

Processes: Johnson also believed that the processes he did such as hauling, drilling were realistic. He stated that these processes were similar that he had observed in his summer practice. But, he complained about the relationship between whether conditions and processes in the game environment. He said that atmospheric effects such as rain were used in the game. But, the conditions were not changed much by the weather. He stated that since the atmospheric effects did not affect anything in the game environment, it was unnecessary and decreased the realism of the game. It made the player thinks that the game was poorly designed and decreased the effect of the game on the players. He stated that;

> *"They were also good; they looked similar that I saw in summer practice, they were realistic…. The weather is rainy but the rain does not affect anything. These make the player to feel that the developers of the game do not care. This decreases the effects of the game."*

> *"Onlar da iyiydi, stajda gördüklerime benziyordu, gerçekçiydi… Yağmur yağıyordu ama yağmur hiç bir şeyi etkilemiyordu. Bunlar oyuncuda oyunu geliştiricilerin hiç özenmemiş gibi bir duygu uyandırıyor. Bu da oyunun etkisini azaltıyor."*

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Visualization: According to Johnson, one of the important strengths of the game was visualization. He stated that the game helped to visualize the contents and terms related with mining in three dimensions. Like the other non-gamer participants in this study, he thought that it was difficult to visualize the concepts of the lessons in their department. Thus, they faced difficulties to understand the content of the lessons correctly. He complained that;

> *"I face difficulties in the lessons due to limited visuals.... For example, we went to field trip; the things explained in there were more effective. At least, since I see, I visualize I do not know it is more effective."*

> *"Derslerde görsel az olduğu için ben zorlanıyorum..... Mesela geziye gitmiştik orada anlatılan şeyler daha etkili oldu. En azından gördüğüm için aklımda canlandırdığım için ne bileyim daha çok etkili oluyor."*

To overcome these difficulties, he saught for images related with the content. But, he stated that they did not help him as much as he wanted because generally they were retouched and were given visual effects. This decreased the reality of the images. He said that to understand the concepts accurately, realistic images, pictures should be shown to students. He believed that these kinds of educational games could be solution to this problem. It could help students to visualize the abstract concepts and terms discussed in the courses. In other words, it could help the students to transform abstract knowledge to concrete ones. In his belief;

> *"Since the pictures on computer environment include visual effects, they are not effective; it is obvious that they are retouched. More realistic pictures should be shown in order to understand the topics.... As far as I see, the game is realistic."*

> *"Bilgisayar ortamındaki resimlerde görsel efekt olduğu için etkili olmuyor, rötuş yapıldığı çok belli oluyor. Daha gerçekçi resimler gösterilmeli konuyu daha iyi anlamak için.... Oyunda da gördüğüm kadarıyla gerçekçiydi."*

Role of the Player: According to Johnson, the last strength of the game was the role of the player. He said that the game provided an environment in which the players took different roles such as miners, operators or engineers. This helped the

player to understand the importance of the people who worked in mine and saw the things from their perspectives. He mentioned that;

> "In the game, you do many things by yourself. This is good to understand the duty and importance of other people in the mine."

> "Oyunda birçok şeyi kendin yapıyorsun. Bu madendeki diğer insanların görevini ve önemini anlamak için iyi olmuş."

In addition to the strengths, Johnson also identified several weaknesses of the game such as mild punishment, similar missions and limited technical information.

Mild Punishment: Johnson stated that the game punished him mildly when he made a mistake. He added that this was not good for the students who played this game. Although he was a non-gamer participant and did several mistakes while playing, he said that mild punishment was not enough to understand the importance of being careful in mine environment. Like the other non-gamer participants in this study, he stated that in a mine environment, everybody had to be very careful while they were doing their jobs. Otherwise, their mistakes might cause severe problems and injuries. Thus, in the game environment, there should be severe penalties for the mistakes. According to him, this forced the players to be very careful and prepared them to their future career. He recommended that;

> "In the game, there is not such kind of severe penalties… I think the game with this kind of mild punishment does not show the students that they have to be careful. With the help of severe punishment, when you make a mistake, you do not do the same mistake again, you act carefully… This prepares you to your future job."

> "Oyunda öyle ağır ceza yoktu… Bence oyun bu şekilde hafif cezalarla öğrencilere madende dikkatli olması gerektiğini göstermez… Ağır cezalar sayesinde bir yanlış yaptığında, bir daha aynı hatayı yapmazsın, daha dikkatli davranırsın….. Bu seni gelecekteki işine de hazırlar."

Similar Missions: Johnson complained about the similar missions provided by the game. Johnson added that missions were strength but this strength turned to be a weakness after a period of time. After a time, doing everything by himself made the game boring. He advised that the designers should be careful and arrange the

appropriate time to set the role of the player only as mining engineer. He suggested that;

> *"But, after a certain amount of time, doing everything yourself becomes boring. At the beginning this is good but in upper levels I think this should be changed. For example, you have workers and you start to give orders to them. That time should be well arranged. At the beginning, you should do many duties by yourself but after a while you should only work as an engineer. This is much better I think."*

> *"Ama, bir yerden sonra her şeyi senin yapman sıkıcı hale geliyor. Oyunun başlarında bu iyi ama ileriki seviyelerde bence bu değişmeli. Mesela işçilerin olur ve sen onlara emir vermeye başlarsın. O zamanı iyi ayarlamak gerek. İlk başlarda çeşitli görevleri kendin yapmalısın ama bir zaman sonra sadece mühendis gibi çalışmalısın. Bu daha iyi olur bence."*

Limited Technical Information: Johnson complained about the information provided in the game. He satated that game gave limited technical information whereas he wanted to use and receive much in order to expand his knowledge. He stated that educational games should give the players much technical information. Thus, the players could gain much information which was necessary for their future career. According to him;

> *"In the game, there is limited technical knowledge. If the game is used in the department, the more technical information will be better. It helps the students to gain much information."*

> *"Oyunda az teknik bilgi vardı. Eğer bölümde kullanılacaksa daha fazla teknik bilgi olması daha iyi olur. Öğrencilerin daha çok bilgiyi öğrenmesini sağlar."*

He stated that studying from the books was generally boring. In addition, the books did not help the players to visualize the concepts. But if the game gave technical knowledge in appropriate times, students could learn in a fun way and understand the concepts more easily. For instance, he advised that the blasting patterns could be given to students before doing blasting. He believed that this helped them to understand blasting more easily since;

"Sometimes, studying from the books can be boring. Sometimes, you may not understand the contents while studying from the books. But, since there are visuals parts in the games, you understand the contents more easily. For instance, the information about blasting can be given before blasting, the blasting designs can be explained. You not only understand more easily but also since you play the game, it is funnier. Hence, the students can understand blasting more easily."

"Bazen kitaptan çalışmak çok sıkıcı olabiliyor. Bazen kitaptan çalışırken de konuyu anlayamayabiliyorsunuz. Ama oyunda görsel kısımlarda olduğu için konuyu daha kolay öğrenebilirsin. Mesela patlatma yapılmadan önce patlatma ile ilgili bilgi verilebilir, patlatma dizaynlarını anlatılabilir. Böylece öğrenciler patlatmayı daha kolay anlar."

4.1.3 Motivational Elements in Simulation Games Used in this Study (Research Question 3)

In Table 9, the opinions of non-gamer participants regarding with the motivational elements in the simulation game used in this study are shown. It is seen that all the non-gamer participants generaly listed similar motivational elements. Field of study, missions, challenge, curiosity and control were the common themes mentioned by all three non-gamer participants. Moreover, the theme realism in design was listed by Kim and Johnson whereas roles of the players were mentioned by Kim.

Table 9 *Opinions of Non-gamer Participants about Motivational Elements in Simulation Games Used in this Study*

Kim	Manny	Johnson
Field of Study	Field of Study	Field of Study
Missions	Missions	Missions
Challenge	Challenge	Challenge
Curiosity	Curiosity	Curiosity
Control	Control	Control
Realism in the Design	Realism in the Design	Realism in the Design
Roles of the Player		

4.1.3.1 Opinions of Kim about Motivational Elements in Simulation Games Used in this Study

Based on her experience, Kim identified field of study, missions, challenge, curiosity, control, realism in the design and roles of the player as motivational elements in the simulation game used in this study.

Field of Study: Kim stated that she liked her department and wanted to work as mining engineer in the future. She looked for opportunities that could prepare her to her future career. Thus, she said that this game took her attention since it was related with her field. This game represented the environment that she would work in the future. She stated that the game showed what she would see, how her life would be when she would start to work in mine. This motivated her to play the game because;

> *"I like the game. It is related with our field. At least, it shows what will be happened in the future, how the mine looks like."*

> *"Ben oyunu sevdim. Bizim alanımızla ilgiliydi. En azından ileride neler olacağını, madenin neye benzediğini gösteriyor."*

Missions: Kim stated that given missions also affected her motivation. It increased her motivation to play the game for two main reasons. Firstly, she explained that due to her nature, she had to finish what she intended to do. She could not leave something undone no matter how long it took. And game helped her to set her aims by giving missions. In other words, after accepting a mission, she set her goal to complete the mission and tried to complete it. She stated that, in the game, she owned a quarry and customers made order for specific rocks and minerals. As a quarry owner, she decided whether to accept the order and if she did, she tried to meet the demand of the customers. For her, these demands from the customers motivated her much. When she accepted an order, she needed to supply it no matter how long it took. She stated that she could not quiet the game before she finished the job she accepted. When she became successful and met the demand, she became happy and peaceful. For this reason, missions motivated her to play the game. She explained that;

> *"Giving missions motivates me… If I start, I have to finish it…. Also in here, if I accept a mission, I have to finish it, no matter how long it takes. When I finish, I become relax, otherwise I cannot be relax. Finishing the missions becomes my only aim."*

> *"Görev vermesi beni motive etti… Ben başladım mı bitirmek zorundayım bir şeyi…. Burada da görevi kabul ettiysem onu bitirmek zorundayım ne kadar sürerse sürsün. Bitirince rahatlıyorum, yoksa rahat edemem. Görevi bitirmek tek amacım oluyor."*

Secondly, the missions helped her to produce a special product such as stones or valuable minerals at the end. This suited her beliefs related with the game. She stated that she needed to produce something at the end of the game. Thus, she could not stand race or actions type of games. She believed that racing with others or fighting among them did not contribute anything to any player. Thus, according to her, those kinds of games were waste of time. When she produced something like she did in this game, she thought that she did something beneficial and did not waste her time. She stated that;

> *"Making me to produce something also motivates me. I think you have to produce something at the end, you see only by killing a man or competing with someone nothing happens… In here, you produce something at the end of the mission, stones etc. It supposed to be like that, otherwise it is waste of time."*

> *"Bana bir şey ürettirmesi de motive ediciydi. Bence oyunun sonunda bir şey üretmelisin işte sadece adam öldürdüğünde yada biriyle yarıştığında hiçbir şey olmuyor ki…. Burada bir şeyler üretiyordun görevin sonunda, taş falan. Öyle olmalı yoksa zaman kaybı."*

Challenge: Due to the reason that Kim was non-gamer participant, it was difficult for her to play the game. However, this situation did not demotivate her; instead it had positive effect on her motivation. She was aware of the fact that the difficulties she faced was caused by her inexperience in digital games. At the beginning of the game, she was not successful as she wanted to be. For instance, Kim made a great effort to load the fragmented rocks. But, she was motivated to overcome the difficulties she faced rather than being demotivated. She stated that if taking the rocks were so easy, she would not want to play. When she challenged, she felt that she had to overcome the challenge. She wanted to be successful and so she

came up new strategies in order to become successful. She stated that she used trial and error method to overcome the difficulties. She enjoyed finding out the possible solutions to the problems. According to her;

> *"I got angry when I could not do but I did not quit. I cannot quit… I try to do till I do no matter how long it takes."*

> *"Sinir oldum yapamayınca ama bırakmadım. Ben bırakamam…..... Onu yapana kadar uğraşırım, ne kadar sürerse sürsün."*

Curiosity: Curiosity was another motivational elements identified by Kim. It was seen that two main things aroused her curiosity. Firstly, she wondered the game design. She analyzed how the vehicles, equipment and processes were simulated in the game. She tried to complete the missions in order to earn money and buy these vehicles and equipment. Moreover, she wondered the next levels of the game. She was curious about how the levels were designed, how the mine in those levels were simulated. Secondly, the aims of the game increased her curiosity. She was curious about how the vehicles and equipment could be used effectively in order to complete the missions. Moreover, the activities such as blasting aroused her curiosity. She stated that she enjoyed watching these activities in mine. At summer practice, she worked with the operators to see how they performed these kinds of activities. Thus, she was curious about how she could do them efficiently. She tried different blasting patters in order to see their effect on the environment simulated in the game. She said that;

> *"I was curious about which equipment, vehicles there are, how they are used. What happens in the next level…. I was curious about how blasting were done."*

> *"Hangi araçlar, ekipmanlar var, nasıl kullanılıyor merak ettim. Bir sonraki seviyede ne oluyor….nasıl patlatma yapılıyor onu merak ettim."*

Control: The last motivational element Kim identified was control. She said that control affected her motivation positively. However, she stated that her sense of control was changed from situation to situation. When she gave all the decisions by herself, she felt that she had full control in the game. For instance, she felt she had full control on pneumatic drill. She stated that she could decide when to stop the

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pneumatic drill and where to drill by using it. Thus, this made her to feel that she really had full control on pneumatic drill. This positively affected her motivation to play. However, as opposed to equipment, the vehicles did not make her to feel in the same way. She thought that she did not give important decisions when she used them. She was just driving the vehicles instead of controlling them. In those situations, she felt she had limited control and this negatively affected her motivation. She believed that;

> *"I was in control. But it is something like sometimes when using pneumatic drill etc. I can control more… I decide on everything, where to drill, how to use it etc. But it is not the same when I am using the vehicle, you just drive it."*

> *"Kontrol bendeydi. Ama öyle bir şey ki bazen pneumatic drill kullanırken falan daha çok kontrol edebiliyordum… Her şeye ben karar veriyordum nereye deleceğim, nasıl kullanacağım falan. Ama araç kullanırken öyle olmuyordu sadece kullanıyorsun."*

The design of the game also affected her sense of control. The key combinations that were necessary to play the game were well-designed. She said that the keys that control the vehicles were near in the keyboard. Hence, she could do the activities by using vehicles and equipment easily via keyboard. She could use them in a way she wanted so it motivated her. For her, she was non-gamer and was not used to use such kind of vehicles in game environment. If it was difficult to use them, she would get bored and would not continue to play. But, she added that she could only use the same avatar in the game which affected her motivation negatively. Because, she lost huge amount of time to transmit the avatar from one location to another. She wanted to control several avatars. She stated that all the vehicles should include a driver in it. And, she wanted to be allowed to change the avatar by pressing a specific key on the keyboard. For her, this helped to speed up the game and the motivation of the players. In addition, she said that having control on perspective of the screen also motivated her to play. She could changes the screen perspectives when she needed to perform the activities more easily. It helped her to be successful so it motivated her to continue to play. She stated that;

> *"The usage of game is easy; I can do whatever I want to do, even I can change camera view… But, that is bad, I only control one*

avatar. It is very time-consuming... In every vehicle there can be someone, I should change from one to another and control it by pressing a button."

"Oyunun kullanımı kolaydı istediğimi yapabiliyordum. Hatta kamera açısını bile değiştirebiliyordum... Ama şey kötüydü bir işçiyi kontrol edebiliyorum. Çok zaman kaybı oluyor... Her aracın içinde biri olabilir ben tek tuşla ondan ona geçip, kontrol edebilmeliyim."

Finally, she said that she could not control the music in the game. She said that there was only one song and it just included a few musical notes and it was playing over and over. In addition, she did not like the music of the game. It annoyed her. Thus she got bored and turned it off. She said that music was necessary in the game. For her, the game should include music. Without it, the game became boring. But, she needed to have more control on the music. Giving permission to take music off and on did not enough to her. She suggested that there should be more song options in the game and the players should choose which they wanted. According to her;

"Music is so boring, it just includes a few melodies, it is also played over and over. It cannot be played without music but there should be different songs, we should select among them."

"Müzik çok sıkıcıydı, sadece bir kaç nota vardı durmadan da çalıyordu. Müzik olmadan oynanmaz ama farklı müzikler olsun arasından biz seçelim."

Realism in the Design: Kim said that she sought for realism in any educational game. For her, realism increased the educational value of the game and she felt that she would learn something if she played it. Thus, realism in the game increased her motivation to play. She believed that;

"If it was not realistic, I would not play, it should be realistic in order to learn, otherwise it is waste of time."

Gerçekçi olmasaydı oynamazdım ki öğrenmek için gerçekçi olsun, yoksa zaman kaybı."

According to her, the game was very realistic and this motivated her to play the game. She stated that the graphics were well-designed and were appropriate to

the real life. For instance, the vehicles she used looked like the ones she saw at summer practice. Thus, she felt as if she really drove them. In addition, the special audio effects also were added to the vehicles. Vehicles warned the player when they went backwards. This also increased the realism in the design as well as her motivation since;

> *"The game is realistic, the vehicles, sounds etc. Of course, it is motivating, I feel like I am actually working in mine."*

> *"Oyun gerçekçiydi, araçlar, sesler falan. Tabi motive ediciydi gerçekten madende çalışıyor gibi hissettim."*

Roles of the Player: Kim stated that different roles assigned by the game to the player also had an effect on her motivation. It increased her motivation. In the game, she needed to work as operator, workers or mine engineer to complete the missions. She stated that this suit her beliefs regarding with education. She believed that gaining experience from the first hand was more educative than being told. By roles, she understood how each person in different roles in mine felt and this motivated her. She stated that;

> *"When you do, it is better of course, you understand better. You do it so you understand exactly; looking how it is done is not educative much… In here, you both do and see who does what."*

> *"Sen yaptığında daha iyi oluyor tabi, daha iyi anlıyorsun. Yapacaksın ki anlayacaksın tam olarak, nasıl yapıldığına bakmak çok eğitici olmuyor….. Burada da hem yapıyorsun, hem de görüyorsun kim ne yapıyor."*

She especially liked to work as an operator. As operator, she drove some vehicles such as wheel loader, dumper truck etc. in the game. She believed that experienced operators had great knowledge because they performed many activities in different situations. Thus, they saw many possible consequences of their actions. In addition, she preferred doing everthing by herself instead of telling others to do. According to her, she learnt much by doing rather than watching the others how they did. Due to all these reasons, being in different roles especially being an operator in the game motivated her to play the game. She believed that;

> *"Actually, the operators teach… Mine engineers give technical information. Besides, mine engineers in summer practice did not*

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give information to us. He asked questions constantly. We learnt the answers from the workers, told him. True information is learnt from workers, operators."

"Aslında operatör öğretir… Maden mühendisi teknik bilgi verir. Zaten stajdaki maden mühendisi bilgi de vermedi de bize. Soru soruyordu sürekli. Biz de cevaplarını işçilerden öğreniyorduk ona söylüyorduk….Gerçek bilgi işçiden öğrenilir operatörden öğrenilir."

4.1.3.2 Opinions of Manny about Motivational Elements in Simulation Games Used in this Study

Based on her experience, Manny identified six main motivational elements which were field of the study, missions, challenge, curiosity, control and realism in design.

Field of Study: Manny liked her department and wanted to work as mining engineer in the future. Thus, anything related with mine or mining engineering took her attention. She stated that she accepted to participate in this study because the game was related with mining. According to her, this game provided opportunities for her to estimate how her life would be if she worked in the mine. Hence, she was motivated to play in order to see her future life. She stated that;

"I liked the fact that it is mining-related. In the future I want to be a mining engineer… The game helped me to understand how my life would be in the future."

"Madencilikle ilgili olması çok hoşuma gitti benim. İleride maden mühendisi olmak istiyorum… Oyun ileride hayatımın nasıl olacağını anlamama yardım etti."

Missions: Manny stated that missions were one of the most important motivational elements that affected her much. She said that missions were appeared in the game. She chose the mission she wanted to do and tried to do her best to finish it. After finishing the mission, she felt that she really did something good; she made a progress in the game. She felt that she was successful. These kinds of feelings motivated her to continue to play and made her want to finish more missions. She thought that;

"You decide the mission, what you do what you do not do…. When that mission is finish, I become happy, I become happy because I finish, I succeed"

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"Göreve sen karar veriyorsun, ne yapıp ne yapmayacağına… O görevi bitirince mutlu oluyorum, bitirdiğim başardığım için mutlu oluyorum"

However, she warned that designers had to be careful in deciding the mission in the game. For instance, she said that in this game the missions were similar. Thus, after a while doing the similar mission over and over made her bored and demotivated her to continue to play. According to her;

"Of course, doing similar missions are boring. In here, it is the same. Similar missions start to come, that makes me bored after a while. This should be considered."

"Tabii aynı görevleri yapıp durmak sıkıcı. Burada öyleydi. Benzer görevler gelmeye başladı o da bir sure sonra beni sıktı. Buna dikkat edilmeli."

Challenge: Manny said that the challenge in the game also had an effect on her motivation. She liked to be challenged. She stated that when she was challenged and could not do the things she was supposed to do, she became furious and tried to be successful. She said;

"When I face difficulties, I become more furious for doing it…. I try to do, I try until I do…. I do not quit, I cannot quit."

"Zorlanınca daha da hırslanırım yapacağım diye…. yapmaya çalışırım, yapana kadar uğraşırım… Hemen bırakmam, bırakamam."

Although she faced difficulties due to her inexperience in game playing, these difficulties did not demotivate her. Instead, her motivation was increased and she sought for possible solutions. She applied trial and error method to overcome the difficulties. She said;

"Of course, I faced difficulties in some parts, I am novice, sometimes I cannot do the easiest part… I think what I could do, I did by trial and error method but did it anyway."

"Tabi zorlandığım kısımlar oldu, acemiyim, bazen en kolay yerleri bile yapamadım…. Neler yapabilirim diye düşündüm, deneme yanılma yöntemiyle yaptım ama yine de yaptım."

Curiosity: Curiosity was another motivational element identified by Manny. She said that generally she was curious about vehicles and equipment, rules of the game and activities while she was playing the game. Firstly, she said that she gave

emphasis on the design of the game. She was curious how the vehicles and equipment were simulated in the game environment and how the rules were set. She analyzed all the vehicles and equipment provided by the game. Moreover, since she was curious about what the game allowed her to do so during the game playing, she tested the rules of the game. She tried to break the general rules like setting the dynamites on fire while she was near the holes to see whether the game allowed, warned or punished her. Then, she wondered how vehicles and equipment were used while she was playing. The activities such as blasting, hauling were also arouse her curiosity and motivated her to play the game. She stated that she wondered how she could perform these activities in the game and continued to play to see them. According to her;

> *"There were a lot of things I was curious about.. Equipment... Activities… For example, what would happen if I hit there, what would happen if I went over there not road, I wondered…. How the game act when I made a mistake, I tried to see that."*

> *"Merak ettiğim bir sürü şey vardı…. Ekipmanları.. Aktiviteler... Mesela şuraya çarpsam ne olur, yoldan değil de başka yerden gitsem ne olur, onu merak ettim…. Oyun nasıl davranacak hata yapınca onu görmek için uğraştım."*

Control: Manny liked to be in control and be responsible for everything. She stated that game allowed her to take the full control since it did not give any hints or tips. She said that she gave all the decisions and did everything by herself without guidance, so she felt that she was the one who was in charge in the game. This motivated her to play the game. She stated that;

> *"I'm in control. I decided everything, I did. The game does not intervene anything, does not say anything, does not guide me. That was good."*

> *"Kontrol bende. Her şeye ben karar verdim ben yaptım. Hiçbir şeye karışmıyor oyun, hiç bir şey demiyor, beni yönlendirmiyor. Bu iyiydi."*

In addition, she also liked the key combination necessary to play the game. According to her, they were well-designed. Although she had problems at the beginning, she got used to the keys in a short time. She

stated that with the help of key combination, she was able to do whatever she wanted easily. Thus, it increased her sense of control in the game environment. She told that;

> "The keys were easy to use, at the beginning it was a problem till I got used to them but later I got used to them, I did what I wanted easily."

> "Tuşların kullanımı kolaydı, ilk başlarda alışıncaya kadar sorun oldu ama sonra alıştım, kolay yapabildim istediklerimi."

Realism in the Design: Finally, Manny said that realism affected her motivation to play the game. She underlined the limited opportunities for her to apply her knowledge. Thus, she believed that realistic games could provide that chance to her. She could explore what happened when she did something by playing realistic games. For that reason, she thought that educative games had to be realistic. She thought that the game she played met her needs about realism and so it increased her motivation to play. According to her;

> "I like its realism very much…. We do not have chance to apply what we know at the department. Since the game is realistic, we can easily practice what we have learnt."

> "Gerçekçiliği çok hoşuma gitti…. Bildiklerimizi uygulama fırsatı olmuyor bölümde. Oyunda gerçekçi olunca daha kolay öğrendiklerimizi tekrar edebiliyoruz."

Like Kim, Manny also thought that graphics were well designed. Particularly, the vehicles she used were similar to ones she had seen at summer practice. In addition, the vehicles and equipment produced special audio effects as the ones in real life. She stated that this property also increased the realism in the design. She felt that she really worked in mine environment and it increased her motivation to play. She stated that;

> "The vehicles looked much more the same with the ones I had seen at summer practice….. The warning voice etc. was also given…. Of course, they affected my motivation."

> "Araçlar stajda gördüklerime çok benziyordu… Uyarı sesleri falan da çıkıyordu… Tabi bunlar etkiledi benim motivasyonumu."

4.1.3.3 Opinions of Johnson about Motivational Elements in Simulation Games Used in this Study

Based on the experience of Johnson, he also listed several motivational elements in the game. According to him, field of study, missions, challenge, curiosty, control and realism in the design were the main motivators in the game.

Field of Study: Johnson said that since the game was related with his interest, he was motivated to play the game. He wanted to be a mining engineer and worked in mine. Since the game was related with mining, it took his attention. Moreover, he stated that while he had been playing the game, he had identified himself with the character in the game. He had imagined what he had done if he had owned such kind of mine in real life. He felt that he really owned the mine simulated in the game and so he tried to be very careful in his decisions. He said that;

> *"In the future, I will be a mining engineer and will work such kind of place ..... While I was playing, I thought about that all the time… If I owned the mine shown in the game, if I made production like this, I imagined how it would be."*

> *"Ben de ileride maden mühendisi olacağım böyle bir yerde çalışacağım….Oyun oynarken de bunu düşündüm hep… Oyunda gösterilen maden benim olsa, ben de üretim yapsam böyle nasıl olurdu diye hayal ettim."*

Missions: Johnson stated that mission provided by the game affected his motivation. He liked to be given missions because missions gave him reason to play the game in his belief. He stated that completing the mission became his aim and this increased his motivation to play. According to him;

> *"The missions were nice at the beginning; they gave me reasons to play the game. When the mission was given, I tried to finish the game. I had to finish the game so I earned Money."*

> *"Görevler başta iyiydi, oyun oynamam için bir sebep veriyordu. Görev verildiği zaman onu bitirmek için uğraşıyordum. Görevi bitirmeliyim ki para kazanayım."*

But, he added that sometimes the missions had negative affects on his motivation. He said that he was a non-gamer and he was aware the fact that he was not successful enough. However, the game did not consider the capabilities of the

non-gamer students. The game might request players to produce huge amount of special rocks before they got used to use the vehicles and equipment effectively. He stated that before gaining any experience, producing huge amount of rocks took a lot of time. Thus, he got bored before completing some of the mission. These kinds of missions demotivated him because;

> *"Some missions could be boring. For instance, it asked me to produce 200 kg. But producing this took much of my time….. At those times, it could be boring."*

> *"Bazı görevler çok sıkıcı olabiliyor. Mesela, benden 200 kg üretmemi istiyor. Ama onu üretmem benim çok zamanımı aldı….. O zamanlarda sıkıcı oldu."*

In addition, the game gave similar missions to the player. For him, at the beginning it was not problem to do similar missions. But after a while, doing the same things over and over demotivated him to continue to play. He said that the players should give break before doing similar missions or the variety of missions should be increased in order to make players not be bored. He suggested that;

> *"Similar missions could be given one after the other….. I wanted to do different things rather than similar missions."*

> *"Art arda benzer görevler gelebiliyordu…. Ben arada başka şeyler de yapmak isterdim benzer görevler yerine."*

Challenge: Johnson said that due to being a non-gamer participant, he faced difficulties while he was playing the game. Especially, performing the necessary activities challenged him much. But, he stated that these difficulties increased his motivation rather than decreasing it. He said that he was aware of the fact that he was challenged in the game due to being non-gamer participant. He believed that he could overcome the difficulties by gaining expertise so he kept playing game. He said that;

> *"In the game, there were parts that I had difficulty in but this did not stop me…. I did not quit, on the contrary I tried much to do…. At the end, I am not a gamer."*

> *"Oyunda zorlandığım kısımlar oldu ama bu beni durdurmadı….. Bırakmadım tam tersi daha çok uğraştım yapabilmek için... Sonuçta oyun oynayan biri değilim."*

In addition, he explained that he rose to the challenge if the challenge matched his skills. Otherwise, he did not try to be successful, he quitted immediately. He said that the challenge in the game did not above his bend so it motivated him to play the game. He played because;

> "I played because I knew that I could do, if I believed that I could not do, I quit."

> "Yapabileceğimi bildiğim için oynadım eğer yapamayacağıma inansaydım bırakırdım."

Curiosity: Curiosity was another motivational elements listed by Johnson. He said that there were three main things that aroused his curiosity in the game environment. Firstly, he was curious about the vehicles and equipment simulated in the game environment. He said that he was so excited to use the vehicles and equipment since in real life; he did not have that chance. So, he was motivated to play the game and tried to earn as much money as he could in order to buy new vehicles and equipment. Secondly, the activities he had to perform in mine environment motivated him to continue. He wanted to see how he could do the activities such as blasting, hauling etc. Finally, he was curious about the rules of the game. He said that he searched for the boundaries of the game. He wanted to see what the game environment allowed him to do while he was playing the game. So, he did several mistakes in order to see how they game would act. He said that;

> "I was curious about the vehicles and equipment…. I tried to see what the game allowed me to do."

> "Ekipmanları ve araçları merak ettim… Oyun neleri yapmama izin veriyor onu görmeye çalıştım."

Control: Johnson identified control as one of the motivational elements in the game. He said that the game allowed him to control everything by giving him several roles such as operator, engineer etc. He gave all the decisions and did the actions. He used everything like the vehicles and equipment himself instead of telling an avatar to do. For all of this reason, he felt that he had control on most of the things in the game and this feeling motivated him to play. He tought that;

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> *"For your aim, you can do everything... I did everything in the game, I was both worker and operator.... I was in control."*

> *"Amacın için her şeyi yapabiliyorsun..... Her şeyi ben yapıyordum oyunda, hem işçi hem operatördüm..... Kontrol bendeydi."*

However, he said that controlling only one avatar decreased his sense of control. He stated that since he could use only one avatar, he had to get on and off the vehicles to perform activities. But, this caused him to waste his time on the road. He wanted to control all the workers simulated in the game not just the one of them. He said that;

> *"Sometimes, I felt decrement in the sense of control.. I managed only one worker.. I should able to control the other workers in the mine."*

> *"Bazen kontrolün azaldığını hissettim... Sadece bir işçiyi yönetebildim... Diğer işçileri de madendeki kontrol edebilmeliyim."*

Realism in the Design: Johnson stated that realism in the design of the game was an important factor that affected his motivation. He said that the game was realistic and it increased his motivation to play the game. Especially, most of the graphics and special audio effects had positive contribution on the realism of the design. He stated that the mine environment simulated in the game looked like the one he had worked in his summer practice. This motivated him to play the game. Moreover, the vehicles and equipment he used in the game was simulated appropriate to the real life conditions. The vehicles gave special warning signal when they went backward. If the warning signal was not given, he probably felt the void of this signal. Hearing these signals motivated him to play because;

> *"The game is realistic. The mine shown in the game look like the one I worked. Most of the graphics are well designed. Of course, when going backwards, hearing different sounds is realistic. Besides, they are important in the mine... They affects positively, if they [sounds] do not exist, I feel the void of them absolutely."*

> *"Oyun gerçekçi olmuş. Oyunda gösterilen maden benim çalıştığım madene benziyordu. Grafiklerin çoğu iyi dizayn edilmişti. Tabi geri geri giderken değişik seslerin duyulması gerçekçi oluyor. Zaten onlar madende önemli şeyler.... Olumlu etkiler bunlar [sesler] olmasaydı bunun eksikliğini hissederdim kesinlikle."*

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However, although most of the graphics were well designed, some of them should be reconsidered according to him. He stated that some of the graphics such as the avatar were not realistic. It may make the players to think that the designer did not give attention to the graphics. When he saw such kind of slapdash graphics, his motivation was decreased. He said;

> *"But some of the graphics should be redesigned. Some of them are slapdash. When you see them, the game seems like it was not elaborated I think. In the game the graphics should be good."*

> *"Ama bazı grafikler tekrar yapılmalı. Bazıları üstünkörü yapılmış gibi. Bunları görünce oyun sanki özenilmemiş gibi oluyor bence. Oyunda bütün grafikler iyi olmalı."*

4.1.4 Suggestions to Improve the Effectiveness of Educational Simulation Game Used in this Study (Research Question 4)

Table 10 represents the suggestions of non-gamer participants to improve the effectiveness of the game used in this study. Detailed technical information, occupational safety rules, problem based design, vehicles and equipment, multiplayer option, severe punishment, full control, character growth and mission were the common themes that mentioned by non-gamer participants. Moreover, two non-gamer participants Kim and Johnson gave suggestions about guidance and feedback whereas Manny gave suggestion about only feedback.

Table 10 *Suggestions of Non-gamer Participants to Improve the Effectiveness of Educational Simulation Game Used in this Study*

Kim	Manny	Johnson
Detailed Technical Information		Detailed Technical Information
Occupational Safety Rules		Occupational Safety Rules
Problem Based Design	Problem Based Design	
Vehicles and Equipment	Vehicles and Equipment	
Guidance and Feedback	Feedback	Guidance and Feedback
	Multiplayer Option	Multiplayer Option
	Severe Punishment	Severe Punishment
	Full Control	Full Control
		Character Growth
		Variety of Missions

4.1.4.1 Suggestions of Kim to Improve the Effectiveness of Educational Simulation Game Used in this Study

Kim gave several suggestions to improve the effectiveness educational simulation game she used. Detailed technical information, occupational safety rules, problem based design, vehicles and equipment and guidance and feedback were the major themes which she gave suggestions about.

Detailed Technical Information: According to Kim, an educational game should give highly detailed technical information about the content it covered in appropriate times. Kim stated that game was a big chance for students to visualize the contents of their courses. If this was supported by explanations, the students could learn the content more effectively. She suggested that this detailed information should be optional. In other words, the player could close the appearance of this information when they wanted. She explained that;

> *"I think there can be more detailed technical information. In here, there is not much technical information. This can be changed."*

> *"Bence daha fazla teknik bilgi olabilir. Burada çok fazla teknik bilgi yoktu. Bu değişebilir."*

For example, she suggested that when the players went to the mine, a window could be pop up. In that window, the information about the benches such as how they were designed, their heights etc. could be given. Students might read that information. And if they were concentrated on the game and did not want to receive any technical information, they could close the pop up window and continued to play. She stated that explanations with visual elements in 3D would increase the effectiveness of the game. She suggested that;

> *"When the players go to the mine, why the mine is designed in that way can be explained. That information can be given in the small area on the screen."*

> *"Oyuncu madene gittiğinde maden neden öyle dizayn edilmiş o anlatılabilir. Ekranda küçük bir alanda o bilgi verilebilir"*

Occupational Safety Rules: Kim stated that occupational safety was also another important issue in mining. She stated that a mining engineer were supposed to apply occupational safety rules in mine to prevent fatal accidents. Thus, she suggested that this game should provide opportunities where the player applied the occupational safety rules. The player should be asked to ensure safety in mine. This helped the mine engineers to learn the safety rules and prepared them to their future life. She recommended that;

> *"I think there can also be something about occupational safety rules. For example, it can want us to apply occupational safety rules. Thus, we can see how we can apply those rules."*

> *"Bence iş güvenliği ile ilgili bir şeyler de olabilir. Mesela bizden iş güvenliği kurallarını uygulamamızı isteyebilir. Böylece o kuralları nasıl uygulayabileceğimizi de görürdük."*

Problem Based Design: Kim also gave suggestion related with the design of the game. She stated that problem based design should be applied to the game. In other words, game should pose several problems to the player. She said that the game she used only provided missions to the players. Although player might face problems while they were trying to complete the missions, this might not enough to develop problem solving skills of the player. For her, the game should pose additional

problem to the player. She stated that in reality, everything was not smooth in mine. Problems could be occurred and mining engineers had to solve these problems before it damaged the work routine in the mine. Thus, she believed that posing problems to the player and wanting them to solve them would increase the effectiveness of the simulation game since;

> *"In mine everything may not go to the way you want. The problems can be occurred. In also here, the problems can be occurred, we can try to solve."*

> *"Madende her şey istediğiniz gibi olmayabiliyor. Sorunlar çıkabiliyor. Burada da sorunlar çıkabilir, biz çözmeye çalışabiliriz."*

Vehicles and Equipment: Another element that Kim gave suggestion was vehicles and equipment provided by the game. She advised that there should be many vehicles or equipment in the game. She said that the game helped the player to understand how the vehicles and equipment were working. So, if it included more vehicles and equipment, the player could get information about them. Moreover, she advised that the properties of these vehicles should be given. If the game provided many vehicles and gave information about them, the player could give best decisions about which they should use. She believed that;

> *"There should be many dumper types etc. Even, the properties of them also should be given and we should select by looking their properties. There should be many different vehicles and equipment."*

> *"Bir sürü kamyon çeşidi falan olmalı. Hatta, bunların özelliği de verilmeli ve özelliklerine bakarak seçmeliyiz. Bir sürü farklı araçlar, ekipmanlar da olmalı"*

Guidance and Feedback: Finally, Kim gave suggestions about guidance and feedback in the game environment. She suggested that the game should guide the players by giving hints before the player did any activity. Moreover, she added that the game should give feedback on the performances and decisions of the players. She said that seeing the consequences of her actions did not help her to estimate whether she gave the best decisions or not. She wanted to receive written detailed feedback about her actions and decisions. She believed that these features would increase the

educational value of the game and helped players to learn the content more effectively. She thought that;

> "I tried to remember but I forgot quarrying.. there should be hint…
> At that time, I can remember more easily what I have learned, I can
> feel more comfortable."

> "Hatırlamaya çalıştım ama unutmuşum quarrying i… hintler olsun… O
> zaman daha kolay hatırlardım öğrendiklerimi, daha rahat hissederim."

To illustrate her point of view, she gave example from her experiences. She said that the main obstacle she had faced in the game environment was remembering what she had benn taught about the quarrying. She stated that she had felt like she had forgotten most of her knowledge related with quarrying. Thus, she had not been quite sure about her decisions and had felt uncomfortable before doing anything. She stated that in those situations, she had needed guidance. She wanted to be given hints such as which place she should start to produce rocks or how she should use the vehicles or equipment. She wanted to be informed about whether the method she used was the best method to apply in that situation or not. She suggested that;

> "Furthermore, after I do something, it should give feedback, at that
> time it stays on mind."

> "Bir de ben bir şey yaptıktan sonra feedback versin, o zaman akılda kalır."

She also suggested that the hints and feedback should also be optional. The player should be able to choose to display or close them. For her, at the beginning of the game, players might need hints and feedbacks to remember the content or be sure about their actions. However, in upper levels, they might not need such kind of tips and feedbacks. In that situation, the appearance of tips on the screen all the time might distract the player. So, they should be able to turn them off. She recommended that;

> "Students should be able to turn it off if they do not want… At the
> begining this hints can be given, students can turn it off if he wants.
> But later, in upper levels, it is not given. At that time students can
> test themself. If it appears all he time, it could distract them."

> "Öğrenciler kapatabilsin ama istemiyorsa… İlk başlarda bu hint ler
> verilebilir, öğrenciler isterse onları kapatabilir. Ama sonra ileriki

seviyelerde verilmez. O zaman öğrenciler kendini test eder işte, daha iyi olur. Hep durursa onları rahatsız edebilir.”

4.1.4.2 Suggestions of Manny to Improve the Effectiveness of Educational Simulation Game Used in this Study

Manny gave several suggestions about design of the game, vehicles and equipment, feedback, player options of the game, punishment and control in order to improve the effectiveness of the game used in this study.

Problem Based Design: Manny gave suggestion about the design of the game. She advised that problem based approach should be implemented in the game. She thought that if the game provided more problems to the players, this helped the players to develop their problem solving skills. Like Kim, Manny thought that in mine environment many problems could be occurred. So, by providing problems and wanting players to solve those problems, students could learn how to deal the problems in mine environment. This made the game more educative. By this approach, she believed that players might get used to possible problems that could be seen any mine environment. So when they became a mine engineer and started to work in mine, they would be more confident and made the best decisions based on their experiences they gained from the game. She stated that;

> *"In addition, for example problems could be occurred in mine and students could be asked to solve those… We would see the possible problems; we would understand how they could be solved.... Also in the future, it helps us much."*

> *"Ek olarak mesela sorunlar çıkabilirdi madende ve öğrencilerden bunları çözmeleri istenebilirdi… Çıkabilecek sorunları görürdük, nasıl çözülebileceğini de anlamış olurduk… İleride de çok işimize yarardı.”*

Vehicles and Equipment: Manny stated that students in the department of mining engineering had limited chances to see the vehicles and equipment used in mine. But, she stated that getting familiar with these kinds of vehicles and equipment was vital for their field because in the future, they might decide on whether the company should buy it or not. She said that they could only see these kinds of vehicles and equipment at their summer practice or field trips. However, she said that they were very expensive machines. Thus, the mine they visited might not have some

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of them. In those situations, game could be useful. It could help the players to get used to the vehicles and equipment that they had never seen before. Based on her experience, she thought that the vehicles and equipment could be designed realistically in the game environment. Thus, she wanted that the variety of vehicles and equipment in the game should be increased. By this, students could see many of the vehicles and equipment so when they worked as mining engineer, they could decide which of the vehicles or equipment should be used in mine more accurately. Thus, the game became more educative compared to the one which contained limited vehicles and equipment. She suggested that;

> *"We do not have much chance to see the equipment and vehicles used in mine. We see either at summer practice or field trips but there is nothing like we absolutely see when we go. They are expensive equipment, and the company may not buy them…. We need to know them. We decide whether they should buy or not…. More equipment etc. can be in the game, so in the game we can see how they are."*

> *"Çok fazla şansımız olmuyor madende kullanılan ekipmanları, araçları görmek için. Ya stajda ya da gezi olursa o zaman görebiliyoruz ama gittiğimizde kesin göreceğiz diye bir şey yok. Bunlar pahalı ekipmanlar ve şirket bunları almayabiliyor…. Bunları bilmemiz gerekiyor. Biz karar veriyoruz alınsın mı alınmasın mı diye…. Daha fazla ekipman falan olabilir oyunda, böylece oyunda görebilirdik nasıllar diye."*

In addition, Manny also advised that in the game, more information about the vehicles and equipment should be given to the players. In the game, the players should be informed about the simulated vehicles such as their capacity, their pearls and pitfalls etc. By this, students could gain more information about them because;

> *"There should also be information about what there are used for, and what are the pros etc... It will be more helpful."*

> *"Onlar hakkında bilgi de olmalı, niçin kullanılıyorlar, artıları eksileri nelerdir falan diye… Daha yararlı olur."*

Feedback: Manny thought that more explicit written feedback should be given to the players after they did anything in the game. She stated that while playing the game, she needed to gain explicit feedback to decide whether she gave most appropriate decisions or not. She thought that detailed feedback could help the

players to judge their decisions and activities. Thus, it increased the effectiveness of the game.

> *"It should give the results of what I do… I do not know, in there something should be written, should give information to me about is what I did right or should I do something better etc."*

> *"Yaptığım şeylerin sonucunu vermeli bana….Ne bileyim orada bir şey yazmalı, bilgi vermeli bana yaptığım şey iyi miydi, yoksa daha iyi ne yapabilirdim falan"*

Multi-Player Option: Another suggestion given by Manny was the inclusion of multi-player option to the game. Although she liked to play alone, she advised that the game should provide opportunity where students could work together. She believed that working together would have positive contribution on students. She thought that by working together, students could share their ideas and create their knowledge together. This helped the players to benefit from each other and expanded their knowledge. She suggested that;

> *"Not against each other but we can play together with our friends. We could decide together than, one of us deal with one job, the other deals with another jobs. Thus, we could discuss and decide together, both the game could speed up and we learn from eachother. I do not know, maybe she knows what I do not know, she will direct me better, those kinds of things there can be."*

> *"Birbirine karşı değil de beraber oynayabilirdik arkadaşlarımızla. Beraber karar alırdık sonra birimiz bir isle uğraşırdı, diğeri de başka işlerle. Böylece beraber tartışıp karar verebilirdik hem oyun daha da hızlanırdı hem de birbirimizden bir şeyler öğrenebilirdik. Ne bileyim belki benim bilmediğimi o biliyor, beni daha iyi yönlendirecek böyle şeyler olabilirdi."*

Severe Punishment: Like Kim, Manny also gave suggestion about punishment in the game environment. She advised that there should be severe punishment in the game. She stated that everybody including mining engineer should be very careful in mine environment. Thus, they needed to increase their awareness as earlier as they could. She suggested that if they increased their awareness in the department, they would be more careful when they started to work as mining engineer in the future. In order to accomplish this, she believed that educational game should severely punish the player when they made a mistake. For her, mild

punishment made players to be less careful. Moreover, it might cause the player to act on impulse rather than taught. However, severe punishment forced the players to be careful in their decisions and actions. Hence, she believes that severe punishment would increase the effectiveness of the game. According to her;

> *"I think there should be severe penalties in the game ... We need to learn to be careful, in mine being careful is very important"*

> *"Bence ağır cezalar olmalı oyunda… Dikkatli olmayı öğrenmeliyiz, madende dikkat çok önemli"*

Full Control: Finally, Manny gave suggestions about the control in the game. She believed that having full control on the game also increased the effectiveness of the game. She stated that students should be allowed to do what they wanted to do. It should not warn students or prevent them to do anything. For example, the game did not allow her to drill a bench. She believed that to increase the effectiveness of the game, the game should allow such kind of the wrong actions. She stated that by doing wrong actions and seeing their consequences, students learnt better. She stated that seeing the consequences of wrong actions were more educative than being prevented or told. She recommended that;

> *"The game do not prevent anything, the students should do whatever they want to do. For example, I tried to drill the bench, I could drill… Otherwise, you say ok fine, you do not think why it does not allow. But when you see what happens at the end, you understand… It would be more educative.*

> *"Oyun hiç bir şeyi engellememi, ne istiyorsa öğrenci yapmalı. Mesela ben bench i delmeye çalıştım ya, delebilmeliyim…. Öbür türlü iyi tamam diyorsun, düşünmüyorsun neden izin vermiyor diye. Ama görünce sonuçta ne olacağını, anlıyorsun… Daha öğretici olur."*

4.1.4.3 Suggestions of Johnson to Improve the Effectiveness of Educational Simulation Game Used in this Study

Finally, Johnson gave several suggestions to improve the effectiveness of the game used in this study based on his experiences. It is found that among the non-gamer students, he gave the most suggestions. Detailed technical information, occupational safety rules, guidance and feedback, multi-player option, severe

punishment, full control, character growth and variety of missions were the themes about which he gave recommendations.

Detailed Technical Information: Johnson believed that learning from game was easier compared to learning from the books because the game allowed the players to learn by doing. This helped them to understand the reasons behind the rules. Thus, he suggested that the game should give students more detailed technical information. He suggested that;

> *"There could be more technic information. We are also wanted to use more technical information…. For instance, it would want us to decide the benches. A window would be opened, we could write the values to there."*

> *"Daha fazla teknik bilgi olabilirdi. Bizden de daha teknik bilgi kullanmamızı isteyebilirdi…. Mesela benchler e bizim karar vermemizi isteyebilirdi. Bir ekran açılır, biz oraya değerleri yazabilirdik."*

Occupational Safety Rules: Johnson also gave suggestion related with the occupational safety rules. Like the other participants, he wanted to learn occupational safety rules in detail. He was the aware of the fact that these rules were vital in mine and all mining engineers had to know them. He believed that these rules also could be covered in the game in addition to quarrying. According to him;

> *"There should be information about occupational safety rules. In mining, these rules are very important."*

> *"İş güvenliği kuralları ile ilgili bilgiler de olmalı. Madencilikte bu kurallar çok önemli."*

Johnson gave an example how these rules could be covered. He thought that the player might be asked to implement these rules in the game environment. Moreover, the game might create a situation in which occupational accidents were occurred in mine. It might inform players about the results of these accidents. Then, it might ask players to take the precaution to prevent these kinds of accidents. This helped them to understand the importance of occupational safety rules and what they should do to prevent occupational accidents. According to him, if the game covered many of these rules, the players could practice them and would remember them more easily in the future. He explained that;

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> *"The game may want us to implement these rules. Even, there should be job accidents. It should tell us the results of work accidents and want us to take precaution to prevent similar accidents... In the future, it will come to his mind, he will remember."*

> *"Oyun bizden bu kuralları uygulamamızı isteyebilir. Hatta iş kazaları da olmalı. Bize iş kazalarının sonuçlarını söylemeli ve benzer kazaların olmaması için önlem almamızı istemel.... İleride de aklına gelir, hatırlar."*

Guidance and Feedback: Johnson stated that while he had been playing the game, he had faced some difficulties. For example, he had had difficulties in giving decisions. He said that in those situations, he had needed guidance and hints. He wanted to get help about what he should consider while he was giving any decision or doing anything. According to him, guidance and hints helped players to make better decisions. This helped them to understand how they should think and what they should consider while working in mine. He said that;

> *"It would give hints for example. I had difficulty in some places.... At those times, the game should lead me, guide me.... This show on what attention should be given while working in the mine."*

> *"Hint verebilirdi mesela. Bazı yerlerde zorlanmıştım... O sıralarda, oyun bana yol göstermeli, yönlendirmeli."*

Moreover, Johnson suggested that feedback should be given directly after the player did anything. He said that seeing the consequences did not help him to evaluate his decisions. Thus, he advised that the player should be given explicit detailed feedback related with whether he did the right thing or not. For him, this was more educative and so it increased the effectiveness of the game. He believed that;

> *"Feedback can be given... When I did something, it should say immediately like that was good cal lor it would be better if you did that."*

> *"Feedback verilebilir... Bir şey yaptığımda hemen söylenmeli, iyi karar ya da, şöyle yapsaydın daha iyiydi gibi."*

Multiplayer Option: Johnson thought that game should include both single and multiplayer options. He believed that students should be able to play with their friends if they wanted. According to him, playing with others could have positive

effects on students. He stated that playing with the friend could be funnier compared to playing alone. Moreover, it created opportunities for players to learn from each other. They could ask each other about the things they did not know or they were not sure. Also, they could discuss each other to find the best decisions. He suggested that;

> "Playing with someone is more educative for instance your friends may know the things you do not know. While playing the game, you can ask him like how we can do this, that, what this is for, whether to buy this or not. Before doing something, you can discuss like whether we should do, how we should do"

> "Biriyle oynamak daha öğretici olur mesela senin bilmediğin bir şeyi belki arkadaşın biliyordur. Ona oyun sırasında sorabilirsin, şunu nasıl yapacağız bunu nasıl yapacağız bu ne işe yarıyor bunu alayım mı almayayım mı diye. Bir şey yapmadan önce tartışabilirsiniz, yapalım mı nasıl yapalım gibi"

Severe Punishment: Johnson also gave suggestion about the punishment in the game. He complained about the mild punishment applied in the game environment and suggested that severe penalties should be given to the players if they made a mistake. He stated that in mine environment, everybody had to be very careful and tried not to do any mistakes. According to him, mild punishment might cause the player to underestimate the consequences of the mistakes in mine environment. If the game gave severe punishment, the player would give more attention on the game and tried to be more carefull. Thus, severe punishment would prepare the students for their future career. According to him;

> "There should be severe punishment in the game….Would be more effective...In the mine, even though a tiny mistake can cause big problems even death…. Severe punishment forces the student to be more careful."

> "Oyunda daha ağır cezalandırma olmalı… Daha etkili olurdu…. Madende en ufak bir hata bile çok büyük sorunlara hatta ölüme bile yol açabilir…. Ağır cezalar öğrenciyi daha dikkatli olmaya zorlar. "

Full control: Johnson advised that the game should give full control to the players. He told that the game prevented him to do big mistakes. For instance, he was not able to drill the benches. He said that he understood why he was not able to do

such kind of mistakes after thinking why the game did not allow him. But, he believed that people learn much when they made a mistake and saw their consequences instead of telling not to do. Moreover, he added that the player might focus on something else so he might not understand why the game prevented him to do what he wanted to do. Thus, he suggested allowing the players to do severe mistakes rather than preventing them. By this, the player could see the consequences of their actions and understand why they should not do those actions in mine. He said that;

> "The game does not allow me to do some things... When I thought, I understand why it did not allow me.... But I think, instead of preventing, it should allow. Then, it should show what will happen.... Instead of preventing people, allowing them and showing the consequences will be more effective I think. In the game sometimes, you may focus on something. If the game does not allow you, you may not pay attention. You may not realize where you make a mistake and why the game does not allow you."

> "Oyun bazı şeyleri yapmama izin vermiyordu... Düşününce neden izin vermediğini anlamıştım... Ama bence engellemek yerine izin vermeliydi. Sonra da göstermeliydi ne olacağını....İnsanları engellemek yerine izin verip sonucunu gösterince daha etkili olur bence. Oyunda bazen bir şeye odaklanabilirsin. Oyun sana izin vermediğinde önemsemeyebilirsin. Nerede hata yaptığını ve oyunun seni neden engellediğini fark etmeyebilirsin."

In addition, he complained about controlling only one avatar in the game. Instead of only using one avatar, he wanted to control several avatars. He thought that by controlling only one avatar, he felt he did not have full control on the game. Moreover, he complained about wasting huge amount of time to transforming one avatar from one place to another. He suggested that there should be avatars in the vehicles. And, he should change the avatars he controled by pressing one single button. Thus, he could change the vehicles he controled by pressing a button. This decreased the time spent on the walking of single avatar from one location to another in order to get on another vehicle and made the players to focus on important issues instead of focusing on the transmission of avatar from one place to another. He suggested that;

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"If the men in the game were controlled, it would be better. In this way, you lose much time. One man, get off the vehicle, walk, get on the other etc…. Instead of walking, you can focus what you should do, for instance."

"Oyundaki bütün adamlar kontrol edilse daha iyi olur. Böyle çok zaman kaybediyorsun. Tek adam, araçtan in, yürü, diğerine geç falan…. Yürütmek yerine ne yapmalıyım ona odaklanabilirsin mesela".

Character Growth: Johnson stated that the game did not allow the players to grow their character whereas it supported financial growth. He said that the game started the player from the beginning. They did not have anything except one bucket wheel. By completing the missions and earning money, the player could buy several equipment and vehicles. He suggested that in addition to financial growth, the game should also support character growth. He stated that the game should allow players to be manager and hire workers in order to expand his business. He believed that this not only increased students' motivation but also helped them to see the things from different perspectives. This could help the player to estimate how the workers and managers felt and thought in mine environment. Thus, they could understand how working in mine was like from different perspectives. Therefore, it improved the effectiveness of the game. In his belief;

"There is growth in the game. At the beginning, while you have only a bucket wheel, you can earn money and buy new vehicles. In addition to this, the game should allow you to be the manager. It should allow you to be general manager …. This, both increase the motivation and shows what managers think, do.. It would be more effective."

"Büyüme var oyunda… İlk başta sadece kepçen varken, para kazanıp yeni araçla alabiliyorsun…. Bunun yanında oyun seni müdür olmana izin vermeli….. Senin genel müdürlüğe kadar yükselmeni sağlamalı…. Hem bu motivasyonunu da artırır, hem yöneticilerin neler düşündüğünü, ne yaptıklarını gösterir….. Daha etkili olurdu."

Variety of Missions: Finally, Johnson gave suggestions about the missions in the game. He stated that the missions given to the players were similar. At the beginning, it was fun to do similar missions. He stated that the player got used to game and gained experience in the game by doing similar missions. But, he added

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that after a certain amount of time doing similar missions might make the players get bored and might demotivate them to play. Thus, he suggested that missions should be varied. For instance, the player could be requested to complete the mission within the certain time. In reality, the workers and mine engineers did not work without time limit. They had to produce the amount of minerals or materials within the certain time. By these methods, working in mine environment could be simulated more accurately and the effectiveness of the game would be increased because;

> *"We do the missions given one after another. As I said, at the beginning this is fun, you learn what you have to do in the game. But, after a while it can be boring..... There could be more exciting things, for instance there could be time restriction. The player get more excited and become wholly absorbed in I think."*

> *"Burada art arda verilen görevleri yapıyoruz. Dediğim gibi bu ilk başta eğlenceli, oyunda ne yapman gerektiği öğreniyorsun. Ama belli bir zamandan sonra sıkıcı olabiliyor…. Daha heyecanlandırıcı şeyler olabilir, mesela zaman kısıtlaması olabilir. Oyuncu daha çok heyecanlanır, daha çok kendini kaptırır bence."*

4.2 Structural Description of the Experiences of Non-Gamer Participants

The findings of this study reveal that the constructs of the structural description of non-gamer participants were similar. However, the underlying reasons of these constructs are varied. In this part, the structural description of each non-gamer participant is given in detail.

Table 11 shows the constructs that shape the structural descriptions of each non-gamer participant. The findings showed that Kim and Johnson assessed all the activities in the game environment and their performance whereas Manny only focused on her performance. Moreover, Kim tested her hypothesis but Manny and Johnson not only tested their hypothesis but also the rules of the game. Information seeking about the vehicles, equipment in the game and quarrying had an affect on both Kim and Manny. On the other hand, Johnson was affected by one construct, information seeking about quarrying. Finally, all three non-gamer participants were influenced by decision making about the activities but only two non-gamer participants, Kim and Manny was affected by emotional change.

Table 11 *The constructs that shape the structural descriptions of each of Non-gamer Participants*

Kim	Manny	Johnson
Assessment of Activities and Her Performance	Assessment of Her Performance	Assessment of Activities and His Performance
Testing Her Hypothesis	Testing Her Hypothesis and Rules of The Game	Testing His Hypothesis and Rules of the Game
Information Seeking about the Vehicles, Equipment in the Game and Quarrying	Information Seeking about the Vehicles Equipment in the Game and Quarrying	Information Seeking about Quarrying
Decision Making about Activities	Decision Making about Activities	Decision Making about Activities
Emotional Change	Emotional Change	

4.2.1 Structural description of Kim's experiences

The structural description of Kim's experience included five main constructs; 1) *assessment of the activities and her performance*, 2) *testing her hypothesis*, 3) *information seeking about the vehicles, equipment in the game and quarrying*, 4) *decision-making about activities* and 5) *emotional changes*. These constructs were interrelated and affected each other.

Information seeking about the vehicles and equipment simulated in the game had an important effect on her experience. Since she was non-gamer participants she needed information about how the vehicles were used and how she could perform specific activities during the game playing sessions. In addition to this, she needed information about quarrying. She tried to remember what she was taught but she did not trust her knowledge. She searched for hints, tips that could guide her during game playing. Hence, before performing any activities, she searched for additional information that may guide her.

Assessment of the activities and her performance also took an important role in the experience of Kim. When she entered the game environment, she observed and assessed everything simulated in the game. She assessed what was going on the mine. She saw that there were other workers and assessed their performance. The

main reason why she observed and assessed the environment was her need of information. She tried to gain information by observing and assessing the environment. Then, based on them, she made decision and performed activities. She also assessed her activities and her performance. For instance in every attempt of loading the wheel loader, she assessed how much rocks she loaded and made decisions whether they were enough and whether she was successful in loading. For her, being successful and finishing the jobs she accepted was important so she evaluated everything in the game environment including her actions and decisions.

Testing her hypothesis was another construct that affected the experience of Kim. She used trial and error method during the game playing. She tried to find the best method that made her successful in the game. Based on her assessment, she came up with hypothesis and tested them. She tried to be successful and met the demand of the customer in a short time. To achieve this, she tested her hypothesis about how she could use the vehicles and equipment effectively and how she should adjust the perspective of the screen that might help her to perform the activities successfully.

The fourth construct that affected the experience of Kim was *decision making about activities*. Based on her observations and assessments she made decisions. She decided on the activities she should perform. She decided where to start rock production, where to drill etc. In addition, she decided on how she should use the vehicles or equipment and when to transport the fragmented rock to the crusher plant. Finally, she made decisions after she tested her hypothesis. She decided whether her hypothesis was true and whether her method was best method to apply in that stuation.

Emotional change was the least important construct that affected the experience of Kim. During the game play, her emotions were changed rapidly. Generally she was concentrated on activities and her performance. She aimed to finish the job as quickly as she could. She obeyed the rules and was careful when she was doing activities. However, when she could not do what she intended to do, she immediately became sad. At the beginning, since she was non-gamer participant, she did not successful as she desired. For instance, she could not load the wheel loader

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with many rocks. In those situations, she became nervous and after many attempts she became hopeless. But this did not affect her desire to play and when she became successful she became happy immediately. Sometimes, when she was doing activities, she was close to have accidents. In those situations, she was panic and excited. She immediately analyzed the vehicle she drove and if it was not damaged, she was relief and continued to play the game.

According to Kim, these kinds of educational games should be integrated to the lessons in her department. She said that unlike videos, games allowed high interaction. Thus, she taught that educational games helped the learner to visualize the concepts and turned abstract knowledge to concrete one by actively performing actions. However, she believed that these games should be single user. The player needed to make all the decisions and did all the activities by himself. This would increase the effectiveness of the game. Moreover, the game should provide more detailed technical information and guidance to the players. For her, the game should guide the learner before doing any activities and should give high detailed information about the content it covered.

4.2.2 Structural description of Manny's experiences

The structural description of Manny's experience included five interrelated main constructs; 1*) assessment of her performance*, 2) *emotional change*, 3) *information seeking about the vehicles and equipment in the game*, 4) *need of gaining and using more detailed information to practice*, 5) *testing her hypothesis and rules of the game*.

Assessing her performance had an important effect on the experiences of Manny. Manny was an ambitious girl who wanted to be successful. Thus, when she made any decisions or performed any actions, she assessed her performance. She assessed whether she made good decisions or whether she accomplished what she wanted. According to her, she had to be successful in what she was doing. She tried to be successful no matter what it took or costed. Moreover, she did not want to be guided when she did anything. She wanted to be successful by herself so she refused to gain any help or guidance. But, while she was playing, she wanted to receive

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feedback about her performance. For her, feedback could help her to assess her performance more accurately.

Emotional change was the second important construct that affect Manny's experience. Based on her performance and assessment, her emotions could change rapidly. During the game playing sessions, when she accomplished a certain task, she became happy and made special noises such as "oley", "yihu" etc. However, when she made any mistake, she got angry and yelled. Sometimes this anger made her become furious and continued to do what she was doing. But sometimes, anger turned to sadness and she gave up doing that. She decided to do something else instead of that action. After a while, when she calmed down, she started to do the task that she had left unfinished.

The third construct that shaped Manny's experience was *information seeking about the vehicles, equipment in the game and quarrying*. Since Manny was a non-gamer player, in some situations she did not able to do the activities in a way she wanted. In those situations, she searched for information that may help her to use the vehicles and equipment more effectively. Moreover, she searched for more detailed technical knowledge about quarrying. She thought that the game was a big chance for her to expand her knowledge since it offered visualization and learning by doing. Thus, she wanted to gain and apply high detailed technical information about quarrying in game environment.

Testing her hypothesis and rules of the game was the fourth constructs that affected the experience of Manny. Manny was a curious girl and she was curious about what would happened when she did something in the mine environment. She saw the game was a big opportunity to do what she was curious about. So, she developed hypothesis based on her assessments, knowledge and experiences. And, she tested these hypothesizes to understand whether they were right or wrong. In addition, due to her curiosity, she tested the rules of the game. She sought what she was allowed to do in the game. She made several mistakes and violate occupational safety rules in order to see how the game acted against her.

Decision making on activities was the last constructs that affected Manny's experience. She gave several decisions about her activities based on her emotions,

assessment and knowledge. She tried to decide what she would do based on her knowledge. But mostly, her assessment about her performance affected her emotion and her emotion affected her decisions. When she thought that she was unsuccessful while she was doing an activity like hauling, she got angry and stoped what she was doing. After a while, she decided to finish the task she had left unfinished. But sometimes, being unsuccessful made her furious and tried to be successful no matter what it costed.

Manny believed that these kinds of educational games should be used in the lessons in her department. She thought that game created a safe environment in which player could apply and practice their knowledge. It gave opportunity to players to learn by doing. Moreover, she thought that gaining experience was essential to be a successful mining engineer and she could gain this experience with the help of the educational games.

4.2.3 Structural description of Johnson's experiences

The findings of this study revealed that four main interrelated constructs which were 1) *information seeking about quarrying,* 2) *testing his hypothesis and rules of the game, 3) assessment of his performance and activities* and *4) decision making on activities* shaped the experiences of Johnson.

Information seeking about quarrying was the first construct which had the most impact on the experience of Johnson. Johnson sought information about quarrying in the game playing sessions. Before doing anything, he searched for whether the game gave basic information about quarrying or whether it guided him. He wanted to receive hints about what he should consider, where he should start etc. before doing or deciding anything because he did not trust his knowledge related with quarrying. He thought that the game could help him to review what he was taught about quarrying and to gain additional information related with it by providing hints and information. In addition, he believed that his need of visual materials to learn could be fulfilled by the game. The mine environment and the processes such as hauling, blasting in quarrying was simulated in three dimensions in the game. He believed this help them to understand quarrying more accurately. For all of these reasons, he sought information and guidance during the game playing.

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Secondly, Johnson *tested his hypothesis and rules of the game* due to his curiosity and his desire to be successful in the game. Before doing anything, he made hypothesis based on his assessment and knowledge than tested them in order to see whether they helped him as he desired. By making and testing hypothesis, he tried to find the best methods that worked and made him successful. In addition, the game aroused the curiosity of Johnson. Due to being curious, he built his hypothesis to see what was changed in the mine environment simulated in the game and how. He believed the game created safe environment where he could explore what he was curious about. Finally, he was curious about the rules of the game and tried to explore what the game allowed him to do. He tested the rules of the game to identify his boundaries in the game environment.

The third construct that shaped the experiences of Johnson was the *assessment of his performance and activities* in the game. During the game playing, Johnson assessed his performance in order to estimate whether his hypothesis worked and whether he succeeded at the game or not. After he did anything in the game, he looked at his performance and judged himself. Based on his judgement, he developed new strategies and hypothesis that could help him to be successful as a way he desired. The main reason for this assessment was his role in the game environment. Johnson liked the game and put himself in the place of avatar in the game. He thought as if he owned the mine simulated in the game. Hence, he was careful in his decisions and actions. He believed that the success he gained in the game showed his potential as a mining engineer. He believed that the achievement of him in the game made him think that he could gain the same achievement in the future in his career. Therefore, he worked hard and tried to be successful in the game.

The final construct that affected the experiences of Johnson was the *decision making on activities*. In the game, he identified his capabilities by testing his hypothesis and assessing his performance. Based on these assessments, he gave several decisions on activities he should or should not do. He decided which the vehicles and equipment he should buy, how he should use them. Moreover, he decided which mission he should accept by comparing the amount he needed to produce and its price. Finally, he made decisions based on his tests and hypothesis.

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He made decisions on whether his hypothesis was true or whether they were best method in that situation.

Like the other non-gamer player in this study, he supported the integration of games in his department. He believed that these kinds of games fulfilled their visual needs in the department. In addition, these games could show their progress and capabilities and could help them to increase their self-confidence.

4.3 Textural Description of Experiences of Gamer Players

There were three gamer participants -Claire, Michael and David- in this study. In this part, the textural descriptions of each player's experience are given briefly.

4.3.1 Opinions about the Usage of Simulation Games for Education (Research Question 1)

Table 12 shows the pre and post opinions of gamer participants regarding with the usage of simulation games for education. The themes extracted from the interviews for pre and posts opinions are organized under benefits and problems. The findings showed that before game play, all the gamer participants came up with similar constructs. Learning by doing and motivation were given by all three gamer partcipants. Moreover, two gamer participants, Claire and Michael believed that visualization could be benefits of games for education. Finally, one gamer participant, David listed fun as benefit. In regard to problems, two gamer participants Claire and Michael indicated that game usage in educational setting could cause problems that were underestimation and misleading. As shown in the Table 12, after playing games, the gamer participants came up with similar benefits. Visualization, learning by doing and motivation were stated by all three gamer participants. In addition, the themes self-confidence and fun were shared by two gamer players. Besides, it is seen that only one gamer participant, Michael stated that game may bring problem that was misleading.

Table 12 *Opinions of Gamer Participants about the Usage of Simulation Games for Education*

Opinions	Claire	Michael	David
Pre-opinions			
Benefits			
	Visualization	Visualization	
	Learning by Doing	Learning by Doing	Learning by Doing
	Motivation	Motivation	Motivation
			Fun
Problems			
	Underestimation	Misleading	
Post-opinions			
Benefits			
	Visualization	Visualization	Visualization
	Learning by Doing	Learning by Doing	Learning by Doing
	Motivation	Motivation	Motivation
	Self-Confidence	Self-Confidence	
		Fun	Fun
Problems			
		Misleading	

4.3.1.1 Pre-opinions of Claire about the Usage of Simulation Games for Education

At the beginning of the study, Claire had positive opininon about the usage of simulation games in educational settings. She identified three benefits of their usage which were visualization, learning by doing and motivation.

Visualization: At the beginning of the study, Claire said that visualization was very important for her for gaining information. She needed to visual materials to understand the content of the lessons better. However, as the other participants in this study, she pointed out the limited usage of visual materials in her department. She believed that without seeing, it was hard to be a mine engineer. In other words, she believed that students in her department needed to see visual elements to understand the contents and to be a good mine engineer. She thought that games could fulfill this gap in their department. Games could provide visuals that they needed. She believed that she could learn better with the help of the game since;

> *"This job cannot be done without seeing… I cannot imagine the content of the lessons much…. The usage of games can be good in*

terms of visuality… We can give many things by the game that the instructor cannot give… We see the things we cannot see by overhead projector, in 3D by the game."

"Bu iş görmeden olmaz… Pek hayal edemiyorum dersteki konuları… Oyunun kullanılması güzel olabilir görsel acıdan….. Hocaların veremediği bir sürü şeyi oyunlarla verebiliriz….. Tepegözde göremediğimiz şeyi oyunda 3d görebileceğiz."

Learning by Doing: Claire thought that game could help students to learn the content better if it was realistic. She stated that simulation games included interactivity. They allowed students to alter some variables and see the consequences. Thus, students could conduct experiments and observed the results. In other words, it helped the students to learn content by providing opportunities in which students could learn by doing. Hence, she believed that game would increase learning as well as the skills of the students. Moreover, since students learnt by doing, she thought they could recall the information more easily in the future. According to her;

> *"It depends on the game; whether it really gives the things in 3D, whether it reflects them. If it provides it realistically, it increases the skills and practical information. It would be better for the students…. If the game is like Sims, in the game, they will change something, the students may conduct experiments, look at the results. These will increase the learning I think, with this, the skills and knowledge will be increased, you can remember in the future more easily."*

> *"Oyuna bağlı gerçekten 3D şeyi verebilecek mi onu yansıtabilecek mi. Eğer onu gerçekçi verebilirse beceriyi de pratik bilgiyi de arttırır. Öğrenciler açısından iyi olur….. Sims gibi bir oyun olursa, oyunda bir şeyleri değiştireceklerdir, öğrenciler deneyler yapabilirler, sonuçlarına bakabilirler. Bunlar öğrenmeyi artırır bence, böyle bilgi ve beceri de artar, ileride daha kolay hatırlayabilirsin."*

Motivation: Finally, Claire thought that games could also have an effect on the motivation of the students. However, she stated that this effect might be positive or negative depending on the consciousness level of the students. She explained her idea by giving an example. For instance, in her ethic lesson, they watched a video. Although the video contained valuable information, some of the students in their

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class did not concentrate on it. She believed that they did not understand the importance of that video so they did not give attention to it. This case could also be seen when the game was integrated to their department. She believed that if students did not understand the importance of the game, their motivation to play would be decreased. But, if they were conscious and aware that the game included valuable information regarding with their field, they wanted to play it in order to develop themselves. Thus, their motivation would be increase to play. And, when they realized they the information they gained from the game were important for their future career, they became more motivated towards the game as well as the courses in their department. She stated that;

> *"I do not know, giving these kinds of things in the lessons to the students might also decrease or increase the motivation..... There could be reckless environment. For instance, last week in ethic lesson, we watched a film. In there, people were laughing, nobody was concentrated on what we were going to watch in the film. At the beginning, for the students, it might decrease the motivation, if they are not conscious. But, after gaining information, if they see that it is important for them, at that time it might increase."*

> *"Bilmiyorum öğrencilere derste böyle şeyler vermek motivasyonu düşürebilir de, artırabilir de.... Laubali bir ortam oluşabilir mesela geçen hafta etik dersinde orda film izledik. Orda insanlar güldüler, filmde ne izleyeceğimize kimse konsantre olamadı. En başta hani öğrenciler için motivasyonu düşürebilir bilinçli değillerse. Ama bilgileri kazandıktan sonra onlarda görürse onlar için önemli olduğunu o zaman artabilir."*

At the beginning of the study, Claire thought that underestimation could be the only problems when the game used in their department.

Underestimation: Claire believed that people generally played the games for entertainment. They wanted to play it for escaping from the real world. Thus, due to their general opininos about the game, they might not understand the importance of the educational games. They might not take them serious. She thought that students might not give the necessary attention to the game and underestimate its value so they may not gain the necessary information. She believed that;

> *"If we look at from the angle of the students, they might say it is just a game so they do not give attention. This can be the negative side, nothing else."*

"Öğrenci açısından bakarsak bu sadece oyun deyip insanlar çok fazla sallamayabilirler olumsuz acısı bu olabilir başka bir şey yok."

4.3.1.2 Post-opinions of Claire about the Usage of Simulation Games for Education

After game play, it is found that the opininos of Claire were similar. She listed visualization, learning by doing and motivation as benefits of the game. She also started to think that game could also have an effect on self confidence of the students. Finally, she did not think that underestimation might be a problem anymore.

Visualization: In the interviews Claire emphasized that she needed visual elements to understand any content appropriately. She believed that seeing visuals related with any topic and reading the explanations were more educative than just reading without the visuals. After the game play, she thought that the game could be used in that purpose. She told that these kinds of games could fulfill her needs for visual materials. For her, a realistic game could show concepts and processes to the students. She gave suggestions about how the game could be used. For instance, according to her, the instructor could explain the content and then wanted students to play the game. Students could see what was explained in the courses in three dimensions by playing the game. She thought that by the help of this method, students would understand any content more easily since;

> *"It provides visualization, I mean you can see the contents discussed in the lessons in these kind of games… This job could not be done without seeing. The game provides you visualization…. I think the content should be explained than the game should be played. In this kind of games, the students can see these games in three dimensions. They learn more easily, it becomes more durable I think."*

> *"Görsellik sağlıyor, hani derste anlatılan konuların ne olduğunu görebilirsin böyle oyunlarda… Bu iş görmeden yapılmaz. Oyun sana görsellik sağlıyor….. Bence konu anlatılsın sonra oyun oynansın. Böyle oyunlarda bilgileri üç boyutlu olarak görebilir öğrenciler….. Daha rahat öğrenirler, daha kalıcı olur bence."*

Learning by Doing: Claire also thought that these kinds of games allowed students to learn by doing. She stated that there were limited chances for them to apply what they learnt. But, they needed to practice them in order to make the

information more durable. According to her, the game could help them in that way. It could create a safe environment where students could practice and expand their knowledge because;

> *"In here, if you see and apply the information, it will stay on mind more. It would make the learning easier I think.. For example, in this semester, I am taking blasting course but there is no place where I can apply those patterns. In here, for example I tried to do blasting patters.. Eventually we are learning now and applying those while learning becomes more durable."*

> *"Burada bilgileri hem görüp hem uyguladığımda hani daha çok akılda kalır. Öğrenmeyi kolaylaştırır bence…. Mesela bu dönem patlatma dersini alıyorum ama o pattern leri yapabileceğim bir yer yok. Burada mesela o pattern leri falan yapmaya çalıştım… Sonuçta şimdi öğreniyoruz ve öğrenirken bunları uyguladığında daha kalıcı oluyor"*

Motivation: Claire thought that the usage of games for educational purpose might also affect the motivation of the students. It could increase their motivation towards the lectures in their department. She believed that one reason that demotivated the students towards the courses was the belief that the lessons were too difficult to learn. When students faced problems to understand the contents of any course, they started to believe that the contents were very difficult and they would never understand them no matter how much they studied. So, they did not want to study. For her, the game could help the students to overcome this belief. It could provide an environment where students could both see the events in three dimensions and practice their knowledge by applying them. She thought that these features of the game could help the students to learn the content more easily. She believed that when students recognized that the contents were not difficult to learn, their motivation would be increased and they would want to learn more. She stated that;

> *"It could increase the motivation….. What happens, when a person does not understand the course, he gets bored in the lessons. He starts to think that he never understand the contents, they are too difficult. But in here, when you see and apply the information, it becomes more durable, you learn more easily. When a person learns, they may want to learn more. He realizes that the content is not difficult, it may take his attention, he may want to learn more in that situation."*

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"Motivasyonu artırabilir… Ne oluyor, insan konuyu anlamayınca derste sıkılıyor. Sanki hiç anlamayacak, konular çok zor gibi düşünmeye başlıyor. Ama burada bilgileri hem görüp hem uyguladığında daha çok akılda kalıcı olur, daha rahat öğreniyorsun. Öğrendikçe de daha fazlasını öğrenmek isteyebilir insan. Konunun zor olmadığını fark eder, ilgisini çeker, daha çok öğrenmek isteyebilir bu durumda."

Self-Confidence: Claire believed that the games could also affect the self-confidence of the students. She stated that the self-confidence of the students was decreased when they believed that they had limited knowledge about a topic. According to her, games helped the students to learn more easily due to its valuable features. It provided visualization and allowed learning by doing. Thus, she believed that students could gain more information by playing compared to the just reading books. In her belief, the more students knew the more they trusted themselves. For all of these reasons, she believed that games could increase the self-confidence of the students. According to her;

"When you learn from the books, if you read three things, 1 will stay on your mind. In here, when you see all the things and apply them all of them stay on your mind and since you think you learn more things, I think it increases self-confidence."

"Kitaptan bir şeyi öğrenince üç tane şey okusan 1 tanesi aklında kalıyor. Burada hepsini görünce ve uygulayınca hepsi aklında kalır ve daha çok şey bildiğini düşündüğün için bence özgüveni artırır."

4.3.1.3 Pre-opinions of Michael about the Usage of Simulation Games for Education

The findings of this study reveal that at the beginning of the study, Michael had positive opinions regarding with the usage of simulation games for education. He listed three benefits of their usage which were visualization, learning by doing and motivation.

Visualization: Before attending this study, Michael believed that simulation games could help the students to visualize the concepts and processes discussed in the lectures. He said that visual materials helped to understand the content much better. For instance, his experiences in summer practice contributed his knowledge a lot. He said that in his summer practice, he had combined his theoretical knowledge with practical ones. After his summer practice, he took some of the courses again and

this time he linked his experiences at summer practice to the information he gained in the courses. He said that he remembered the things he observed in his summer practice while he was attending the courses. According to him, he correlated his observations and the information given in the course together and so he understood the lessons more easily. He believed that the game also could use for this purpose. The game could simulate the contents of the lessons so that students explore the environment in three dimensions. They visualy see what was explained in the course. It could help students to combine both theoretical and practical knowledge. In other words;

> *"It could show the mine environment to a student who had not seen it before. It may show the topics covered in the course, may take place in the middle between the courses and mine. There may be such kind of contribution... The things you cannot see in summer practice or the important parts can be shown by the game, and then be told. At that time, the courses might be more understandable."*

> *"Madeni görmemiş bir öğrenciye madeni gösterebilir. Derste işlenen konuları gösterebilir, sahayla dersin ortasında bir yer alabilir. Böyle bir katkısı olabilir..... Stajda göremediğin yada önemli olan kısımlar gösterilebilir oyunla, sonra anlatılabilir. Daha anlaşılır olur o zaman dersler."*

Learning by Doing: According to Michael, the games might have positive contribution on the learning process of students. It could increase learning by fostering learning by doing approach. He stated that games could be seen as test environment. Students might come up with hypothesis, conduct experiments and analyze the results. Then, they could search justification for the results. With the help of learning by doing approach, the students could investigate what they wondered and learn by experiencing actively. He said that;

> *"That eventually could be seen as test environment in which main experiments could be conducted... It contributes the knowledge if it is realistic... You design something, you conduct an experiment. If the results are the same as what you expect, you become certain. Or, if the results are different, you can research why they are different."*

> *"O sonuçta bir deney ortamı olarak gözükebilir bir belli başlı çalışmaların yapılabileceği.... Bilgiye gerçekçi ise katkısı olur... Bir*

şeyler tasarlar, deney yaparsınız. Beklediğiniz sonuçlar geliyorsa emin olursunuz. Ya da sonuçlar farklı çıkıyorsa neden farklı çıktı yani araştırılabilirsiniz."

Motivation: Michael thought that game would have an effect on the motivation of the students. He believed that if the game was enjoyable, the players would want to play it. And afterwhile, they started to wonder why things were happened in that way. This could force the players to search the logic behind the actions to satisfy their curiosity. So their motivation towards the lectures would be increased. But he warned that to achieve this, the game had to be funny. Otherwise, the students got bored and might make a generalization that they were not interested in the contents of the game. Hence, they might be demotivated towards the lectures. According to him;

> *"Of course, related with the quality of the game and the pleasure it gives, it might increase the motivation… If it is very boring and you have to play it, of course it demotivates people but if it gives pleasure, it increases the motivation towards the course. Because, you do something in there, you search for its rationale, why it happens in that way. In the courses, it increases the motivation to learn, I think."*

> *"Tabi oyunun kalitesi ve ne kadar zevk verdiğiyle ilgili olarak motivasyonu artırabilir… Çok sıkıcıysa ve bunu oynamak zorundaysanız tabi ki demotive eder insanı ama zevk veriyorsa derse de ilgisini artırır. Çünkü orada yapıyorsunuz bir şeyleri onunda mantığını arıyorsunuz, neden öyle oldu diye. Derste de öğrenme motivasyonunu arttırır bence."*

Alhough Michale had positive feeling regarding with the usage of the games in educational settings, he warned that game also could cause a problem which was misleading.

Misleading: Michael believed that the design of the game had to be very realistic otherwise they may mislead the students. He said that students played the game to learn. Thus, if even a tiny unrealistic element was added the game, students may interpret them wrongly and may build their knowledge in that respect. For this reason, he emphasized that the game had to be realistic and showed the processes or events appropriate to real life conditions. According to him;

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"If the game is not realistic, it might mislead people in a negative way. If you know that the things are true in there, there will be an orientation based on that. You gain that wrong information..... If it is such a game, if it is an educational game, it may mislead."

"Oyun gerçekçi değilse olumsuz olarak yanlış yönlendirebilir insanı.... Oradaki şeylerin doğru olduğunu bilirseniz ona göre bir yönlendirme olur. Siz de o yanlış bilgileri alırsınız... Eğer böyle bir oyunsa eğitsel bir oyunsa, yanlış yönlendirebilir."

4.3.1.4 Post-Opinions of Michael about the Usage of Simulation Games for Education

Michael had more positive opinions related with the integration of games to educational settings. After game play, he listed more benefits of the game which were visualization, learning by doing, motivation, self-confidence and fun.

Visualization: After attending this study, Michael believed that game really could help the students to visualize the terms and processes discussed in the lessons. He said that visual materials helped the information last longer. For instance, according to him, field trips were beneficial to the students. In field trip, they saw the things they taught in the lessons so they could memorize the information more easily. He believed that the game could help students in the same way. He said that games had the capability to represent them realisticly. Acording to him, when he saw the visuals and did the activities after reading the information, the information became more durable. He believed that;

"As far as I see, it shows the certain things..... For example, we went to a field trip, when we see the topics of the courses, it stays on mind more easily. The game has such kind of benefits.... There is visuality in here, you work on it. Not only by reading, doing activities in the game after reading something might be more durable. It could be more beneficial."

"Gördüğüm kadarıyla belli başlı şeyleri gösteriyor... Mesela geziye gittik, dersteki konuları tabi görünce daha kolay akılda kalıyor. Oyunun da öyle bir yararı var..... Görsellik var burada, uğraşıyorsunuz üstünde. Sadece okumakla değil, okuyup bir şeyleri ardından oyunda aktivite yapmak biraz daha kalıcı olabilir. Daha yararlı olur yani."

Learning by Doing: Michael said that games could affect the learning process of the students. It could increase their learning by allowing students to do what they

knew or learnt. He believed that games could be useful in learning the processes in mining. According to him, students could practice each steps of the processes. He told that in reality, they had limited chances to apply their knowledge. But, they needed to apply what they had learnt in order to make them more durable. According to him, game could fulfill this need. It could provide an environment in which they could practice safely. He believed that;

> *"If the game is a realistic, it has huge effects on learning. For example, even if it teaches a tiny thing, if it teaches what I should do in there step by step, it will be good…. At the end, I do not have such a chance in real life. But, this is like a test environment, I can conduct experiments safely. It would be nice to conduct experiments and see what happens."*

> *"Gerçekçi olursa oyun öğrenmeye çok büyük etkisi olur. Mesela küçük bir şeyi bile öğretse bana orada adım adım neler yapmam gerektiğini öğretse iyi olur…. Sonuçta gerçek hayatta böyle bir şansım yok. Ama burası test alanı gibi, deneyler yapabilirim. Deneyip görürsem iyi olur ne oluyormuş diye. "*

Motivation: According to Michael, the game might affect the motivation of the students. He believed that any game that was designed for their department included information about mining. According to him, if the game took the attention of the students, they might wonder about the activities shown in the game. They might search to see whether they were realisticly represented not. He assumed that;

> *"May be, the players become curious about how it is done in reality. If the game takes their attention, they may search the things they did to see how they are really done, whether they are right."*

> *"Belki oynayanlar merak edebilir gerçekte nasıl yapılıyormuş diye. Oyun ilgilerini çekerse, yaptıklarını araştırabilirler gerçekten nasıl yapılıyormuş doğru muymuş diye görmek için."*

Moreover, Michael stated that the activities in the game environment might help the students to identify their interest area and work in that way. He believed that if the game was enjoyable and students liked the game, they might be motivated to be mining engineer and studied their lessons to improve themselves. For instance, if they liked blasting, they might search how they were done and became expert in that

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area. However, he warned that to accomplish this, the game should be realistic and funny. Otherwise, students might think that mining was boring and being a mine engineer was not appropriate to them. Hence, they might be demotivated towards their department. According to them;

> *"For example, someone may like blasting in here, wonders how it is done in reality and build his career on that… But, it makes someone to love it or hate it… If the game is boring, you will hate it, if it is funny, challenging, if it includes the events in real life, it might make people like it."*

> *"Mesela patlatmayı buradan çok sevip birileri gerçekte nasıl yapılıyor diye merak eder, oradan ilerler... Ama kişiye sevdire de bilir nefret ettirebilir de.....Oyun çok sıkıcıysa nefret edersin, çok eğlenceliyse, uğraştırıcıysa, gerçek hayattakine benzer olaylar olursa sevdirebilir."*

Self-Confidence: Michael believed that game might affect the self-confidence of the students. Their success in the game environment might increase or decrease their self-confidence. For him, the game could show the students what they were capable of, what they needed to study etc. Thus, when they saw that they could do the complicated activities in the game environment, they trusted themselves more. He said that;

> *"If I am successful in here, if I see that I can do, of course my self-confidence will be increased. If I see that I cannot do, it can be decreased since even in the game I cannot do, how I can do in real life, I said to myself."*

> *"Ben burada başarılıysam, yapabildiğimi görürsem tabi özgüvenim artar. Yapamadığımı görürsem de azalabilir, oyunda bile yapamıyorum, gerçekte nasıl yapayım derim kendi kendime."*

Fun: The last theme Michael gave related with the benefits of game usage in their department was fun. Michael believed that the game was a fun way to learn. He believed that game was powerful tool which hypnotized the players. They forgot the time and places when they were playing. However, he stated that studying the lesson was boring. Thus, he suggested that these two things should be combined. With games, students could learn while they were having fun. He stated that;

"If the game and lessons were combines, it will be nice of course, one of them is boring, the other is funny. At least, you have fun while studying."

"Oyunla ders birleştirilse güzel olur tabi, biri sıkıcı diğeri eğlenceli. En azından eğlenirsin çalışırken."

However, he warned that playing the game should not be obligatory. Students should play it voluntarily. Michael said that educational games should not be given as homework. If they were graded based on their performance in the game, they might be demotivated towards the game. Because, he believed that in that situation, students played for getting good grade, not for learning. The fear of getting bad grades might affect them negatively in his belief. But, if they were advised to play it and if they saw that they were successful in the game, they became more motivated to play it. According to him;

"If it is obligatory, you might make the player hate the game…. If it is given as homework and affects the grade, it will not be fun. You play the game for the grade not for the entertainment. You cannot do something you want at any points, you cannot say let's try this, at the end there is a grade."

"Zorunlu olursa oyundan nefret ettirebilirsiniz…. Ödev verilirse notu etkileyecek olursa eğlenceli olmaz. Not için oynuyor olursunuz, eğlence için değil. Bir yerde istediğiniz bir şeyi yapamazsınız şunu deneyim diyemezsiniz, not var sonunda."

After game play, Michael still thought that misleading could be a problem that could be seen in the integration of games to their department.

Misleading: Michael emphasized the importance of realism in the game. According to him, the game had to be realistic if it aimed to teach. Otherwise, it might mislead the students and cause them to gain wrong information. He believed that, the students would use them to learn so that they accepted everything in the game as true. Thus, even an unrealistic event in the game might mislead the students and might cause them to misinterpret the events. He said that;

"If it is played for education, eventually, in there you accept everything as true. When something is happened you say this

happened in this way. If it is not realistic, if something happens instead of what must happens, at that time you accept that as true, you say, look it is like this. But, it will be wrong. That's why, it must be realistic."

"Eğitim amaçlı oynadığında sonuçta sen oradaki her şeyi doğru kabul edeceksin. Bir şey olduğunda bu böyle oluyormuş diyeceksin. Eğer gerçekçi olmazsa, olması gerekenden başka bir şey olursa o zaman onu doğru kabul edersin, bak böyleymiş dersin. Ama yanlış olur. Bu yüzden gerçekçi olmalı."

4.3.1.5 Pre-opinions of David about the Usage of Simulation games for Education

As the other participants, David was interviewed in order to gain his pre-opinions about the usage of simulation games in educational settings at the beginning of the study. The interviews results showed that he supported the integration of games in education due to three main reasons which were learning by doing, motivation and fun.

Learning by Doing: David stated that game could help the students in their learning process. He said that games had high interactivity and required active participation of the players. Players performed several actions in any game. This feature of the game could be useful if it was integrated into their department. He told that students could be asked to do several duties in the game environment. With the help of these duties, they could learn by doing. In his belief, this would increase their learning since;

"In the game, eventually there is interaction, you have to do something. This can be used for example. For example, it says do this to you, you do…. Instead of just reading, doing will be better for us of course."

"Oyunda sonuçta interaction var, bir şeyler yapmak zorundasın. Bu kullanılabilir mesela. Mesela sana şunları yap der, sen de yaparsın…. Sadece okumaktansa yapmak daha iyi olur bizim için tabi."

Motivation: David also thought that educational games might have positive contribution on the motivation of the students. He believed that it could increase the students' motivation to learn. He illustrated his idea by giving an example. He believed that the difficulties students faced in the game might trigger their ambitious.

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They might want to overcome those difficulties no matter what it took. Thus, they might be motivated to search for the possible solutions to overcome those difficulties. He explained that;

> *"For example, at some point he choose the wrong thing, he sticks in the game, it is collapsed or not exploded, he loses money. He might curious about why it is in that way etc., searches to find the best method."*

> *"Mesela bir yerde yanlış şeyi seçiyordur oyunda takılmıştır, çöküyordur ya da patlamıyordur, para kaybediyordur. Neden böyle diye merak edip, araştırabilir doğru yöntemi bulmak için."*

Fun: David liked to play the games. So, at the beginning of the study, he believed that learning from the games would be funnier than learning from the books. He stated that;

> *"For example, studying is boring. But, studying by playing the games might be funnier, might be very beneficial.*

> *"Mesela ders çalışmak çok sıkıcı. Ama oyun oynayarak çalışmak çok daha eğlenceli olabilir, çok faydalı olabilir.*

He said that studying from the books made him bored. Thus, he tried to find additional sources to study in order to have fun while learning. For instance, he stated that instead of studying English from the book, he listened songs in English and looked at the lyrics. He believed that this helped him more than the books. He stated that games also could serve this purpose. He believed that most of people liked to play the games and integrating the games to educational settings could create an environment in which students had fun while they were learning. He believed that;

> *"For example, I did not like to study English but I listened to music in English. I printed out the lyrics, when I encountered with that music on TV, I watched that. I learnt English by that, studying from the books were more boring. It may be the same by the game. You do not get bored while you are playing."*

> *"Mesela ben İngilizce çalışmayı hiç sevmezdim ama İngilizce müzik dinlerdim. Çıktısını alırdım müzik sözlerinin, televizyonda o şarkıyla karşılaşınca ona bakardım. Ben öyle öğrendim İngilizceyi, kitaptan çalışmak daha sıkıcıydı. Oyunla da bu olabilir. Oyun oynarken sıkılmazsın."*

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4.3.1.6 Post-Opinions of David about the Usage of Simulation Games for Education

After attending the study, his opinions related with integration of games to educational settings did not change dramatically. He added visualization as the benefits of games in addition to learning by doing, motivation and fun.

Visualization: Like the other non-gamer participants in this study, David drew attention to the limited usage of visual materilas in their lessons. He stated that he had problems to visualize the concepts and processes discussed in the lessons. But after game play, he believed that games could fulfill his visual needs to some extend. According to him, visual materials were important in their department. It helped them to understand the content better. Without visuals, he felt that he could not understand the content accurately so he just focused on memorizing the main points to pass the exam instead of understanding the logic behind them. He believed that seeing the processes in the game could help the students to understand them better. Moreover, when they saw them in real life at their summer practice, they could compare them with their experiences in the game. This would help them to understand these processes better since;

> *"It helps you to visualize in your mind…. You cannot imagine, you just memorize, you take the exam to get a grade. But, if he sees it for example, he understood something, he says aaa in that game it is like that etc. When he goes to summer practice, he remembers the things he sees at the game, he compares them with the things he faces at the summer practice, he comprehends."*

> *"Kafanda canlandırmana yardımcı olur…. Hayal edemiyorsun sadece ezberliyorsun sınava not almak için giriyorsun. Ama bunu görse mesela anlar bazı şeyleri, aa şu oyunda şu şöyleydi falan der. Staja gitti mi oyundaki gördüklerini daha kolay hatırlar, onlarla karşılaştırır gördüklerini, iyice kavrar."*

Learning by Doing: David stated that games provided opportunities for students to learn by doing. He emphasized that he had limited opportunity to practice his knowledge. He stated that he needed experiences to be a good mining engineer but the only way to gain experiences was summer practices. But summer practices were not enough to gain the necessary experiences since they were generally

observer in mine. In there, they were not allowed to give any decisions. Instead, they observed what the other mining engineers did. But, he needed to apply what he was taught in the courses. For him, games could fulfill this need of the students and prepared them to their future career. He said that;

> "You cannot apply what is taught in the lessons, you just study from the books and you memorize the things such as this is this and that is that…. We need experiences, the only place you can gain experience is summer practice. But, at summer practice, we just observe, we just see what they are doing how they are doing."

> "Derste anlatılan şeyleri uygulayamıyorsun ki sadece kitaplardan çalışıp bu böyleymiş şu şöyleymiş diye ezberliyorsun…. Bize deneyim gerekli, deneyim kazanabileceğin tek yer de staj. Ama stajda da sadece gözlem yapabiliyoruz, sadece ne yapıyorlar nasıl yapıyorlar onu görüyoruz. Oyun senin yapmanı sağlıyor."

Motivation: David also believed that the game could affect the motivation of students. He stated that games posed difficulties to the players. Generally, these difficulties made the players to be more passionate for being successful. Thus, he believed that when the students faced difficulties and be challenged, they would be motivated to find the way to overcome those difficulties and searched for solutions. They looked at the books, searched from the internet or asked their instructor in orer to find the best method to overcome the problem. Hence, it could increase the motivation of the students towards the courses. He told that;

> "Generally, the game raises difficulties to you…. Generally, these difficulties make the player more passionate….If the educational game is designed to be more complicated, the students may stuck in a level, for example he searches, tries to find the solution. For example, he asks his instructor, get advices."

> "Genelde oyun sana zorluklar çıkarıyor… Genelde o zorluklar oyuncuyu hırslandırır. Eğitsel oyunda biraz daha komplike olursa, öğrenci bir level da takılır mesela araştırır bulmaya çalışır çözümü. Mesela hocasına sorar, tavsiye alır."

Fun: After game play, David thought educational games could help students to have fun while they were learning. According to him, playing educational games was funnier than studying from traditional materials. He said that he had poor

attention span and his attention span was decreased when he tried to focus on boring things. Thus, he told that he could not study his lessons from traditional learning materials such as books, videos for long hours, he got easily bored. However, he added that his attention span was increased while he played a game. He said that playing a game gave him great pleasure so he could focus his attention more easily on the game. He believed that since most of students liked to play, they would also like game based learning. According to him;

> *"It is the game, I mean it is not like studying, you like the game, you play. Studying from the books is boring… If the game is funny, instead of studying from the books, you sit and study by playing; you both play the game and learn."*

> *"Bu oyun yani ders çalışmak gibi değil ki oyun hoşuna gidiyor oynuyorsun. Kitaptan çalışmak çok sıkıcı… Oyunda eğlenceliyse, kitaptan çalışmak yerine oturur oyun oynayarak çalışırsın, hem oyun oynamış olursun hem de öğrenmiş."*

4.3.2 Opinions about the Strengths and Weaknesses of Simulation Game Used in This Study (Research Question 2)

Table 13 shows the opinions of gamer participants related with the strengths and weaknesses of the game used in this study. As shown in the Table 13, gamer participants had different ideas related with the strengths and weaknesses of the game. Visualization was the common theme that was considered as strength of the game by all three gamer participants. Realism in design and roles of the players were also seen as strengths of the game. Finally, active participation and learning by doing were listed for strengths of the game by one participant, Michael. In addition to strengths, the gamer participants identified the weaknesses of the game. Similar mission was mentioned by all three gamer participants and lack of saving option was stated as a weakness by two gamer participants, Michael and David. In addition, limited vehicles and equipment and lack of details were given by Michael whereas pace of the game and lack of character growth were told by David.

Table 13 *Opinions of Gamer Participants about the Strengths and Weaknesses of Simulation Game Used in this Study*

	Claire	Michael	David
Strengths			
	Visualization	Visualization	Visualization
	Realism in Design		Realism in the Design
		Roles of the Player	Roles of the Player
		Learning by Doing	Learning by Doing
Weaknesses			
	Similar Missions	Similar Missions	Similar Missions
	Limited Technical Information		
		Lack of Saving Option	Lack of Saving Option
		Limited Vehicles & Equipment	
		Lack of Details in the Design	
			Pace of the Game

4.3.2.1 The Opinions of Claire about the Strengths and Weaknesses of Simulation Game Used in this Study

Claire identified two main strengths of the game which were visualization and realism in the design.

Visualization: Claire believed that visualization was one of the big strengths of the game. During the interviews, Claire emphasized that she gave great importance on visualization. Without visual materials, she had difficulties in learning. According to her, the visual materials were also important for all the students in their department. She stated that the contents they were learning were new phenomenon for all of them so they had difficulties to imagine them. She thought that game simulated realistic mine environment. Moreover, some of the processes such as hauling, drilling were shown in the game. Thus, for her, to some extent game could fulfill the needs of students to visual materials because;

> *"They design the mine environment is well, at least it shows what kind of a place the mine is…. In here, actually a lot of student comes to this department by knowing nothing about it, technical terms or processes are not the things we know before, so it is hard*

to understand, at least I have difficulties…. Visuality is important for me…. The game provides this partially."

"Maden ortamını iyi tasarlamışlar, en azından madenin nasıl bir yer olduğunu gösteriyor…. Buradaki birçok öğrenci aslında çok bilmeden geliyor bölüme, teknik terimleri, process ler de daha önceden bildiğimiz şeyler değil o yüzden anlamak zor oluyor, en azından ben zorlanıyorum….. Görsellik önemli benim için…… Oyun da bunu kısmen sağlıyor."

Realism in Design: According to Claire, realism in the design of the game was another strength of the game. She stated that the game was realistic enough to make the students gain idea about what a mine was like.

Mine Design: Claire thought that the mine simulated in the game was realistic. The designer of the game considered the important aspects of the quarry well. She stated that the benches of the mine, the roads, the plant was well considered in the game. Moreover, she stated that the vehicles and equipment were also well simulated. The vehicles made special sounds when they went backward. According to her, this increased the realism in the game. He stated that;

"It shows the environment, it is very good actually. The things are realistic, the mine environment, the trucks, the other things…. The benches are well designed."

"Ortamı gösteriyor gayet güzel aslında. Şeyler gerçekçiydi bence maden ortamı, kamyonlar, öbür şeyler…. Bench ler falan iyi tasarlanmış."

Processes: According to Claire, the game showed the processes in quarrying by giving missions to the players. She stated that in the game, they needed to produce several specific stones and minerals and this was also true in real life. According to her, the game helped the students to understand the basic processes in the quarrying by meeting the demand of the customers. However, she added that they could be more detailed. She wanted to see more details in these processes. For instance, students could be asked to do decide the amount of anfo etc. She believed that more details would increase the realism of the game. She stated;

"It shows what is done in quarrying, it is realistic. We are wanted to produce something, you see what is done and how… They are

also good, the blasting etc, but they are simple, there could be more details in order to be more realistic. More things could be wanted, for example we are wanted to determine the amount of anfo."

"Taş ocağında neler yapılır, onu gösteriyordu, gerçekçiydi. Bizden bir şeyler üretmemiz isteniyordu, üretirken görüyordun ne nasıl yapılır..... Onlar da iyiydi, patlatma falan ama biraz basitti daha fazla detay olabilirdi hani daha gerçekçi olması için. Daha fazla şey istenebilirdi, bizden mesela anfo miktarını ayarlamamız istenebilirdi."

In addition to strengths, Claire also identified the weaknesses of the game used in this study. Similar missions and limited technical information were two main categories that she complained about.

Similar Missions: Claire complained about the missions provided by the game. She stated that similar missions were appeared in the game and after a while these missions made the players get bored. Moreover, it did not show the actual picture of mine environment so it might mislead the students. She thought that in mine, there was variety of missions of each worker so she thought that they should be represented in the game too. Or, the tasks could be detailed to increase the variety of missions. For instance, students could be asked to do specific actions by using specific methods. Acording to her;

"All the time, cut, take there. Though, it would be the same but, at least for example in blasting, there are three methods, you make different patterns etc. If they were included, different missions would be appeared. There could be something like that…. It makes people bored after a while… Actually, in mine the things you can do are limited, the missions cannot me differentiate much, but at least everyone has duties. They could be shown much."

"Sürekli kes oraya götür. Gerçi aynı görev olacak ama en azından mesela patlatmada üç tane metot var şekilleri farklı diziyorsun falan. Onlar falan olsaydı daha farklı görevler çıkabilirdi ortaya. Öyle bir şey olabilirdi… Sıkar insanı bir süre sonra…. Aslında madende yapabileceğin şey de sınırlı görevin de çok değişebileceği bir şey yok da ama en azından herkesin görevleri var. Onlar daha çok gösterilebilirdi."

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Limited Technical Information: Claire also complained about the technical information in the game environment. She stated that she had forgotten most of her knowledge related with quarrying. So, she said that needed to gain and apply more information in order to remember them. However, the game provided limited technical information so it was a weakness. She stated that;

> *"I do not remember quarrying. If I remembered, I would act according to that. But I did it without being ensure….The game should provide information, want us to apply that. In here, it is not much. This is missing in the game."*

> *"Hatırlamıyorum ben quarrying i. Hatırlasaydım ona göre davranırdım ama ben emin olmadan yaptım…. Oyun bilgi vermeli, onları uygulamamızı istemeli. Burada o yoktu fazla. Bu eksikti oyunda."*

4.3.2.2 The Opinions of Michael about the Strengths and Weaknesses of Simulation Game Used in this Study

Michael identified visualization, roles of the player, learning by doing as the main strengths of the game.

Visualization: According to Michael, game helped the students to visualize the processes in quarrying. He stated that the game simulated a quarry appropriate to reality. Moreover, it showed the processes in quarry to the students. Thus, he believed that students could get an idea of what a quarry was and what processes were held in there. He stated;

> *"The quarry is realistic; the works done are also realistic, at least students get an idea what kind of environment a quarry is, what is done, they have an idea before."*

> *"Quarry gerçekçiydi, yapılan işler de gerçekçiydi, en azından öğrencilerin bir fikri olur, quarry nasıl bir yermiş, neler yapılıyormuş, önceden fikirleri olur."*

Roles of the Player: The roles of the player were another strength of the game identified by Michael. He stated that the players were assigned different roles in the game environment. They had to be workers, engineers, operators etc. in the game in order to meet the demand of the customers. He thought this helped the players to understand the activities in the quarry from different point of view. He believed;

"In there, you are doing a variety of tasks alone. At least you see who does what, who should be aware of what etc. "

"Orada çeşitli görevleri sen yapıyorsun tek başına. En azından kim ne yapar görmüş oluyorsun, kim nelere dikkat etmeli falan."

Learning by Doing: Michael also defined learning by doing as strength of the game. For him, game forced the students to be active and do everything by themselves. They had to analyze the environment, give several decisions and do several activities in order to be successful. This approach made the players to be responsible of everything in the quarry in the game. He stated that since a mining engineer was responsible everything in mine, this approach prepared them to their future career. Moreover, doing evething helped them to understand quarrying better. This helped them to practice their knowledge related with quarrying. According to him;

"In here, you decide everything, you do, you are responsible for everything. You do something so that something is happened…. Of course, this has a good side, it is a good thing. Later, when you take the responsibility of mine, you have to decide, in here too…. Doing everthing also contributes a lot to you, you see what is done and how."

"Burada her şeye sen karar veriyorsun, sen yapıyorsun, her şeyden sen sorumlusun. Sen bir şey yapacaksın ki bir şeyler olsun… Tabi bunun iyi yanı var, iyi bir şey. İleride bir madenin sorumluluğunu aldığında senin kararlar vermen gerekiyor, bunda da… Herşeyi yapmanın sana katkısı da çok oluyor, görüyorsun ne nasıl yapılır. "

When Michael was requested to identify the weaknesses of the game, he said that similar missions, lack of saving option, limited vehicle and equipment and lack of detail in the design, could be considered as weaknesses.

Similar Missions: Michael complained about the variety of missions in the game environment. He stated that the game gave similar missions to the players and for him; this was a weakness of the game. He stated that similar missions not only made the players get bored but also made the game unrealistic. According to him, the missions should be reconsidered. He stated;

"It is not realistic…. In mine, the mission is not just given and you do, something else also happens. In this way, it is not realistic,

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players will get bored after a while, missions should be reconsidered."

"Gerçekçi olmamış.. Madende sadece görev gelir sen de yapmazsın, başka şeyler de olur. Böyle gerçekçi değil, bir süre sonra sıkılır oynayan, tekrar gözden geçirilmeli görevler."

Lack of Saving Option: Michael also complained about lack of saving options in the game environment. He thought that this was the weakness of the game. According to him, trial and error method was one of the best methods that increased learning. In his belief, students learnt more when they did something, observed its results and altered some variables. And the game created an opportunity in which students could use this method. It was a safe place where they could practice their knowledge. They could design experiments and analyzed the results. But, students needed to save their progress to practice their knowledge. He added that lack of saving option might cause the player not to be brave in their decisions and prevented them to search what they were curious about. He said;

"It affects, of course, for once when I make a mistake if I start the game from the beginning I will not start... May be, for example, you become curious and make an experiment, you look for how the results are or you make a difficult action."

"Etkiler tabi ki bir kere ben hata yaptım mı ben oyunu baştan başlayacaksam başlamam... Belki mesela merak edip orada kendin bir deney yapacaksın, sonuçları ne oluyor diye bakacaksın ya da zor bir hareket yapacaksın.."

Limited Vehicles & Equipment: Michael criticized the vehicles and equipment simulated in the game. He said that there were limited vehicles and equipment and this was a weakness of the game. According to him, this affected the playability of the game. It decreased both the realism of the game and the motivation of the players. He wanted to be given variety of vehicles and equipment of different brands. For instance, he stated that only one type of truck and wheel loader was given in the game. But, he wanted to be given trucks and wheel loader in different size as well as of different brands. He thought that this approach would increase the realism and also the benefits of the game. He said;

> *"Like I said, it should be realistic. In there, I am given a limited range of trucks, wheel loader etc. They should be in different sizes; I should be able to select what I want..... I should test them so I can understand the differences between them."*

> *"Dediğim gibi gerçekçi olmalı. Orada bana vermişler sınırlı çeşitte kamyon, kepçe falan. Bunlar farklı boyutlarda olmalı, ben istediğimi seçebilmeliyim... Ben onları denemeliyim ki aralarındaki anlayayım."*

Lack of Details in the Design: Michael stated that he liked reality in any games and according to him; details increased the reality of the games. So he gave his attention to even tiny things in order to evaluate realism of the game. During the game playing, he analyzed whether the designers worked on details or not. In his belief, in the game used in this study the details were not considered much and this was its weakness. He thought that details should be considered and added to the game in order to increase its realism as well as its educational value. According to him;

> *"Everything should be detailed, it should be considered to the finest detail if it is educational. Details in any case will give you that thing, that information. In here, there are not details that much. Ok, it is given little attention, but it is not enough. There should be more details."*

> *"Ayrıntılı olmalı her şey, en ince ayrıntısına kadar düşünülmeli eğer eğitici olacaksa. Ayrıntılar zaten size o şeyi, o bilgiyi verecektir. Burada ayrıntı yoktu o kadar. Tamam, biraz dikkat edilmiş ama yeterli değildi. Daha da fazla ayrıntılı olmalı."*

For instance, he stated that the vehicles could be simulated in details. The control panel could be added and players could use them via control panel like the ones in reality. By this, the players could get used to these vehicles and understand how they worked exactly. Or, games could help the players to feel the differences when vehicle was loaded with much or less stones etc. Finally, the weather conditions could affect the performance of the vehicles. When it was raining, it could be hard to drive the vehicles in mud road. By this, students could have an idea about how the weather conditions could affect mining. These kinds of details could increase to the realism of the game. He recommended;

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"For example, if I enter the inside of the vehicle, I should be able to see the panels. It should be like in the real life, driving that vehicle should be realistic; I should drive by using panels. Or, I load the vehicles 500 kg or 800 kg, I should feel the differences between them. Or, it was raining, nothing was happened, when it was raining"

"Mesela ben buradan aracın içine girdiğimde görebilmeliyim panelleri. Gerçek hayattaki gibi olmalı, gerçekçi olmalı o aracı sürmek, panelleri kullanarak sürmeliyim. Ya da araca 500 kilo yükledim ya da 800 kilo bunların arasındaki farkı hissedebilmeliyim. Ya da yağmur yapıyor bir şey olmuyor, yağmur yağınca aracı çamurlu yolda sürmenin zor olduğunu görmeliyim."

4.3.2.3 The Opinions of David about the Strengths and Weaknesses of Simulation Game Used in this Study

The opinions of David related with the strengths of the game are given below. According to him, there were four main strengths of the game which were visualization, realism in the design, roles of the player and learning by doing.

Visualization: David thought that visualization was one of the strengths of the game used in this study. He said that it was a bit difficult for students to imagine a mine environment without any visual materials. He added that the some of the terms, concepts they had been learning was also difficult to imagine for students. He thought that the game could show the students how a quarry was like and the processes in there. He believed that the game represented mine environment better than videos and pictures. For him, it showed the processes, vehicles and equipment in three dimensions. Moreover, players could investigate them by changing the view of camera. In other words, unlike the videos and pictures, students could investigate them from different angles. These attribute of the game powered the effects of it and helped the students to visualize the concepts and processes much better. He said;

"In the lectures, sometimes it is difficult to understand, the instructors explains something but since I cannot imagine exactly, I do not understand. A person want to see what is explained… In this game, at least students can gain information about a quarry. In the lectures, they can say "aa in the game it is like that, we do in that way etc."… In the videos or pictures, it not the way I want. The game is in three dimensions, you can change the camera view."

"Derslerde bazen anlamak zor oluyor, hoca bir şeyler anlatıyor ama tam olarak hayal edemediğim için anlamıyorum. Anlatılan şeyleri görmek istiyor insan.... Bu oyunla en azından öğrenciler taş ocağı hakkında bilgi sahibi olabilirler. Derste falan da Aa oyunda böyleydi, böyle yapıyorduk diyebilirler.... Videolarda ya da resimlerde istediğim gibi olmuyor. Oyun üç boyutlu, kamerayı değiştirebiliyorsun"

Realism in the Design: David classified realism in the design as the last strength of the game used in this study. He thought that the design of the mine, missions and processes in the game environment were realistic.

Mine Design: David thought that the mine design in the game was realistic. He said that the mine and the crushing plant simulated in the game were designed appropriate to real life. According to him;

"Of course, according to me, it is nice since I did my summer practice. It is similar... For someone who never goes, it gives an idea, how the benches are etc. In there, there are workers; in here there is crushing plant. In reality, it is in that way, I mean the mine is far away, the crushers comes to the crushing plant, you cannot establish it nearside of the mine.... According to me, it is nice, the realism is not bad I mean."

"Tabi bence güzel ya hani staj yaptığım için. Benzer .... Hiç gitmemiş birine bir fikir sunabilir bench lerin durumu falan. Orada işçiler falan var burada tesis var. Gerçekte de öyledir, yani ocak uzaktadır, kırıcılar tesise gelir, onu ocağın dibine kuramazsın.... Güzel bence gerçekçiliği fena değil yani."

However, David had conflicted ideas related with the vehicles and equipment. He said that they were realistically simulated. The special sounds of the vehicles were also considered and added. But, he said that the problems about their moves could be seen. It did not seem realistically. The wheels of the vehicles were seemed like slipping instead of rotating. Thus, their moves should be reconsidered. He added that sometimes they acted problematically when the player made difficult moves. According to him, if the physic engine of the game was redesigned, the realism in their moves would be increased. He said;

"The equipment is appropriate to realism. They are the vehicles with limited moves, those movements are also limited. I do not know, they produce special sounds when go to backwards. They consider that detail, those sounds are important in mine, they

warn the workers etc…. It could be more appropriate to realism, for example, sometimes in difficult moves, it can behave weird."

"Ekipmanlar gerçeğe uygundu. Bunlar manevra kabiliyeti düşük ekipmanlar onların da manevra kabiliyeti düşük. Ne bileyim geri geri giderken sesler çıkarıyor falan. O ayrıntıya da dikkat emişler, o sesler madende önemli, uyarıyor işçileri falan…. Gerçeğe çok daha uygun olabilir mesela bazen zor hareketlerde acayip hareket edebiliyor."

Processes: David also thought that the processes they did in the game were realistic. He stated that the required processes such as hauling, crushing was appropriate to real life conditions. He stated that he had observed similar processes in his summer practice. He mentioned;

"The processes are also good, transporting, crushing etc. are not bad, they are realistic."

"Prosesler de iyiydi, taşıma, kırma falan, fena değildi gerçekçiydi."

But he added that severe punishment should also be included in order to make the game more realistic. He said that when he had made a mistake, the game should show the possible consequences of the mistake. In real life, when an accident happened, the vehicle might be damaged. It also could be shown in the game. Moreover, the weather did not affect anything in the game environment. If it was rained, the conditions should be changed. For instance the road should become muddy when it was raining. They decreased the realism of the game. He suggested;

"What can be added, for example, the punishment can be added to be more realistic… For example, if you make a huge accident, the vehicle can be broken. Or there was rain, but it did not affect anything. The road can be moddy when it is raining."

"Ne eklenebilir, ya mesela cezalar eklenebilir daha gerçekçi olması için… Mesela büyük bir kaza yaparsan araç bozulabilir. Veya yağmur vardı ama hiçbir şeyi etkilemedi. Yağmur yağdığında yol çamurlu olabilir."

Roles of the Player: David also identified the roles of the players in game environment as the strength of the game. He said that the game allowed the players to explore different roles in quarry such as operators, workers etc. This helped the

students to see the jobs in quarry from different perspectives. However, he added that although assigning different roles in the game environment was good way to understand the relationships of workers in quarrying, he warned that it became boring after a period of time. He suggested that his roles should be fixed to a mining engineer after a certain time. Moreover, he wanted to give orders to other workers and made them did the necessary tasks in the mine instead of doing everything by himself in the upper levels. He said;

> *"At the beginning, it is good to do everything by yourself. You see what an operator does etc by this. But, after a certain time, it makes people bored. After a period, I should be just mine engineer, give orders to others."*

> *"İlk başlarda böyle her şeyi senin yapman iyiydi. Operatör ne yapar, ne eder falan görüyorsun böylece. Ama belli bir noktadan sonra insanı sıkıyor…. Belli bir yerde ben sadece maden mühendisi olayım, diğerlerine emir vereyim."*

Learning by Doing: According to David, learning by doing was one of the important advantages of the game. He said that game allowed them to do the activities like blasting, hauling, transporting etc. by themselves. This helped them to understand these activities better compared to studying them from traditional materials such as books. According to him;

> *"I did everything in here, I decided everything, I went, drilled, transported, crushed etc. Of course, it shows how these should be done, you understand them better. In here, since you dwell on it, you comprehend better."*

> *"Burada her şeyi ben yaptım, ben karar verdim gittim deldim, taşıdım, kırdım falan. Tabi en azından bunların nasıl yapılması gerektiğini gösteriyor, daha iyi anlıyorsun onları. Burada kafa patlattığın için daha çok kavrıyorsun."*

David also identified the weaknesses of the game used in this study. Similar missions, lack of saving option, pace of the game and lack of character growth were the general themes he complained about.

Similar Missions: David thought that similar missions in the game were weaknesses of the game. He stated that missions given in the game gave reasons for

players to play the game. But, he added that doing similar missions over and over made the game boring after a while. Thus, he suggested that the missions in the game should be reconsidered. For example, he suggested that players could compete with the owner of other quarries etc. These kinds of things could be implemented in order to increase the variety of missions. He said;

> *"The similar missions are given.. At the beginning, it seems good, you earn money, it makes you play the game but constantly doing similar things makes you get bored after a while…. I do not know what kinds of missions are given in stone quarry; I do not know there could be another stone quarry; you compete with it etc.… I mean, new things should be added, that parts should be reconsidered."*

> *"Ya hep aynı tarz görevler veriliyor…. Başta iyi geliyor, para kazanıyorsun, oyunu oynamanı sağlıyor ama sürekli aynı şeyleri yapmak da bir sure sonra sıkıyor… Bilmiyorum taş ocağında nasıl görevler olacak da ne bileyim yeni şeyler eklenebilir. Ne bileyim başka taş ocağı olur rekabet yaparsın falan…… Yani yeni işler de eklenmeli, tekrar düşünülmeli o kısımlar."*

Lack of Saving Option: As the second weakness, David complained about lack of saving option in the game. He wanted to save his progress in the game. Since he was ambitious game player, he feared to lose everything he gained so far by a tiny mistake when he was playing the game. This fear prevented him to be brave in his decisions. He said that the possibility of losing everything gained so far might cause the players to not investigate what they really wondered. He said that a realistic game could create a safe environment to investigate which actions worked best for specific problem. But, if the player afraided of losing, they might just try to focus on the safe method. They might not perform the actions which they did not trust. For him, a mining engineering student should apply every action he considered and see the consequences. This helped the students to understand which method and actions worked best in that situation and why. And also, this helped them to increase their knowledge. So, he suggested;

> *"I lost my mind, I stuck in… I will do something and lose what I gain… If there is a saving option, I save it, than do what I want, when I make a mistake, I start the point I save before. In this, the*

person cannot be comfortable, what if I lose, what if I start from the beginning."

"Kafayı yedim ya takıldım... Bir şey yapacağım kazandıklarım da gidecek.... Ya kaydetme seçeneği olsa, kaydederim sonra gene istediğimi yaparım, yanlış yapınca da tekrar önceden kaydettiğim yerden başlarım. Böyle olunca rahat edemiyor ki insan, ya kaybedersem baştan başlarsam."

Pace of the Game: David was an ambitious player who strived for success no matter what it took. Thus, he was impatient to be successful and could not stand to wait for a long time. According to him, the pace of the game was slow and this could make the players get bored after a while. He believed that in mining, the important thing was earning money and the only thing he could not retrieve was the time. Thus, he did not want to waste of his time on activities much. He wanted to be allowed to speed up things in game environment. For instance, he wanted to speed up the crusher to decrease his time on crushing the fragmented rocks or made the avatar run faster to decrease its travel time from one location to another. He stated;

"Time is important eventually. The vehicles are of course, go faster than the avatar, the avatar goes so slowly so I lose much time. Luckily, I can make the avatar run but even its running is slow I think.... Of course, in mining the aim is earning money. The only thing you cannot bring back is time. It is better to earn money as soon as possible."

"Zaman önemli sonuçta. Araçlar tabi adamdan daha hızlı gidecek de adam o kadar yavaş gidiyor ki çok zaman kaybediyorum. Allahtan adamı koşturabiliyormuşuz ama koşması bile yavaştı bence.... Tabi madencilikte de amaç para kazanmak. Geri getiremeyeceğin tek şey zaman. En kısa sürede para kazanırsan iyi."

Lack of Character Growth: David complained of lack of opportunities to growth his character in the game. He believed that it was one of the weaknesses of the game. For him, the game should allow character growth. He wanted to start as a worker but later by his success, he wanted to be a manager and run the quarrying. He suggested that he should give orders to the operators and workers in the game and if they did not want to do it, he should find ways to persuade them. He believed that

this not only increases the motivation of the players, but also helped the players to develop their persuasive skill. According to him;

> *"I should grow; I should not do the same things. In here, it is the same, you cut, crush etc….Makes you get bored…. After a while, if I own the quarry, give orders to others, not do everything by myself, it will be better… you learn how to rule."*

> *"Büyüyebilmeliyim ya hep aynı şeyleri yapmamam gerek. Burada hep aynı, sen kesiyorsun, kırıyorsun falan…. Sıkıyor… Bir süre sonra ocağın sahibi olsam, başkalarına görev versem, her şeyi ben yapmasam daha iyi olur… Nasıl yöneteceğini de öğrenirsin."*

4.3.3 Motivational Elements in Simulation Games Used in this Study (Research Question 3)

In Table 14, the opinions of gamer participants regarding with the motivational elements in the game are given. It is seen that control, challenge and curiosity were the common motivational elements stated by all three gamer participants. In addition, mission was given by Claire and David and realism in the design was mentioned by Claire and Michael. Finally, role of the player was seen as motivational element by Claire whereas field of study was told by David.

Table 14 *Opinions of Gamer Participants about Motivational Elements in Simulation Games Used in this Study*

Claire	Michael	David
Control	Control	Control
Challenge	Challenge	Challenge
Curiosity	Curiosity	Curiosity
Mission		Mission
Realism in Design	Realism in Design	
Role of the player		
		Field of Study

4.3.3.1 Opinions of Claire about Motivational Elements in Simulation Games Used in this Study

According to Claire, control, challenge, curiosity, mission, realism in design and roles of the player were the main motivational elements in simulation games used in this study.

Control: Claire stated that control affected her motivation in the game. She felt she was in the saddle while she was playing the game. According to her, she could do whatever she wanted to do in the game environment. This increased her motivation. In addition, she stated that she could change the camera view in the game. This helped her to do what she wanted easily so it affected her motivation positively. She said;

> *"Of course, I am in the saddle….. It is nice to change the perspective, I see where I'm going, I see what's around me, for that reason it is nice to change… It allows you to do whatever you want, this is something that increase the motivation eventually."*

> *"Tabi ki gayet kontrol bendeydi…. Perspektifi değiştirmek güzeldi, nereye gittiğimi görüyorum etrafında ne var onları görüyorum o açıdan güzel şey değiştirebilmek… İstediğini yapmanı sağlıyor bu da motivasyonu artırıcı bir şey sonuçta."*

Claire added that she sensed the control in different levels. For instance, she felt that she had more control on the equipment like pneumatic drill compared to vehicles. She stated that she decided everything about the pneumatic drill like when to start or stop it, so she felt she controlled it more. According to her;

> *"Since I used pneumatic drill, did the blasting with that equipment, for that reason we were in control more at this time. When you use the pneumatic drill by yourself, when you start and stop it, it is like you are in control much. I do not feel like that in vehicles."*

> *"Pneuamtic drill i kullanınca patlatmayı yapınca aletle o yüzden kontrol biraz daha bizdeydi bu sefer…. pneumatic i kendin kullanınca, kendin durdurup başlatınca istediğin gibi sanki daha çok kontrol ediyormuşsun gibi oluyor. Araçlarda öyle hissedemiyorum."*

Finally, Claire stated that she had some problems regarding with the usage of keyboard to play the game. She thought that the necessary key combinations to play the game caused some problems for her to play. Thus in those situations, she felt that she lost control over the game and her motivation was decreased. She thought;

> *"The key combination is not appropriate. The direction keys and the ones that control the wheel loader are close. If they were far, if one was in the left, the other was in the right, I think it would be more affective, would be nice, the playability of the game would be easier. But, the camera annoys me all the time, you click left. This camera for example, instead of clicking left button, when moving the mouse, its angle may also changes, this would be better."*

> *"Tuş takımı hiç de uygun değil. Yön tuşları ve kepçeyi kullanma tuşları birbirine çok yakındı. Ayrı olsa bir sağda biri sol tarafta olsa bence daha etkili olurdu, daha iyi olurdu, oyunu oynamak kolaylaşırdı. Ama bu kamera çok sinir etti beni her zaman sağ tuşuna basıyorsun. Tuş takımı hiç de uygun değil. Bu kamera mesela sağ tuşla basmak yerine direk mouse u oynatınca açısı değişebilir, bu daha güzel olur."*

Challenge: Claire stated that challenge affected her motivation too. In the game, she had difficulties to deciding anything and performing several activities like using the vehicles effectively. However, these difficulties did not stop her, instead it stimulated her ambitious. She stated that she tried to overcome the challenge no matter how difficult it was. She said;

> *"When I succeed, I feel good, it was nice…. Of course, they are the things that increase the motivation….. If I challenged much, I would not quit. I would play till I finished."*

> *"Başarınca iyi hissettim kendimi gayet güzeldi….. Tabi ki ya bunlar motivasyonu artırıcı şeyler…. Çok zorlansam da bırakmazdım. Bitene kadar oynardım."*

Curiosity: Claire also stated that curiosity had an effect on her motivation. Like the other participants in this study, she was curious about the opportunity to play the game related with her department. It increased her motivation to play. She stated that due to being a woman, it was difficult for her to use the vehicles and equipment and conduct activities such as blasting or hauling. She stated that she

wondered especially these activities in the game. She kept playing the game in order to see all the activities in quarrying.

> *"At the very beginning, I was curious about how a game related with mining could be…. Actually, I was curious about the vehicles and equipment most. Since I am a woman, it is unlikely to use them in real life or doing blasting etc. by using them, it is very difficult in real life. I was curious about how they were done… I continued to play the game till I saw all of them."*

> *"En başta madenle ilgili oyun nasıl olur onu merak ettim… Aslında ben en çok o araç gereçleri merak etim. Bayan olduğum için onları kullanmama pek ihtimal yok gerçek hayatta, ya da onlarla blasting falan yapacağım çok zor gerçek hayatta. Onlar nasıl yapılıyor onu merak ettim.…... Hepsini görene kadar da oynamaya devam ederdim."*

Mission: Claire stated that mission given in the game was also affected her motivation. She thought that when she accepted a mission, she felt that she had to finish it no matter how long it took. Finishing the mission became her goal so missions increased her desire to play. She also stated that the amount of order given in the game also affected her motivation. Especially, if the mission required huge number amounts of orders such as 300-400 kg of gravel, she was motivated to finish the mission as quick as she could so she continued to play. According to her;

> *"The thing that affects my enthusiasm is that huge numbers. That 400-300 kg gravel etc., I play constantly to finish them quickly… It increases my motivation, yes. I played to finish as soon as possible."*

> *"Benim isteğimi etkileyen şey o çok sayılardı. Şu 400 300 kg gravel falan. Onlar bir an önce bitsin diye sürekli oynadım…. Motivasyonumu artırdı evet. Bir an önce bitsin diye oynadım."*

Realism in Design: Claire stated that realism in the design of the game had contribution on her motivation. For her, the realism in the design made her feel that she really worked in the mine while she was playing athe game so she felt that she did something good for her career. Especially, the special sounds that the vehicles produced when going backwards motivated her because she felt that she really used those vehicles. She said;

Of course, its realism affected. I felt that I was in mine, the vehicles etc. made that sound, it was like I was in mine….It was like I really used those vehicles…. Of course it makes you feel good, you do something for your future, I mean you do not waste your time."

"Tabi gerçekçiliği etkiledi. Kendimi madende hissettim, araçlar falan o sesleri de çıkarıyor ya madendeymişim gibi oldu… O araçları gerçekten kullanıyormuşum gibi… Tabi iyi hissettiriyor, geleceğin için bir şey yapmış oluyorsun yani boşa vakit geçirmemiş oluyorsun."

Roles of the Player: Claire defined roles of the player in the game as final motivational element in the game. She explained that in reality, it was difficult to experience different roles in mine. For instance, especially for women, it was difficult to be an operator and use the vehicles. She said that games provided this chance to her. It gave several roles to her so that she could gain different experiences. She stated that the chance of being different roles in the game motivates her to play the game. She told;

"It was nice that a woman drove wheel loader…. Eventually, you can do a thing that you cannot do in real life, it is nice a thing, it affects your motivation."

"Bir bayanın loader sürmesi gayet güzel oldu..... Sonuçta gerçek hayatta yapamadığınız bir şeyi yapabiliyorsunuz güzel bir şey bu, motivasyonunuzu etkiliyor."

4.3.3.2 Opinions of Michael about Motivational Elements in Simulation Games Used in this Study

Based on his experience, Michael identified control, challenge, curiosity and realism in the design as the motivational elements in the game.

Control: Another motivational element mentioned by Michael was control. He liked to be in saddle in the game environment. He said that being allowed to do what he wanted to do in game environment increased his motivation to play. But for him, his control in the game was not enough; the game restricted him at some points and this demotivated him to play. For instance, he wanted to control the other workers simulated in the game. He said that he was only given permission to control one worker, his avatar. He was not allowed to control the other workers in the game

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environment. Thus, he felt that he did not have full control on the game and this affected his motivation negatively. He said;

> *"I did not feel that much; I mean that I was not in control much… I did not feel so dominant that much. Of course, if I am in control more, it will be better, I try more at least in taking something etc. At least, I should be able to control the workers in there. If there is a worker in there, I should be able to control it and give orders."*

> *"Çok fazla hissetmedim… Tam o kadar hâkim hissetmedim. Tabi ben daha hâkim olsam daha iyi olur daha bir uğraşırım an azından bir şeyleri alırken falan. En azından oradaki işçileri kontrol edebilmeliydim. Orada bir işçi varsa onu kontrol edip emir verebilmeliydim. Tamam, başta ben de işçi olayım ama ileride onları da kontrol edebilmeliydim."*

Moreover, he added that he was not allowed to do vital mistakes such as drilling the benches. He wanted to be allowed to do these kinds of mistakes to see their results. He said that these kinds of things increased the sense of control of the players as well as their motivation. According to him;

> *"It did not allow me to do mistake, I tried to drill the bench, it did not allow…. I should do whatever I want to do, should see what will happen."*

> *"Hata yaptırmıyor bana, bench i delmeye çalışıyorum izin vermiyor… Ben istediğimi yapabilmeliyim, ne olacak görebilmeliyim."*

Challenge: According to Michael, challenge was another motivational element that enforced him to continue to play the game. He said that when he played any game, he analyzed the difficulty level of the game. It had to match his skills, otherwise he did not play. For him, the playability of any game should be easy but the missions or duties should be challenged. These kinds of games increased his motivation. He told that the game used in this study met this criterion to some extend so he continued to play the game. He said;

> *"If it is too difficult, I do not play, I mean after a while I do not play… Not simple but easy, I mean, the game should not be easy but should be play easily…… For example, if I spend 2 days in front of the computer and earn 3000 euro, if the truck is 19000 euro and I spend 5 days to this work, 6 days I will not play. But,*

now, in half an hour since I almost earn the money to buy a truck, it can be played. That's good."

"Çok zor olursa oynamam tabi yani bir süre sonra oynamam..... Basit değil ama kolay yani oyun basit olmamalı ama kolay oynanabilir olmalı..... Mesela bilgisayar başında 2 gün harcayıp 3000 euro kazanırsam ben, kamyon da 19000 euro olsa ben 5 gün harcayacaksam bu işe 6 gün harcayacaksam oynamam. Ama şimdi hani yarım saatte falan hemen hemen kamyon alacak parayı kazandığım için oynanabilir. Bu iyi olmuş."

Curiosity: According to Michael, curiosity was one of the most important motivational elements in the game. He believed that generally curiosity increased the players' motivation towards the game. When they stopped wondering, they quitted the game in his belief. Due to his special interest, the main thing he wondered was the realism of the game. He analyzed how realistic the game was. Thus, he analyzed the design of the game such as its elements, rules etc. He wanted to see how vehicles, equipment processes were simulated in the game. Moreover, he searched for whether he could crush the other workers simulated in mine in the game or whether he could break the vehicles by making accidents etc. in order to assess the realism of the game. After his analysis on the design of the game, he searched for the activities. He wondered how he could perform the activities such as hauling, blasting in the game environment and whether they were realistic. He explained;

"I try to earn money so that I can buy something... People become curious of course about what happens in there, what happens in here, how they are doing... for example, whether I have any effect on the men in there, whether I can crush them, such kind of staff.... How much affect do we have on game, how detailed the game is, how realistic it is ... I was curious about whether I can do only the things it says or whether I can also add something."

"Para kazanayım da bir şey alayım diye uğraştım... İnsan meraklanıyor tabi orada ne olacak şurada ne olacak, nasıl yapılacak diye... Mesela oradaki adamları bir etkim var mı ezebiliyor muyum yani o tarz şeyler.... Ne kadar oyuna etkimiz var oyun ne kadar ayrıntılı, ne kadar gerçekçi.... Sadece dediği şeyleri mi yapabiliyorum yoksa kendimde bir şeyler ekleyebiliyor muyum, onu merak ettim."

Realism in Design: Finally, Michael stated that realism in the game was the main motivational element that forced him to continue to play any game. He told that he gave special attention on the realism and liked to play highly realistic games. He said that if the game was not realistic, he became demotivated to play. For him, the main element that increased the realism of any game was the details that the designers considered. He sought details in the game environment and became motivated when he saw details in the design. However, the game used in this study was not highly detailed as much as the ones he played according to Michael and this decreased his motivation to play. For example, he stated that mine design in the game was realistic and motivated him to play. However, the vehicles and equipment were not simulated in detail. According to him, more details should be added to the games. He believed;

> *"For me, the important thing is reality. I seek this in every game. This can be supplied by details. The more details, the more realistic it is. In here, some parts were good, for example the mine design etc. But, in some parts, there were problems, for example in vehicles..... Sometimes, they consider a tiny detail, that detail attaches you to the game.*

> *"Benim için en önemli şey gerçekçilik. Bütün oyunlarda bunu ararım. Bunu da detay sağlar. Ne kadar detaylıysa o kadar gerçekçi olur. Burada bazı yerler iyiydi, mesela maden dizaynı falan. Ama bazı yerlerde sorunlar vardı, mesela araçlarda.... Bazen ufak bir detayı düşünürler, o detay seni oyuna bağlar"*

4.3.3.3 Opinions of David about Motivational Elements in Simulation Games Used in this Study

David listed five main motivational elements which were control, challenge, curiosty, missions and field of study.

Control: David said that control was motivational element that kept him to play the game. David liked to play the game and he focused on success while he was playing. Being successful by his own efforts made him to be proud of what he was accomplished. Thus, he liked to be in the saddle and control everything in a way in order to be successful. He stated that game allowed them to control everything and this motivated him to continue to play the game. He said;

"Everything is under your control… I could change the view angle of the camera. Besides, it has to be like that, I should control everything. I should do whatever I want to do so when I succeed, I can say I do. Otherwise, it bores me, I cannot play. Just I cannot control something and be unsuccessful because of that, I cannot stand, I will go nuts."

"Her şey kendi kontrolünde… Zaten böyle olması gerekir, her şeyi zaten benim kontrol edebilmeliyim. Ben istediğimi yapabilmeliyim ki başardığımda ben yaptım diyeyim. Yoksa sıkar beni, oynayamam. Hele bir şeyi kontrol edemeyeceğim, o yüzden başarısız olacağım dayanamam, kafayı yerim."

Challenge: David also listed challenge as motivational element in the game. He liked to be challenged in any game. He said that in the game environment he saw challenge as something he had to overcome no matter how long it took. Thus, he could not quit the game before overcoming that challenge. Challenge made him more ambitious to success. It made him to work harder. When he overcame that challenge, he felt sense of achievement. Moreover, he said that seeing the improvements on his performance also increased his motivation him to play. When he recognized that he could do the things which had challenged him before, this progress made him happy and motivated him to continue to play. He said;

"No, No. No way, I cannot quit any game. I do that in any case, that needs to be done for me… When I cannot do something, I become more ambitious about how it can be done…. Especially, later when you start to do the things easily that challenged you before, I am pleased "

"Hayır hayır. Katiyen ben bırakmam hiçbir oyunu. Onu yapacağım ne olursa olsun o benim için yapılmak zorunda…. Bir şey yapamadın mı ya bu nasıl olacak diye daha fazla bir hırslanıyorum…. Hele ilk başta zorlayan şeyleri sonradan rahat yapabilmeye başlayınca hoşuma bile gidiyor. "

Curiosity: David said that curiosity affected her motivation. His curiosity towards the design and aims of the game increased his motivation to play. The first thing that aroused his curiosity was the design of the game. He analyzed the environment, the vehicles and equipment in order to satisfy his curiosity. He wanted to see how they were simulated. Thus, he continued to meet the demand of the

customer in order to earn money and buy new vehicles and equipment. Moreover, he kept playing the game in order to see the next level of the game. He was curious about what were offered, what changed in the later levels of the game. Then, the activities took his attention in the game. He wanted to see the activities such as blasting, hauling in the game. He played the game to see all the activities in quarrying. According to him;

> *"I examined the equipment, vehicles. I looked at what there was, what I could buy. Probably you saw, as soon as I earned money, I looked at the equipment, I did shopping immediately…. Of course, I was curious about how they made it, how I could use. What else, hmm, I wondered blasting, transporting etc., I wondered how they were done, they took my attention… I wondered the next mine, how they designed it."*

> *"Ekipmanları, araçları falan inceledim, neler var ben neleri alabiliyorum diye baktım. Görmüşsünüzdür, para kazanır kazanmaz ekipmanlara baktım, alışveriş yaptım hemen… Tabi nasıl yapmışlar nasıl kullanacağım merak ettim. Başka hmmm, yaa işte acaba patlatma, taşıma falan onları merak ettim nasıl yapılıyor diye, ilgimi çekti benim… Bir sonraki ocağı merak ettim, nasıl dizayn etmişler."*

Missions: David stated that missions had effect on his motivation. He liked to be given mission in the game. As written above, David wanted to work as a mining engineer in the future. He said that missions made him feel that he really worked in mine. He put himself in the place of the avatar and acted as he owned the quarry. He assessed the missions by comparing how much he needed to produce and the money he was offered. Based on his assessments, he decided to accept the mission or not. He said that completing the missions and earning money motivated him to play the game. He tried to earn money as quick as he could since the money allowed him to buy whatever he wanted such as new vehicles etc. He said;

> *"It is nice to earn money. The demands are come to you; you earn money by meeting them. In real life it is the same. I always look the money and the demand in order to earn money… By earning money, you buy new things. People would desire to win money consistently to also buy this or that etc."*

> *"Güzel tabi para kazanmak. Sana talepler geliyor, yaptıkça para kazanıyorsun. Gerçek hayatta da böyle. Ben hep para ve üretim miktarına baktım para kazanabilmek için… Kazandıkça yeni şeyler*

alabiliyorsun… Sürekli para kazanma isteği olur insanın şunu da alayım ya bunu da alayım falan diye."

Field of Study: David wanted to work as a mining engineer in the future. Thus, he sought opportunity that might help him to be a good mine engineer. He said that the game took his attention and motivated him to play due to its relevance with his department. For him, the game illustrated how his life might be in the future. When he was playing the game, he put himself in the place of the avatar. He considered what he might do if he had owned that quarry in real life and acted in that way while he was playing. According to him;

> *"I like its relevance with the department. You see there, the men did something in there. Your future comes into your mind, I for example I will also be a mine engineer. You start to think, if I own that quarry, I will also do this, that."*

> *"Bölümle alakalı olması hoşuma gitti. Orayı görüyorsun adamlar orada bir şeyler yapmışlar. Geleceğin geliyor aklına, ben mesela ben de madenci olacağım. Düşünmeye başlıyorsun, bu ocak benim olsa bende şöyle yaparım böyle yaparım."*

4.3.4 Suggestions to Improve the Effectiveness of Educational Simulation Game Used in this Study (Research Question 4)

Table 15 shows the suggestions of gamer participants to increase the effectiveness of the game used in this study. All three gamer participants suggested that the game should include more detailed technical information and should allow players to growth their character. Moreover, Claire suggested that the game should provide guidance and feedback whereas David only wanted to be given feedback related with his performance and actions. Claire and Michael wanted to be given multi-player option and variety of vehicles and equipment and Michael and David emphasized the importance saving option and variety of missions in the game. Finally, Michael suggested that players should be given full control and David thought that severe pusihment should be given.

Table 15 *Suggestions of Gamer Participants to Improve the Effectiveness of Educational Simulation Game Used in this Study*

Claire	Michael	David
Detailed Technical Information	Detailed Technical Information	Detailed Technical Information
Character Growth Guidance and Feedback	Character Growth	Character Growth Feedback
Multiplayer Option	Multiplayer Option	
Variety of Vehicles & Equipment	Variety of Vehicles & Equipment	
	Saving Option	Saving Option
	Variety of Missions	Variety of Missions
		Severe Punishment

4.3.4.1 Suggestions of Claire to Improve the Effectiveness of Educational Simulation Game Used in this Study

Claire gave several suggestions to increase the effectiveness of the game used in this study. Detailed technical information, character growth, guidance and feedback, multiplayer option, variety of vehicles and equipment were the major themes she discussed.

Detailed Technical Information: Claire complained about limited technical information in the game and suggested that the game should provide more detailed technical information to the students. She stated that if it gave more information to the students and asked them to apply them; they would learn the content better. Thus the effectiveness of the game would be increased. According to her;

> "*If there were technical points of information, if it gave information etc., it would be nice… In some place, that information may be given, in that gravel for example. What gravel was, what it was used for or how much it was for example we produced 1 tons, how much we could use from them etc. It could give those…. It will be nice that if there is an engineer who walks around and says them what they do, the technical information I said could be given by this engineer with bubbles coming from the month of him.*"

> "*Teknik açıdan bir şeyler olsaydı, bilgi verseydi falan daha güzel olabilirdi… Bazı yerlerde o bilgileri verebilirdi o gravel da mesela.*"

*Gravel ın ne olduğunu ne işe yaradığını falan ya da bu ne kadar mesela
1 ton çıkarttık onun ne kadarını kullanabildik falan onları
verebilirdi..... Ortada dolaşan bir mühendis olup onların hepsine ne
yapacağını söylese güzel olabilir, bu dediğim teknik bilgiyi mühendisin
ağzından baloncuk çıkarak falan verebilirdi."*

Character Growth: Claire also gave advice related with character growth in
order to make the game more educative. She recommended that the game should
allow character growth. She stated that it was nice to start from the beginning and
doing everything alone. By this, students could see different roles in the mine. But
for her, after a while the character should be promoted to the boss position and
started to give orders to other workers simulated in the game. Moreover, she added
that as a boss, she should be able to decide to expand the quarry or not and how she
should expand it. According to her, the game became more educative by this method
because;

> *"In Sims… it has wide frame, but in this game there are not so
> many things. In the simplest term, I could grow in here, at the
> beginning I can be worker and do everything by myself, than I
> could be chief and boss etc. Thus, I could see who do what. Then,
> I could give orders and when the production is decreased, I could
> expand the mine. I can expand the house in Sims, in here I could
> expand the mine, this could be for example. It would be funnier…
> would be more educative."*

> *"Sims de … geniş bir çerçevesi var da bu oyunda o kadar şey yok. Ya
> en basitinden ben büyüyebilirdim burada, başta işçi olup her şeyi
> kendim yapıp sonra şef patron falan olabilirdim. Hani kim neler
> yapıyor görürdüm böylece. Daha sonra emirler verip işte üretim
> azaldığı zaman madeni genişletebilirdim. Sims de evi
> genişletebiliyorum, burada da madeni genişletebilirdim, bu olabilirdi
> mesela. Daha zevkli olurdu… Daha öğretici olurdu."*

Guidance and Feedback: Claire complained about guidance and feedback
mechanism in the game environment. She suggested that guidance and feedback
should be given to the players in detail. She stated that she had problems to
remember the information related with quarrying. Thus, she could not be sure while
she was deciding and doing anything in the game environment. In those situations,
she sought explicit guidance and feedback in the game environment. For her, if the

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game provided hints, tips and feedback explicitly to the students, they might be certain whether they did the best choice or not. By this method, she believed that the game become more educative. She said;

> "It could be more difficult actually, but at the corners it could give hints for example…. There could be technical information at the corners… Because, I do not remember things about quarrying much… I think it would be funnier to know what you do why you do, it is better I think."

> "Çok zor olabilir aslında ama kenarda hintler falan verebilir mesela… Teknik bilgiler olabilirdi kenarlarda… Çünkü hatırlamıyorum quarring ile ilgili bir şey….. Bence eğlenceli olur ya neyi ne için yaptığını bilmek daha iyi bence."

Multiplayer Option: Claire aslo gave suggestion related with the player options in the game. She recommended that the game should include multi-player option. She stated that playing alone and doing everything by themselves might make the students get bored. Moreover, like her situation, if the player did not remember the content or had problems in decisions, they might be frustrated and demotivated towards the game. She believes that if the game was played with a friend, they could work together to finish the missions. This not only increased the pace of the game, but also increased their motivation to play. Moreover, she believed that playing with the friends could promote learning from each other. They could discuss before giving any decisions so that they could come up with the best idea together and expand their knowledge. According to her;

> "It could be multiple player indeed, for example while somebody crushes in there, the other can use loader…… I think multiple player is better because in this way constantly there has to be process, for example you crush something, you leave it there than you get off from that, get on the other, collect, load. All of them are happening separately but if all of them were done together, it would be nice…. Also, we could discuss how we could do, what we could do each other, maybe we learn something from each other, it would be nice."

> "Çok kullanıcılı olabilir aslında mesela biri kırarken orada diğeri loader ı kullanır…. Bence çok kullanıcılı daha iyi çünkü böyle sürekli bir işlem olması gerekiyor mesela bir şeyleri kırıyorsun orada bırakıyorsun sonra ondan in öbürüne bin topla yükle. Hepsi ayrı ayrı

oluyor ama hepsi aynı anda olsa bence daha güzel olabilir…. Hem nasıl yapabiliriz, ne yapabiliriz tartışabilirdik birbirimizle, birbirimizden belki bir şeyler öğrenirdik, daha iyi olabilirdi.”

Variety of Vehicles & Equipment: The final suggestion given by the Claire was related with vehicles and equipment. For her, the game should provide variety of vehicles and equipment to the players. She stated that the game gave limited vehicles such as one kind of truck and wheel loader. But, in reality there were wheel loaders and trucks in different size for different purposes. She believed that if the game gave several options about the types of vehicles, the students could understand them more easily. She stated that since one of their duties was the increment of production in mine and they could supply it by using several vehicles, they had to know them in detail. They had to know which kind of vehicles and equipment could help them to increase the production. Thus, she wanted to be given several vehicles and equipment in different sizes. She suggested;

> *"There could be variation, for example to me only one kind of truck and wheel loader was given. There were problems about them, the truck was too big, the wheel loader was small etc…. Eventually, when we design mine, we also decide how the vehicles should be. We make calculations about how the production can be increased; we decide how the vehicles should be used. If they are in different sizes, we can see them, how they are working, how they can be used etc.”*

> *"Çeşitlilik olabilirdi, mesela bana sadece bir çeşit kamyon ve kepçe verilmiş. Onlarda da problemler vardı mesela işte boyutları sorunluydu, kamyon çok büyüktü, kepçe küçüktü falan…. Sonuçta biz maden dizayn ederken işte araçlar nasıl olmalı ona da karar veriyoruz. İşte üretim nasıl artabilir onunla ilgili hesaplar yapıyoruz, hangi araçlar kullanılmalı ona karar veriyoruz. Eğer değişik boyutlarda olursa onlar, biz de onları görmüş oluruz, nasıl çalışıyorlar, nasıl kullanılabilirler falan.”*

4.3.4.2 Suggestions of Michael to Improve the Effectiveness of Educational Simulation Game Used in this Study

Michael gave several suggestions which were detailed technical information, character growth, multi-player option, variety of vehicles and equipment, saving option, variety of missions and full control.

Detailed Technical Information: Michel believed that realistic simulation games were a great opportunity for him to test his knowledge and hypothesis. Thus, he wanted to use more technical information in the game. He suggested that the game could be designed in a way that students were provided more technical information and requested to apply them. For instance, they might be asked to prepare their own dynamite. They could select the ingredients and decide the amount of them. After, they could explode the dynamite to see their effects. This helped them to understand and remember the information easily in their future. He suggested;

> *"There should be real technical information, for example when I do blasting, I should be informed what the ingredients of dynamites are, so that I can choose. Even, I should do the dynamites; I should look at what happens when I put something. For instance, if I make a mistake, it should warn me."*

> *"Gerçek teknik bilgiler olmalı mesela patlatma yaparken ben bilgilenebileyim dinamitlerin içinde ne var, ona göre ben seçeyim. Hatta dinamitleri ben yapayım, bir şeyi koyunca ne oluyor diye bakayım. Mesela yanlış olursa da beni uyarsın."*

Character Growth: Michael also complained the lack of character growth in the game. He advised that the game should allow the players to growth their character in the game environment. He said that it was good idea to start from the beginning in the game and did everything yourself by assigning different roles. However, he added that after a certain time, doing everything made the players get bored. Moreover, the player did not focus on the important things since they just focused on the tasks they had to do to earn money in the game environment. He said that in reality, they observed the events and gave duties to the workers in order to increase the efficiency of the mine. He suggested that this approach could be applied to the game environment. After a certain time, the players could be assigned to manager position and started to give orders to the workers simulated in the game. Moreover, they might be allowed to own more than one mine and compete with other managers in different mines. He added that this not only increased the fun of the game and motivation of the players but also helped the players to practice how they could arrange labor force. He recommended;

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"For example, my budget is definite, eventually the number of workers I can hire is definite, for example in a mission for example, if it says 3 workers can do this, for example I have 3 workers, I will send them to there. I have to the duties left... I have to facilitate the coordination for being chief... This, not only increase the fun of the game, they enjoy more while they are playing, but also you learn to arrange the labor force, at least you practice it."

"Mesela bütçem belli sonuçta tutabileceğim işçi sayısı belli mesela bir görevde mesela 3 işçi yapabilir diyorsa mesela benim 3 tane işçim vardır 3 işçiyi oraya yollarım. Kalan tüm görevleri benim yapmam lazım.. Koordinasyonu ben sağlamalıyım amir olarak.... Bu hem oyunu daha zevkli hale getirir, daha çok eğlenirler oynarken, hem iş gücünü ayarlamayı da öğrenirsin, en azından pratik yapmış olursun."

Multiplayer Option: Michael gave suggestion about the player option of the game. He believed that the game should offer multiplayer option to the players. He said that playing the games with friends could help the students to expand their knowledge. He stated that students could learn from each other by discussing together while they were playing the games. He also added that by multiplayer option, if the game was onine, students in mining engineering department around the world could play together. They could share their experiences and knowledge. Thus, he believed that the educational value of the game would be increased. He believed;

"It would be better, multiplayer is always better, it becomes more realistic.... Otherwise, for example, you can learn something from others, he did something and says that "look, do this like this, like that", it can be learnt by that..... For example, if we assume that I played other people all over the world, there can be information exchange."

"Daha güzel olur, multiplayer her zaman iyidir, daha bir gerçekçi olur... Öbür türlü mesela birilerinden bir şey öğrenebilirsiniz o bir şey yapmıştır der "bak şunu şöyle yap böyle yap", öyle öğrenilebilir.... Mesela dünyadaki başka insanlarla da gayet oynadığımı düşünürsek bilgi alış verişi olur."

Vehicles and Equipment: Michael also gave advice related with the vehicles and equipment simulated in the game. He advised that there should be variety of vehicles and equipment in the game. According to him, the new vehicles and

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equipment took the attention of the player and motivated them to play the game. In addition; he stated that in reality, everyone could buy any vehicle and equipment. Thus, he suggested that all the equipment and vehicles used in mine should be added to market in the game. Students should see all of them and buy what they wanted. This helped them to see all the vehicles and equipment used in the mine and learn which one was used in where. Finally, he suggested that the brand of the vehicles could be given. Students could select the brand and saw their performance. According to him, these methods would increase the motivation of the students as well as the realism and the educative value of the game. He suggested;

> *"In these games, it is like a rule, you create a need to buy new things so that a person continues to play.... It should be whether it is not used in that mine, I look, say aa this is useless. I see which do what. In real life, is not it the same, I can buy what I want... Then, the brands can be added, I do not know, for example Chinese and English goods are added. Chinese goods would be cheaper but their performance would be less, you look, if you do not like, you buy English goods etc.... these kinds of things will increase the motivation exactly.... Of course, the reality will be increase, it becomes more educative."*

> *"Bu oyunlarda kural gibi bir şeydir yeni bir şey alma ihtiyacı doğuracaksınız ki oyuna devam etsin kişi... O ocakta kullanılmasa da olmalı, ben bakarım aa bu işe yaramıyormuş derim. Hangisi ne yapıyor görmüş olurum. Gerçek hayatta da öyle değil mi istediğimi alabilirim.... Sonra markalar eklenebilir, ne bileyim mesela Çin malı ve İngiliz malı eklenir. Çin malı daha ucuz olur ama performansı az olur, sen de bakarsın, beğenmezsen İngiliz malını alırsın falan.... Böyle şeyler motivasyonu artırır kesinlikle... Tabi gerçekçiliği de artar, daha eğitici olur. "*

Saving Option: Michael also gave recommendation related with saving option of the game. He said that the game provided test environment to the students. They could test their hypothesis or knowledge by altering the environment. But he added that students should be encouraged to test their hypothesis. For him, this could be supplied by providing saving option to the players. By saving option, they could test what they wanted, could see the results and return back to the specific point. In his belief, this would increase the effectiveness of the game. He believed;

"For example, I think that I make a mistake at some point; I should go back and continue. I should have another chance. There is no saving option, I buy equipment and let's say I buy wrong equipment, what will I do at that time? I cannot go back. At that time, I cannot do whatever I want. I try not to do any mistake. In here, I should do whatever I want without fear."

"Mesela bir şeyde hata yaptığımı düşünüyorum, geri dönüp öyle devam edebileyim. Bir şansım daha olmalı. Burada save yok ben bir ekipman aldım, diyelim yanlış ekipman aldım ne yapacağım o zaman? Geri dönemem. O zaman istediğimi yapamam ki. Hata yapmamak için uğraşırım. Burada istediğimi korkmadan yapabilmeliyim."

Variety of Missions: Michael gave several suggestions related with the missions in the game. He stated that the variety of missions should be added in order to increase the effectiveness of the game. According to him, the missions should be carried out in detailed. He complained that the missions in the game were so simple, they were just designed for one aim and nothing happened. He said that an order and the price were appeared on the screen and he decided to accept it or not. He just produced rocks in order to meet the demand of the customers, nothing else were occurred. In his belief, things were not so simple in reality. In real life, they did not deal with only one thing, sometimes they had to do many tasks at the same time. These should be reflected in the game environment too. He told;

"As I said, there should be extra duties. I should not stick in one duty; I should choose the mission myself…. Instead of the game leads me, I should lead the game. One mission, one type, it gives me, I do something….. As I said, it should be in detailed. I have only one purpose while doing the missions. At once, there should be a few things to deal with at the background or the things that aroused apart from me. Everything is up to me in here; I do something so that something is happened."

"Dediğim gibi ekstra görevler olmalı. Ben bir görevde takılıp kalmamalıyım ben kendim seçmeliyim görevi…. Oyunun beni yönlendirmesindense ben oyunu kendim yönlendirmeliyim. Tek görev tek düze o kendisi veriyor bana ben bir şeyler yapıyorum … Dediğim gibi ayrıntılı olması lazım….. Tek amacım var burada görevleri yaparken. Bir anda bir kaç şey daha olması lazım arka tarafta uğraşılan ya da benim dışımda gelişen. Her şey bana bağlı burada her şey ben bir şey yapacağım ki bir şey olacak."

To increase the variety of missions, he gave some suggestions. For instance, he suggested that multiple missions could be appeared at the same time and he could select which he wanted. In addition, the price of the stones might be increased or decreased in the market so he could make a profit or lose. Or, the game provided an environment where he could store the stones and sold them after. In addition, he suggested that real cases could be shown to the players. He stated that there were landslides occurred in open cast coal mine. These could be given to the players and wanted them to give advice about what to do to overcome or prevent these kinds of things. They could earn money based on their advice. These kinds of thing would contribute the realism and educational value of the game according to him. He suggested;

> *"Something should be happened at the background, for example the environment may change, the price of something may decreased, instead of selling them, I should stock them. May be they increase in the value in the future, that time I sell them for example. All the time the mission is given, the mission should not be given in a short time so, I stock something. When the mission is given, I will be ready and give it directly. …… Real cases can be given. You become an expert… you give advice, earn money."*

> *"Arkada bir şeyler olsun mesela ortam değişsin bir şeylerin fiyatı düşsün ben satmak yerine stok yapayım. Belki ileride değerlenir diye o zaman satayım onları mesela. Hep görev geliyor, görev gelmesin kısa zamanda da ben bir şeyleri depolayım. Görev gelince bende hazır olurum direk veririm…. Gerçek olaylar verilebilir. Sen bilirkişi olursun… tavsiye verirsin, para kazanırsın."*

Control: Michael stated that he liked to have full control on the game environment so that he gave several suggestions related with control in the game. He said that he wanted to control everything in the game environment but the game restricted him. He believed that the game provided an opportunity where he could conduct experiments. For this reason, he stated that the game should allow everything to the players. The players should be able to find out what they were curious about. For instance, he stated that students should be able to blast the bench and observe what happened instead of being prevented. He believed that this would increase the effectiveness of the game. According to him;

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"I should control everything…. That way, it becomes more realistic, for example in real life, if I want, I can drill the bench, for that reason I should be able to drill in here… I should do whatever I wonder, I should not be restricted."

"Her şeyi kontrol edebilmeliyim… Öyle daha gerçekçi olur, mesela gerçek hayatta istesem bench i delebilirim, o yüzden burada da delebilmeliyim… Merak ettiğim her şeyi yapabilmeliyim, kısıtlanmamalıyım."

Moreover, he stated that the players should be able to control all the workers in the game environment, not only one avatar. This also would increase the motivation of the players and represent more realistic environment. He told that in reality, they were able to give orders to workers so this also should be reflected in the game. By this, he stated that they could accept and do more than one mission at a time and this increased the reality and the effectiveness of the game. He believed that by this method students could see how their future would be. He said;

"In there, I should control everyone not only one person….. Let's say I should choose one from the missions. In the future, I should take two missions at the same time, have one worker do one mission, do the other myself; I also should control it myself."

"Oradaki bütün herkesi kontrol edebilmeliyim sadece bir kişiyi değil… Atıyorum birçok görev arasından ben kendim seçmeliyim. İleride iki tane görevi aynı anda alıp birini işçiye yaptırıp diğerini kendim yapmalıyım, onun kontrolünü de ben yapmalıyım."

4.3.4.3 Suggestions of David to Improve the Effectiveness of Educational Simulation Game Used in this Study

Based on his experience, David gave some suggestions in order to increase the effectiveness of the game used in this study. Detailed technical information, character growth, feedback, saving option and variety of missions and severe punishment were the main suggestions given by him.

Detailed Technical Information: David said that he had some problems to concentrate on the books while he was studying. His attention was easily distracted while he was doing bored things such as studying from the books. On the other hand, his concentarion span was increased while he was doing fun things. He believed that game was fun way to learn unlike the books so; he could easily concentrate on the

games. Thus, he wanted to gain more detailed technical information. He said that game showed what happened in quarrying. But, in addition to them, a mine engineer had to do many things in quarrying such as some specific calculation. If they covered most of the technical information, they could memorize them in the future more easily and the game became more educative. He believed;

> *"It should be developed, for example, it should measure the level of knowledge. There should be more detailed information…. Blasting could be more detailed for example. For example, I do not know, how much dynamite should be thrown, what should be distance, which patterns should be applied, those can be added in detail."*

> *"Geliştirmeli mesela bilgi seviyesini ölçmeli… Çok fazla ayrıntılı bilgi olmalı… Patlatma daha ayrıntılı olabilirdi mesela. Mesela ne bileyim ne kadar dinamit atılmalı aradaki mesafe ne olsun hangi dizayn kullanılmalı, onlar ayrıntılı olarak eklenebilir."*

Character Growth: David criticized the lack of character growth in the game environment. He wanted to growth his character in the game. He said that in reality, a mine engineer was kind of manager who gave orders to the workers and operators in order to increase the efficiency of the mine. Thus, later on the game, he wanted to be a manager and gave orders to the workers and operators instead of doing everything by him. He said that at the beginning of the game, doing everything by him taught a lot. This approach not only taught him how to play the game, but also helped him to see the quarry in the eyes of the workers and operators. This helped him to understand the quarrying better. But, he said that doing everything by himself made the game boring after a while. He added that if the game allowed him to be manager, this not only increased the motivation of the players but also showed what a mine engineer really did in mine environment. The players could focus on important subjects like increasing the efficiency of the quarrying instead of focusing how to drive the vehicles. He said;

> *"It starts from the zero; I should do everything by myself like this at the beginning. This is nice, you come from the zero, the person gets excited when he buys new vehicles etc… You see who do what… But after, I should grow, give orders to the workers. That point, instead of using the vehicles, I try to expand the quarry… I should not deal with tiny things."*

"Sıfırdan başlasın, her şeyi yine böyle kendim yapayım en başta. Böyle güzel oluyor, sıfırdan bir yere geliyorsun, insan heyecanlanıyor, yeni araçlar falan aldıkça…. Kim ne yapar görüyorsun….Ama sonra ben ilerleyeyim, işçilere emir vereyim. Artık orada araç kullanmak için değil de işte madeni genişletmek için falan uğraşayım… Küçük şeylerle uğraşmayayım."

Feedback: David gave recommendation about the feedback mechanism in the game. He advised that the game should provide immediate written feedback in order to increase the effectiveness of the game. He said that seeing the consequences or preventing to make vital mistakes might not be educative as desired. For him, the students might not understand or overestimate these actions. However, he believed that if the game gave written explicit feedback in the game environment, students might understand the important points better. He suggested;

"For example, when someone gives a wrong decision, the game should make it clear. For example, someone do blasting…. If he blasts the bench, the upper part will be destroyed; the game should make it clear… It should say turn back etc… It could say mission failed."

"Mesela bir yanlış karar verdiğinde hani onu açıkça belli etmeli oyun. Mesela biri patlatma yapıyor …. benchi patlatmaya çalışırsa yukarısı mahvolacak bunu belirtmeli oyun…. Geri dön falan demeli…. Mission failed diyebilir."

Saving Option: Another suggestion of David was related with saving option. He said that he used trial and error approach in the game. This helped him to identify the best method working in that situation. But, he complained that the game did not support this approach. According to him, game could encourage the players to use this approach by providing saving option but the game did not allow the players to save their progress in the game environment. This might make the player to be scared of using trial and error approach. For him, this approach was the best way to understand the logic behind the theorems and game had potentials to provide this opportunity to the players. If the game offered saving options to the players, students were encouraged to use this approach. Thus, in his belief the effectiveness of the game would be increased. He recommended;

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"Of course trial and error, if the man goes down from there, I should not start from the beginning. In every game it is the same.... In here, if you save, you can act more confortably, you try what is done and how more confortably. In that way, it is understood more easily what is what and how it is done; you undersand the logic of some of the things. Otherwise, people may be scared. For example, if I lost everthing I earn, I would lose my mind, I cannot risk for that reason."

"Tabi deneme yanılma adam oradan aşağıya giderse baştan başlamayayım. Her oyun da öyledir.... Burada da kaydedebilsen daha rahat hareket edersin, daha rahat denersin ne nasıl yapılır. Öyle daha kolay anlaşılır, ne nedir nasıl yapılır, mantığını anlarsın bazı şeylerin. Öbür türlü korkabilir insan. Mesela ben bütün kazandığımı kaybetsem kafayı yerdim, riske atamam o yüzden."

Variety of Missions: David also gave suggestion about the missions in the game. He suggested that the missions should be varied. He said that doing the similar missions over and over made the players get bored after a while. He advised that the missions should be varied after a certain time. For instance, new duties could be given to the players such as expanding the quarry. Or, the player could give consultancy in order to earn money. Instead of missions, the problems could be appeared on the screen with options. The player read the problem and chose the best method to overcome it. He might be given money based on his advices. David said that this would increase the motivation of the players and also would increase their knowledge related with quarrying. He said;

"Something should be done related with the missions, I think. This way, there is not much continuity of the game. Doing the same things makes you bored... New things should be added, for example we can expand the quarry or a problem is appeared on the screen, someone else wants advices, you give the advice and earn money."

"Görevlerle ilgili bir şeyler yapılmalı bence. Bu şekilde çok devamlılığı yok oyunun. Hep aynı şeyleri yapmak sıkıyor..... Yeni şeyler eklenmeli, mesela madeni genişletebiliriz, ya da ekranda bir sorun çıkar başka biri tavsiye istiyordur, tavsiye verirsin para kazanırsın."

Severe Punishment: David complained about punishment in the game and suggested that severe punishment should be given to the players in the game. He said

that severe punishment forced the players to be careful in the mine. Moreover, it showed the importance of equipment failure. He explained that the equipment and vehicles used in the mine were much expensive. In addition, the repairment of them cost much. Thus, people in mine had to use this vehicles and equipment carefully. He believed that severe punishment could show the importance of being carefull in mine environment to the players. He suggested;

> *"I had a car accident, nothing much happened .... These are expensive vehicles; the slightest thing can cause big money. You cannot drive as the way you want..... That would not be educational."*

> *"Araçla kaza geçiriyorum çok bir şey olmuyor.... Bunlar pahalı araçlar, en ufak şey büyük paralara sebep olabilir. Öyle istediğin süremezsin ki...... Eğitici olmaz."*

4.4 Structural description of the experiences of Gamer Players

In Table 16, the constructs that shape the structural descriptions of each gamer participant are showed. It is seen that Kim sought information about quarrying but Michael and David focused on chances to gain and apply more detailed technical information. Moreover, Claire assessed her performance and her activities while Michale generally assessed the acitvities and environment and David assessed the activities as well as the missions given by the game. Claire tested only her hypothesis whereas Michael and David tested their hypothesis and rules of the game. Finally, it is seen that all the participants made decisions on activities but only David was affected by emotional changes.

Table 16 *The constructs that shape the structural descriptions of each of Gamer Participants*

Claire	Michael	David
Information Seeking about Quarrying	Information Seeking about Quarrying	Information Seeking about Quarrying
Assessment of Her Performance and Her Activities	Assessment of the Activities and Environment	Assessment of the Activities and Missions
Testing Her Hypothesis	Testing His Hypothesis and Rules of The Game	Testing His Hypothesis and Rules of the Game
Decision Making on Activities	Decision Making on Activities	Decision Making on Activities
		Emotional Changes

4.4.1 Structural description of Claire's experiences

The structural description of Claire's experience included four main constructs 1) *information seeking about quarry*, 2) *assessment of her performance and her activities* 3) *testing her hypothesis* and 4) *decision making on activities*.

The first constructs that shaped Claire's experience was *the information seeking about quarry*. During the game playing, she needed and sought information regarding with quarrying since she did not trust her knowledge. She had problems to remember what she was learnt so she searched for guidance and tips that could help her to remember and be sure of her decisions. In addition, her needs to visual materials to learn and her beliefs that game could fulfill this need forced her to seek more detailed technical information. She searched for opportunity which she gained or used more detailed technical information related with quarrying.

The second construct was the *assessment of her performance and her activities*. During the game, she assessed all the activities in the game environment and her performance. She assessed them in order to determine what she should do and whether she gave the best decisions or not. Moreover, she was tidy and obedient person. Since she gave great importance on rules and orders in her life, she assessed her actions to control whether she obeyed the rules or she kept the mine neat.

Thirdly, Claire built and *tested her hypothesis* during the game playing in order to be successful. Based on her assessments in the game environment, she built hypothesis and tested them whether they were true. If they were, she kept applying them in all situations. But, if they did not work, she altered them a bit and applied them to see whether it fulfilled her needs in game environment.

The final construct that shaped the experience of Claire was the *decision making*. She gave several decisions while she was playing. She decided what she should do in the game by taking into account her assessments and hypothesis. However, since she had problems related with remembering the information about quarrying, she could not be sure of her decisions. This situation demotivated her while she was playing and caused her to seek for help in the game environment such as hints and tips.

Like the other participants in this study, Claire believed that games should be integrated to the educational settings especially to her department. She thought that students became demotivated and their self-confidence was decreased when they did not understand any topic. But, based on her experiences, she thought that the game could help the students to learn by providing visualization and learning by doing. Thus, she believed that the game could help the students to be motivated towards the course and increased their self-confidence.

4.4.2 Structural description of Michael's experiences

The experiences of Michael consisted of four main constructs which are 1) *assessment of the activities and environment*, 2) *testing his hypothesis and rules of the game* 3) *decision making on activities* and 4) *information seeking about quarrying*. The first construct of Michael's experience was the *assessment of the activities and environment*. He analyzed the environment simulated in the game in order to decide how realistic they were. Michael gave great importance on realism so that he focused even tiny details in the game environment to see whether they were realistic. He changed the angle of the camera and evaluated how much details were considered in the activities. In addition, he analyzed all the activities he or the other workers in the game conducted and evaluated their realism. If he did not satisfy with the realism of the game, he demotivated to play.

Secondly, he *tested his hypothesis and rules of the game* while he was playing. But, he did this in order to evaluate the realism of the game. He sought his boundaries in the game environment, what he was allowed to do. Moreover, he tested what happened when he made any tiny mistake. He tried to find how realistically the game acted when he made anything.

The third construct that shaped his experience was *the decision making on activities*. He gave several decisions based on mainly his curiosity. Michael generally focused on realism of the game and tiny details instead of his success. Thus, he came up with an idea and implemented to see what would happen. Then, he gave decisions whether they were appropriate to reality or not.

Finally, *information seeking about quarrying* could be given as fourth construct that shape his experience. He needed to gain and use more detailed technical information in order to make them more durable and retrieve them quickly when he needed. He believed that game could supply this by simulating realistic cases and asked students to do task or by giving information. Thus, during the game playing, he sought for the chances in which he gained or applied more detailed technical information.

Michael believed that games should be used in his department. He believed that the the realism of the game had huge effect on its educational value so it had to be highly realistic. According to him, game could be seen as a test environment where students aplied their knowledge and satisfied their curiosity. They could conduct many experiences and could expand their knowledge by analyzing the results. So, if the game reacted unrealistically, it may mislead the students and might cause them to make wrong interpretations.

4.4.3 Structural description of David's experiences

The findings of this study reveal that David had five main constructs that shaped his experience. These constructs were 1) *assessment of the activities and missions*, 2) *testing his hypothesis and rules of the game*, 3) *decision making on activities*, 4) *emotional change* and 5) *information seeking about quarrying*

Assessment of the activities and missions in the game was the first construct that shaped the experience of David. During the game playing, he assessed all the

activities carried out in the game. He assessed not only his activities but also the ones that other workers conduct in the game environment to give the right decisions in the game. Moreover, he analyzed the environment in order to fulfill his needs to visual materials to learn. He looked at what was simulated in the game and how. Finally, since he was goal-oriented, he assessed the missions and its price and decided whether it worth or not. His belief that the most important thing in the mining was money and the one thing that nobody could bring back was time forced him to assess whether his efforts in comleting one task worth the price he would earn or not.

Secondly, he *tested his hypothesis and rules of the game*. His desire to be successful forced him to build hypothesis and tested them whether they helped him to achieve his goals. Moreover, he tested the rules of the game for being successful. Since he was ambitious player, he pushed his boundaries and tried to finish the mission and earn the money as quick as he could.

Decision making was the third construct that shaped the experience of David. During the game playing, he gave several decisions on activities by considering his hypothesis and assessments. He decided what he should or should not do. He just focused on the success and took actions immediately.

The fourth constructs that shaped his experience was the *emotional change*. His emotions were rapidly changes while he was playing. He identified himself with the character and behaved as if he owned the quarry in real life. So he was focused on the success no matter how long it took and what it costed. Thus, when he made even a tiny mistake, he got angry and when he succeeded anything, he became happy.

And the final constructs in his experience was *information seeking about quarrying*. He suffered from attention deficit so he had to be active to keep his focus on something. He could not stand to be passive and wait quietly. Thus, during the game playing, he could not stand in the same positions and be silence. He talked himself, he was constantly moving. Even in intro parts in the game, he just looked at and as soon as he got the point, he skipped the introduction part and kept to play the game. Since he suffered from attention deficit, he could not listen to the instructor in the lessons. So, since he was active in the game environment and focused his

attention on the game, he wanted to gain and use more detailed information in order to learn and practice.

David supported the integration of the games into the educational settings. He enjoyed while he was playing games and so he believed that this was also true for most of the students. Thus, he thought that students could get more fun while they were learning from game than traditional materials such as books. In addition, he believed that games could increase the learning by providing visuals and allowing learning by doing.

4.5 Composite Textural Description of Experiences of Participants

In this part, the composite textural description of all non-gamer and gamer participants is given in detail.

4.5.1 Opinions about the Usage of Simulation Games for Education (Research Question 1)

In Table 17, the opinions of both non-gamer and gamer participants about the usage of simulation games for education are given. This study shows that at the beginning of the study both gamer and non-gamer participants had positive opininos related with the integration of games to the educational settings. But it is also seen that gamer participants came up with more benefits compared to non-gamer participants. Visualization, learning by doing, motivation, and fun were the major themes identified from the data obtained by interviews with the participants. In addition to them, the theme K12 level was stated by only one non-gamer participant, Johnson. Despite the possible benefits, it is also seen that participants had concerns about the usage of games. Addiction, underestimation and misleading were the themes mentioned by participants for possible problems the game may bring. It is also found that after attending the study, that the opininos of both gamer and non-gamer participants were changed positively. The themes, visualization, learning by doing, motivation were listed by all the non-gamer and gamer participants. Moreover, the theme self-confidence was shared by four participants and fun was listed by three participants. Addiction was not seen as a problem but underestimatation was told by Kim instead of Manny. Moreover, time management and misleading was also listed by the participants as possible problems.

Table 17 *Opinions of Participants about the Usage of Simulation Games for Education*

Opinions	Non-Gamer Participants	Gamer Participants
Pre-opinions		
Benefits		
Visualization	Kim, Manny	Claire, Michael
Learning by Doing	Kim	Claire, Michael, David
Motivation	Manny	Claire, Michael, David
Fun		David
K12 Level	Johnson	
Problems		
Addiction	Manny	
Underestimation	Claire	
Misleading		Michael
Post Opinions		
Benefits		
Visualization	Kim, Manny, Johnson	Claire, Michael, David
Learning by Doing	Kim, Manny, Johnson	Claire, Michael, David
Motivation	Kim, Manny, Johnson	Claire, Michael, David
Self-Confidence	Manny, Johnson	Claire, Michael
Fun	Manny	Michael, David
Problems		
Underestimation	Kim	
Time Management	Kim	
Misleading		Michael

4.5.1.1 Pre-opinions about the Usage of Simulation Games for Education

At the beginning of the study, all the participants were interviewed in order to reveal their pre-opinions related with the usage of the games in education. All the participants agreed that these kinds of games should be integrated to the educational settings. But when they were asked related with the possible positive effects of these games on students, they mentioned only a few benefits of these games. Moreover, it is seen that gamer participants listed more benefits than non-gamer participants.

Visualization: At the beginning of the study, four participants Kim, Manny, Claire and Michael thought that the game could help students to visualize the processes and concepts they were taught in the department. They pointed out that they had problems related with the visualization. They could not imagine what was explained thus they felt that they did not understand the courses completely.

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According to them, game could fulfill this need. It could visualize the topics of the lessons so that students could understand the contents more easily.

Learning by Doing: All gamer participants, Claire, Michael David and a non-gamer participant Kim also believed that game could provide an environment in which students could learn by doing. They stated that there was a limited chance for them to apply what they learnt. The game could help the students in this way. It could provide an environment in which students altered some variables and analyzed the consequences. This could help the students to understand the content more accurately and recalled the necessary information back in the future.

Motivation: All gamer participants, Claire, Michael and David and a non-gamer participant Manny, thought that games could affect the motivation of the students. They stated that games could increase the motivation of the students towards the courses and even to the department for different reasons. Claire stated that if the students were believed to possible benefits of the game, their motivation towards the game and also the courses would increase. She thought that when the students believed that they would gain important information via the game in the course, they became motivated to game as well as to the course. However, Michael believed an enjoyable game aroused the curiosity of the students so they searched why things happened in that way. Thus, their motivation towards the lectures would be increased. For David, the difficulties in the game would impassion the students and forced them to search ways to overcome those difficulties. Finally, Manny thought that since the game was different than traditional learning materials it would take the attention of the students and motivated them to play.

Fun: A gamer participant, David also thought that game was fun way to learn. He stated studying from traditional materials such as books were boring. But, he believed that most of people liked games, they enjoyed playing. So, according to him, if the games integrated to educational settings, most of people had fun while they were learning from them. In his belief, most of the students would prefer learning from games than learning from traditional materials.

K12 level: From all the participants in this study, only Johnson believed that the game could be used in just K12 level not university level. At the beginning, he

taught that the courses in university were too difficult and university students were too old to learn from the games. Hence, they could not be taught by game. Games could help only the students in K12 level.

Before game play, it is found that only some students had concerns related with the usage of games in the educational settings.

Addiction: At the beginning of the study, Manny had doubt about the integration of simulation games. From all six participants, only she believed that the game could cause addiction. Manny stated that the students may like the game much so they may became addicted to play it. However, the other participants believed that educational games designed for education and they would have limited scope. So, they believed that since these games were designed to teach, students could not be addicted. Instead, they played them for a while then they started to play more excited, high technological commercial games.

Underestimation: Claire had concerns related with underestimation of the games when they used in educational settings. She stated that students might not understand the importance of the game. They might think that they just played games; it was not a big deal. So, when they played, they might not give their attention to game. Thus, they might not gain the information provided by it. The other participants in this study did not think students underestimate the educational games. According to them, university students were conscious students and they would know why they played the game, what it would contribute to them. So, they believed that students gave their attention while they were playing an educational game.

Misleading: Finally, Michael worried that these games might mislead the students if they were not realistic. For him, students accepted everything in the game environment as true since it was used in educational settings. Thus, they would accept even unrealistic events as true. That's why everything must be realistic, according to him. The other participants did not agree with this idea. They stated that university students were conscious so they could estimate the accuracy of the information.

4.5.1.2 Post-opinions about the Usage of Simulation Games for Education

After attending this study, the opinions of participants about the usage of simulation games for education changed in similar ways. It is seen that all the participants mentioned about similar benefits in the interviews.

Visualization: All of non-gamer and gamer participants in this study stated that visualization was one of the most important benefits of these kinds of games. All the participants emphasized the limited usage of visuals in the courses. For this reason, they stated that they faced difficulties to understand the contents of the lessons completely. To overcome this, they tried to find additional materials such as video, pictures to fulfill this need. However, they stated that these materials did not help them in a way they wanted. All of these materials had some drawbacks. For them, game could eliminate all of these drawbacks. Students could observe the events from different angles in three dimensions. For all of these reasons, they thought that these games should be integrated to the educational settings.

Learning by Doing: All of non-gamer and gamer participants in this study also thought that game could allow students to learn by doing. They emphasized that one of the best way to learn something was doing it. This helped the students to understand and remember it more easily in the future. But, they had limited opportunity to apply what they were learning. According to them, game could fulfill this need of the students. It created an environment in which students could do experiments. They could apply what they know or wonder, and saw the consequences. By the help of the game, they believed students could practice the contents of their lessons more effectively.

Motivation: Again all of non-gamer and gamer participants believed that game could affect the motivation of the students. According to them, it could increase students' motivation towards the lectures. But they gave different reasons why the game could increase the motivation. Kim believed that games could show students their knowledge level, such as what they knew and what they needed to study whereas Manny thought the more students learn; the more they became interested to the lessons. Since games helped them to learn the content more easily, this could increase their motivation towards the lectures. According to Johnson,

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game could show the different types of mining techniques such as surface mining or undergraduate mining so students could decide in which branch they wanted to be an expert. For Claire, one of the demotivating factors towards any course was the belief that the course was too difficult to understand. She believed that game could show the students that the topics were not difficult. Games could help the students to overcome this belief and became motivated to the courses. Finally, Michael stated funny and realistic games could show students what the mining was so they might be motivated to be mine engineer and study their lessons in order to be a good mining engineer. On the other hand, David thought that the difficulties provided by the game could force the students to seek for possible ways to overcome these difficulties so they became motivated to the lessons.

Self Confidence: After attending this study, Manny, Johnson, Claire and Michael thought that the self-confidence of the students could be increased by the game. According to them, students could analyze their performance in the game environment. They could estimate what they were capable of and what they could not. For them, the game might make the players to think that if they were successful in game environment, they could also be successful in real life. However, Kim and David disagreed with this idea. They thought that students would be aware of the fact that they were just playing games. So, they might think that their success in the game did not prove that they could also be successful in reality. Therefore, self-confidence of the students might not be increased by just being successful in game environment.

Fun: A non-gamer participant Manny and two gamer participants, Michael and David believed that game was fun way to learn. For them, it was not like books in which the students just read the information and imagined them. They believed that the features of the game could easily take the students attention and gave them pleasure while they were playing. However, Kim, Johnson and Claire had doubts about the fun of the game. They stated that some students might not like games. According to them, not all of the people enjoyed and played any games. Hence, for those people learning from the game might not be funny.

After attending this study, some of the participants still thought that as well as benefits, games might pose some problems which were underestimation, time management and misleading.

Underestimation: After attending the study, the opinions of Kim and Claire regarding with underestimation of the games changed in opposite ways. Claire started to think that students would not underestimate the games whereas Kim started to think the opposite. Claire thought that students needed additional materials which they could see, do and observe things and events. This could be supplied by the game so when the students recognized the importance of the game, they did not overestimate the games. On the other hand, Kim thought that some students might still see the game as an entertainment tool so they might not be serious and pay attention when they were playing. Therefore, they might not benefit from these games as much as desired by the educators.

Time management: After participation to the study, Kim recognized that playing games required high amount of time especially for non-players. This might bring problems since students had lots of things to do in limited time. Hence, she stated that students might not find necessary time to play the games. But, the other participants, especially gamer participants thought that time for games could be allocated easily since people generally found time to play games no matter how busy they were. So, they did not think that time management could be a problem for the students.

Misleading: At last, the opinions of participants about that game might mislead the students did not change after game play. Michael still thought that misleading could be a problem when simulation games were integrated to educational settings. He emphasized that students could conduct experiments with the help of these games. They could do activities to see what would happen. Thus, according to him, these games were suposed to be highly realistic. Otherwise, it might show unrealistic events to the students and so it might mislead the students. Contrary, the other participants thought that university students were conscious students. They did not get wrong interpretation. For this reason, they thought that game did not mislead the students.

4.5.2 Opinions about the Strengths and Weaknesses of Simulation Game Used in This Study (Research Question 2)

Table 18 shows the opinions of both non-gamer and gamer participants related with the strengths and weaknesses of the game used in this study. Visualization was the common theme that was considered as strength of the game by all six participants. In addition, realism in design was given as strength of the game by all the participants except Michael. Missions, learning by doing and roles of the players, lack of guidance were also seen as strength of the game. In addition to strengths, the participants in this study also listed the weaknesses of the game. It is found that participants had different ideas related with the weaknesses of the game. Mild punishment, lack of guidance, similar missions, less feedback, limited technical information, lack of saving option, limited vehicles and equipment, lack of details in the design, pace of the game, lack of character growth were the themes that participants identified as a weakness of the game.

Table 18 *Opinions of Participants about the Strengths and Weaknesses of Simulation Game Used in this Study*

Opinions	Non-Gamer Participants	Gamer Participants
Strength		
Visualization	Kim, Manny, Johnson	Claire, Michael, David
Realism in the Design	Kim, Manny, Johnson	Claire, David
Mission	Kim, Manny	
Learning by Doing	Kim, Manny	Michael
Roles of the Player	Kim, Johnson	Michael, David
Lack of Guidance & Hints	Manny	
Weaknesses		
Mild Punishment	Kim, Manny, Johnson	
Lack of Guidance	Kim	
Similar Missions	Manny, Johnson	Claire, Michael, David
Feedback	Manny	
Limited Technical Information	Johnson	Claire
Lack of Saving Option		Michael, David
Limited Vehicles & Equipment		Michael
Lack of Details in the Design		Michael
Pace of the Game		David
Lack of Character Growth		David

The strengths of the game from the point view of the participants were given below in detail.

Visualization: All the participants in this study thought that visualization was one of the important strengths of the game used in this study. During the interviews, they mentioned that they had problems to visualize the topics of the courses. They stated that they tried to learn the things that they never had known before so it was difficult for them to imagine. But, the game showed some of them in three dimensions. It showed a mine environment and some of the processes in quarrying realistically. They believed that the game could fulfill the students' needs of visuals to some extend so they categorized it as strength of the game.

Realism in the Design: All the participants in this study except Michael identified realism in design as the strength of the game used in this study. They believed that the game was realistic enough and could show the mine environment, processes, some of the vehicles used in quarry to the students. However, for Michael the realism in the design was not enough. He stated that he gave great importance in detail so he sought realism even in tiny detail. He believed that designers of the game did not consider the details enough in the game environment so he did not see it as the strength of the game.

Mission: From the non-gamer players, Kim and Manny also thought that mission was strength of the game. For them, the mission gave reason for them to play the game. It forced them to play till they finished the mission they accepted. Moreover, they believed that by completing the missions, students could see the processes occurred in quarrying. They could see how the fragmented rocks were produced in quarrying in three dimensions. The other participants in this study thought that although mission was good, it was not enough to identify it as strength. For them, it should be reconsidered and its scope should be widened.

Learning by Doing: According to two non-gamer participants, Kim and Manny and a gamer participant Michael learning by doing was strength of the game. Kim believed that the design of the game for single player forced the players to actively participate and did everything by themselves. For Manny, doing everything helped the players to gain firsthand experience. Finally Michael doing everthing in the game environment helped the students to understand the quarrying better as well as made them to be responsible of everything in the quarry.

Roles of the Player: Four participants in this study, Kim, Johnson, Michael and David, stated that roles of the players in the game environment were strength of the game. Especially Kim liked to be in different role such as workers or operators. She stated that students could learn more from the operators than the engineers. She believed since operators did the similar works in different situation they had more experiences and so knowledge. Thus, for her, students could learn the details of mining from them. According to Johnson, Michael and David by assigning different roles students could see the mining from different perspectives. This helped the

students to understand who did what in mine environment. On the other hand, Manny and Claire stated that although they liked the roles given in the game, some students might not like to be in different roles. In that situation, they might not gain the desired outcomes. So, they did not identify it as strength of the game.

Lack of Guidance & Hints: From the participants only Manny identified lack of guidance and hints as strength of the game. According to her, without gaining any guidance, the players forced to take all the control like the mine engineers working in real mine. By this method, they became responsible for all their actions and decisions so they had to find best methods or decisions in order to be successful. However, the other participants did not agree with Manny. They stated that they needed guidance at some times while they were playing, so they did not identify lack of guidance as strength of the game.

In addition to strengths, participants identified several weaknesses of the game used in this study.

Mild Punishment: All non-gamer participants in this study complained about mild punishment in the game. According to Kim, Manny and Johnson, mild punishment might cause the players not to understand the importance of being careful in the mine. They stated that any person who worked in mine had to be careful. A tiny mistake could cause big problems even death in mine environment. Thus, they stated that this situation also was needed to be shown in the game. According to them, one way to succeed it was the severe punishment. By severe punishment, students could get used be careful whereas mild punishment might cause them to overestimate carefulness. On the other hand, the gamer participants believed that mild punishment was necessary in the game. According to them, severe punishment might demotivate non-gamer students since they probably made lots of mistakes. Thus, they suggested that the game should be in two modes, beginners and advance. In beginner mode, mild punishment should be given whereas in advanced mode severe punishment should be applied. This approach might satisfy the needs of the players in different skills.

Lack of Guidance: From the participants, Kim identified lack of guidance as the weakness of the game. She stated that she needed to be guided in the game. She

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said that she forgot most of information regarding with quarrying so she needed hints and tips to remember quarrying and be sure about her decisions and actions.

Similar Missions: Manny, Johnson, Claire, Michael and David thought that similar missions in the game environment were weakness of the game. For them, doing similar missions over and over made the players get bored after a certain amount of time. Moreover, it did not show the whole work in mine. They stated that in mine, there were lots of things to do so doing only similar mission did not show the accurate picture of the mine environment to the players. However, for only one participant, Kim, the missions given to the players were appropriate to the reality. They helped the students to gain insight about the quarrying, what was done in there. So, she believed that missions should not be considered as weaknesses of the game.

Feedback: Only Manny complained about the feedback in the game environment. She stated that the game provided limited feedback to the players and this was a weakness. She stated that since the player did not give any hints from the game, they wanted to be given more detailed written feedback about their actions. According to her, players should be informed whether they gave the best decisions or did the right actions. But, for the other participants, game provided feedback to some extend. Although they stated that it would be increased, it should not be considered as weakness.

Limited Technical Information: Johnson and Claire thought that there was limited technical information in the game and this was a weakness of the game. According to them, the game should provide more detailed technical information to the students if it was designed to use for education. On the other hand, the other participants believed the game could be seen as a place where students could practice safely. So, they did not identify this as weakness.

Lack of Saving Option: From all six participants, only two gamer participants, Michael and David complained about lack of saving option in the game. They mentioned that in these kinds of games saving option was provided to the players in order to help them successful. By saving their progress, players could be brave in their decisions and actions. Thus, saving option also should be given in the game

used in this study. According to them, it helped students to explore which actions work best for specific situation and so increased their knowledge.

Limited Vehicles & Equipment: Finally, only Michael identified limited vehicles and equipment as a weakness of the game. He stated that in reality there were lots of vehicles and equipment in different brands. Miners could buy any of them if they had enough money. This should be reflected in the game. According to him, providing limited vehicles and equipment decreased the realism of the game as well as its effectiveness. Thus, it was a weakness in his belief.

Lack of Details in the Design: According to Michael, games had to be realistic if it aimed to use in education. He believed that realism was increased by considering even tiny details. So, he stated that he gave great importance on tiny details and he stressed that the details in the game were not considered as much as he wants. For this reason, he identified lack of details in the design as the weakness of the game. Contrary, other articipants did not give much attention on tiny details. For them, the game was realistic enough to show what a mine was and how things worked in there. So, they did not agree with Michael.

Pace of the Game: David complained about the pace of the game. He stated that the game was slow. However, for him, time was important in mine. He stated that in mining, it was desired to earn as much as money in the shortest time. Thus, he wanted to be able to speed things up in the game environment. He stated that the game did not allow the players to speed up things much so it could make the players especially ambitious players to get bored after a while. Therefore, pace of the game was a weakness of the game. Unlike David, the other participants in this study did not become obsessed with the pace of the time. Non-gamer participants stated that they spend lots of their time in completing single mission so they did not aware of the pace of the game. For Claire and Michael, although the pace of the game was slow, it did not affect them much so they did not identify it as weakness.

Lack of Character Growth: From all the participants, only David identified lack of character growth as the weakness of the game. He stated that he was ambitious player so he wanted to grow his character. According to him, if the game allowed the players to growth their character after being successful, the motivation of

the students would be increased. Moreover, they learnt how to run the quarry as the manager. In contrast, non-gamer participants did not give importance on character growth. For them, finishing the missions was more important than growing their character so they did not focus on growing their character. From gamer participants, Claire and Michael believed that it would be nice if the game allowed character growth. It would increase the motivation of the players and showed the perspectives of managers to the students. But not allowing the character growth was not a big problem so it should not be given as a weakness of the game.

4.5.3 Motivational Elements in Simulation Games Used in this Study (Research Question 3)

Table 19 shows the the motivational elements identified by all the non-gamer and gamer participants. Curiosiry, challenge, control were the common motivational elements listed by all the participants. In addition, field of study was given by only non-gamer participants whereas missions were stated by all the participants except Michael. Finally, realism in the design was mentioned by four participants, Kim, Johnson, Claire and Michael however roles of the player was told by only two participants, Kim and Claire.

Table 19 *Opinions of Participants about Motivational Elements in Simulation Games Used in this Study*

Motivational Elements	Non-Gamer Participants	Gamer Participants
Curiosity	Kim, Manny, Jonson	Claire, Michael, David
Challenge	Kim, Manny, Jonson	Claire, Michael, David
Control	Kim, Manny, Jonson	Claire, Michael, David
Field of Study	Kim, Manny, Jonson	David
Mission	Kim, Manny, Jonson	Claire, David
Realism in the Design	Kim, Johnson	Claire, Michael
Roles of the Player	Kim	Claire

In this study, it is seen that participants identified variety of motivational elements in simulation games used in this study. First of all, it is seen that all six

participants mentioned that challenge, curiosity and control affected their motivation positively during game playing.

Curiosity: All the participants in this study stated that curiosity had positive affect on their motivation. According to them, it forced them to play the game. They also mentioned that they were curious about the similar things. At first, the design of the game took their attention. They were curious about how the environment, the vehicles, the equipment were designed. They tried to buy as the vehicles and equipment in order to see all of them. Secondly, they were curious about the aim of the game. They wanted to see how they run the quarry and how they could conduct the activities such as blasting, hauling. These features of the game took their attention and motivated them to continue to play the game.

Challenge: In this study, it is also revealed that challenge in the game affected the motivation of the participants. All the participants stated that they liked to be challenged in the game environment but their attitudes towards challenge were changed. Only one non-gamer participant, Johnson and one gamer participant Michael thought that the challenge had to match their skills. If they believed that the challenge in the game was above their ability level, they quitted. On the other hand, the other four participants in this study stated that they did not mind the level of challenge in the game environment. Instead, they stated that they became motivated to overcome the challenge no matter what it costed.

Control: The final element that was identified by all six participants was the control. All of them stated that having control on the game was important for them. They liked to be in the saddle and control everything in the game environment. This motivated them to play. But, especially three participants, Kim, Johnson and Claire felt the sense of control was changed from situation to situation. According to Kim and Claire, they felt that they had more control on equipment than the vehicles. For them, they just drove the vehicles. But since they decided on when to stop and start the equipment while using them, they felt they had more control on equipment compared to vehicles. On the other hand, Johnson felt that his control on the game was decreased when he could not control the other workers simulated in the game. He wanted to control all the workers in the game environment not only one worker.

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Finally, Manny mentioned that lack of guidance and hints affected her sense of control. She believed that without guidance, she felt that she had more control on the game and took all the credits of her success.

Field of Study: The relatedness of the game with the field of the participants also affected the motivation of four participants. It was found that it especially increased the motivation of non-gamer students to play the game. They stated that they wanted to work as mine engineer and they sought opportunities to develop themselves in order to be successful mine engineers. Since the game was related with quarrying, it took their attention and motivated them to play. From gamer participant, only David stated that relatedness of the game with mining affected his motivation. He said that he put himself as the place of avatar in the game. He acted as if he owned the mine simulated in the game so his motivation towards the game was increased.

Mission: Five out of six participants stated that their motivation was also affected by the missions given in the game. They told that their motivation was increased for different reasons. Kim stated that missions forced her to play the game until she accomplished it. Moreover, the missions in the game made her feel that she accomplished something since the missions forced her to produce valuable products. According to Manny, missions helped her to see her progress. When she completed a mission, she felt that she really did something good and she was successful in the game environment. For Johnson, missions gave him reasons to play the game but he complained some properties of them. He said that he needed to be considered his own capabilities for being non-gamer. The mission that required high amounts of time demotivated him. Thus, he stated that the game should demanded small amount of products for the players at the beginning in order to help them to get use to the game and motivated them. On the other hand, Claire became motivated with missions especially the ones which required high amount of products. The high amount made her feel that she had to work hard to finish it as quickly as she could. Thus, she gave her attention to the game in order to finish the mission quickly. For David, the missions made him feel that he really worked in mine and so he evaluated

the price and the demand then decided whether to accept it or not. He tried to finish it as quickly as he could in order to earn lots of money.

Realism in Design: Kim, Johnson, Claire, Michael stated that realism in the design had positive affect on their motivation. It motivated them to continue to play. Kim, Claire and Michael liked the realism in the game environment. They thought that the environment simulated in the game was appropriate to the real life. They felt that they really worked on the mine and this motivated them to play. However, for Michael who was a gamer participant, realism was the main motivator to play any game and he gave great attention up to finest detail in the game environment. Thus, he stated that he examined the details while he was playing. At the end, he did not satisfy with the realism in the design of the game. According to him, the designers of the game did not consider the finest detail such as including control panel in the vehicles like the ones in real life and these kinds of things decreased both the realism in the design of the game and his motivation. Only two participants out of six, Manny and Johnson stated that realism did not affect their motivation although they thought that the game used in this study was realistic enough.

Role of the Player: Finally, two non-gamer participants, Kim and Claire thought that roles of the players in the game environment affected their motivation. It increased their motivation to play the game. Particularly, Kim believed that a person learnt more from the operators and workers than the engineers. She said that they gained more experiences because of doing similar things in different conditions. Thus, being in different roles in the game environment made her feel that she learnt more so she became more motivated to play when she was assigned to different roles. For Claire, women in mine had limited work duties. They could not be workers or operators. Thus, according to her, being in these roles gave her an opportunity to experience something that she could never experience in real life. For this reason, she stated that her motivation was increased. On the other hand, the other four participants stated that assigning different roles in the game at the beginning was nice but after a certain amount of time, they wanted that their role was fixed as the engineer or manager. They stated that being different role became tiresome after a

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while. Thus, it did not increase their motivation. Instead, it decreased their motivation after playing the game for hours.

4.5.4 Suggestions to Improve the Effectiveness of Educational Simulation Game Used in this Study (Research Question 4)

In Table 20, the suggestions given by all the non-gamer and gamer participants are listed. The themes, detailed technical information, vehicles and equipment, feedback, multi-player option, character growth were generally mentioned by the majority of participants in this study. On the other hand, it is seen that participants also gave several suggestions related with guidance, full control and variety of missions. Finally, problem based design, occupational safety rules, severe punishment were given by only non-gamer participants and saving option was told by only gamer participants.

Table 20 *Suggestions of Participants to Improve the Effectiveness of Educational Simulation Game Used in this Study*

Suggestions	Non-Gamer Participants	Gamer Participants
Detailed Technical Information	Kim, Johnson	Claire, Michael, David
Vehicles and Equipment	Kim, Manny	Claire, Michael
Feedback	Kim, Manny, Johnson	Claire, David
Guidance	Kim, Johnson	Claire
Problem Based Design	Kim, Manny	
Occupational Safety Rules	Kim, Johnson	
Multi-Player Option	Manny, Johnson	Claire, Michael
Severe Punishment	Manny, Johnson	David
Full Control	Manny, Johnson	Michael
Character Growth	Johnson	Claire, Michael, David
Variety of Missions	Johnson	Michael, David
Saving Option		Michael, David

The suggestions of the players in order to increase the effectiveness of the game were explained below in detail.

 Detailed Technical Information: All the participants except Manny gave suggestion related with the information provided in the game. They suggested that

more detailed technical information should be given in the game and wanted students to apply them in order to increase the effectives of it. They saw the game as a great opportunity where they could practice their knowledge. They stated that the game helped them to visualize the main process and concepts they had taught in the courses, allowed learning by doing and increased their motivation. So, they wanted to use and be given more detailed technical information. Especially for David, due to the reasons that he had short attention span and it could be increased by doing fun things such as playing games, gaining more technical information was important. He said that because of his short attention span, he had troubles to focus on studying. Thus, he tried to find materials which gave him pleasure and increased his attention span. He stated that playing the game gave him pleasure so that he could focus on the game more than the books. So, he wanted to be given more detailed technical information and used it in order to learn better. Only one non-gamer participant, Manny did not give suggestion related with information provided in the game. She stated that the game could be seen as test environment in which students could practice what they learnt. Hence, she stated that although it would be nice if the game provides more technical information to the players, it was not necessarily.

Vehicles and Equipment: Four participants out of six -Kim, Manny, Claire and Michael- gave recommendations related with the vehicles and equipment simulated in the game. All four participants suggested that equipment and vehicles should be varied in the game environment. According to them, the game was a great opportunity for the students to get used to these vehicles and equipment. They could see the relationship between them, how they were used etc. So, increasing variety of vehicles and equipment helped the students to understand each of them and prepared them to their future career. For Michael, the game should provide all the vehicles and equipment used in mine not just quarrying. Moreover, the brand of these vehicles and equipment should be added. He stated that in reality miners accessed all of this information. According to him, these methods would increase the reality and so the effectiveness of the game. On the other hand, Johnson and David did not give any suggestions related with the vehicles and equipment. According to them, the game

provided some of the important vehicles and equipment used in quarrying. So, they believed that including extra vehicles and equipment was not necessary.

Guidance and Feedback: The participants also gave several suggestions related with guidance and feedback in the game environment. Kim, Johnson and Claire suggested that the game should give guidance and feedback whereas Manny and David wanted to be given only feedback related with their actions. Kim, Johnson and Claire stated that they had problems to remember what they were taught related with quarrying. Thus, they were not sure in their decisions and this affected them negatively. So, they believed that if the game provided guidance by giving tips and hints to the players, the players could give more appropriate decisions and be sure about their actions. Consequently, the effectiveness of the game would be increased. In addition to guidance, if the game gave more detailed written feedback, students learnt the content better. However, Manny and David advised that the game should just give feedback to the players. Manny thought that guidance decreased her control in the game environment. She wanted to give all the decisions by herself. She objected to anything that may affect her in her decisions such as guidance. She wanted to take all the responsibility and evaluated her performance by giving all the decisions and doing everything by herself. So, she suggested that only detailed written feedback should be given to the students. They should be given feedback in order to understand whether they gave the best decisions in specific situation or how their performance was in the activities in the game environment. According to David, students should get used to take the responsibility of their action and decisions. They did not have chance to get guidance while they were working. So he did not want to be given guidance in the game. But, he added that feedback should be given since it helped the students to understand the important points better. For him, it would be more educative.

Problem Based Design: Only two non-gamer participants, Kim and Manny gave suggestions related with the design of the game. They stated that they wanted to face problems in the quarry. According to them, the processes in quarry were not so smooth. Problems could be occurred any time in the mine. So, they believed that game should pose problems to the students and ask them to solve. This helped the

students to see the possible problems that could be seen in quarry and prepared them to their future career.

Occupational Safety Rules: Again, only two non-gamers, Kim and Johnson gave suggestion related with the contents covered in the game. In addition to quarrying, they suggested that occupational safety rules could be included in the game. They stated that these rules were vital in mine and they were responsible of implementation of these rules in there. They stated if these rules were added and players were asked to apply them, students could learn these rules better and they could remember them easily in their future.

Multi-Player Option: Both non-gamer participants except Kim and gamer participants except David suggested that the game should include multi-player options. They agreed that playing with friends increased the effectiveness of the game. By playing together, they believed that students could learn from each other. They could discuss before giving any decisions, so they could expand their knowledge by these discussions. Then, they could share jobs to finish the missions in shorter time. According to them, this would increase both the pace and the effectiveness of the game. Moreover, they believed that playing with the friends made the game funnier. However, Kim and David did not agree with them. For them, the educational games should be played individually. Students should do all the activities and give all the decisions by themselves. By this way, they could estimate their knowledge level and their needs.

Severe Punishment: Manny, Johnson and David complained about the punishment in the game. They thought that in order to increase the effectiveness of the game, severe punishment should be given to the players when they made a mistake. According to them, people had to be careful and obeyed the rules in mine. Otherwise, severe injuries even death could be seen. Thus, students needed to get used to be careful as early as they could. They stated that if the game severely punished the players, this would help the students to understand the importance of being careful in mine environment. Conversely, Kim and Claire did not complain about the punishment. They stated that they were tidy and obedience person. For this reason, they were very careful and tried not to do any mistake when they were

playing so they did not focus on the punishment in the game environment. Moreover, Kim believed that severe punishment might have negative effects on non-gamer students. Based on her experience, she stated that non-gamer students did a lot of mistake and if the game severely punished them for all their mistakes, they might lose everything they gained and so became demotivated to play.

Full Control: Manny, Johnson and Michael drew attention to the control in the game environment. They believed that increasing control of the players on the game would increase the effectiveness of the game. They recommended that players should be given full control on the game environment. According to them, the game restricted the players to do some activities such as drilling the benches or controlling the other avatars in the game and this should be changed. Students should be allowed to do anything. They should be allowed to use all the workers simulated in the game and do whatever they wanted. By this, students could take more responsibility as well as the fun and the pace of the game would be increased. Moreover, since they could do whatever they wanted, they could discover what they wondered and saw what happened. According to Kim, Claire and David the players had control on the game so they did not give any suggestion related with control.

Character Growth: All gamer participants, Claire, Michael, David and a non-gamer participant Johnson gave recommendation related with character growth. They suggested that the game should allow players to grow their character in the game. According to them, the idea of starting from the beginning and doing everything themselves was nice but after a while that made the game boring. Moreover, this approach prevented the player to focus on important things. In other words, the player generally focused on how they could use the vehicle instead of what they should do. For this reason, they suggested that the game should allow the students to grow their character after certain amount of time. According to them, they could be manager and gave orders to the other workers. This helped the students to see what a manager did in mine and focused on important things like how they could increase the efficiency of the mine. On the other hand, Kim and Manny did not give any suggestions about character growth. They believed that doing everything by themselves was educative so they did not need to give orders to others.

Mission: Missions in the game were also criticized by the participants. Johnson, Michael and David suggested that the variety of missions should be added to the game. They stated that giving similar mission to the players made the game bored and also prevented the players to understand the quarrying completely. They stated a mining engineer dealt with different duties in mine. These also should be reflected. For instance, they stated that the players might be wanted to expand the quarry. According to Michael, giving similar mission decreased the realism of the game, therefore its effectiveness. He stated that in reality, the orders were not given in sequence. Sometimes, more than one customer demanded something. This could be reflected to the game. More than one mission could be appeared and students could accept which they wanted. These increased both the realism and effectiveness of the game. As opposed to them, Kim and Manny did not complain about the missions in the game. As previously stated, they just suggested that problems based design should be applied in the game. According to them, problem based design both increased the variety of missions and effectiveness of the game.

Saving Option: Especially, Michael and David who were ambitious gamer participants in this study gave suggestions about the saving option in the game. According to them, the game should give opportunities to the students to save their progress in the game environment. They stated that they used trial and error method to test their hypothesis and find the best method during their game playing. But, while using trial and error method, they awared of the risk of losing everything they gained. According to them, sometimes this demotivated them to be brave in their decisions and actions. Sometimes, it prevented them to do what they wanted. However, they added that if there was saving option, they could save their progress. They believed that saving option encouraged the player to feel more comfortable and be brave in their actions. By this, the game would be more beneficial and its effectiveness would be increased in their belief.

4.6 Composite Structural Description of Experiences of Players

The structural description of the experiences of participants in this study showed that participants generally were affected with similar constructs. But, it was found that each participant had been affected in different ways and their personal character had the most impact on their experiences.

This study revealed that *information seeking* affected the experiences of all the participants. Especially this construct had huge effect on non-gamer participants. The non-gamers mostly sought information regarding with how they could use the vehicles or did some activities effectively. When they faced a problem or did not able to do something as they wanted, they searched for information which could help them. Moreover, non-gamer participants did not trust their knowledge about quarrying. They searched information that might help them to remember what they learnt about quarrying and made them to be sure about their actions and decisions. From the perspective of gamer participants, only Claire sought information about quarrying. She understood how she could use the vehicles or perform the activities effectively in a short time but like the non-gamer participants, she had problems to remember the information about quarrying. Thus, she searched for information about it in order to be sure about her decisions and actions like the other non-gamer participants. On the other hand, two gamer participants, Michael and David sought information in order to benefit from the game more. Since they saw the game as a test environment to practice their knowledge, they searched for more detailed technical information to review quarrying.

Secondly, it was seen that *assessment of the activities* had an effect on the experiences of the participants. Kim, Michael and David not only assessed their performances and activities but also analyzed the activities of other workers simulated in the game environment. But the underlying reasons for this assessment were varied within each participant. Kim did not trust her knowledge about quarrying so she analyzed the environment to decide what she should do. When she did anything, she assessed her performance to evaluate whether she was successful as she wanted. Michael did assessment all the activities to decide how realistic they were. He evaluated their realism since he gave great importance on realism. Finally,

David assessed all the activities conducted in the game environment by other avatars to give the right decisions and be successful. He analyzed what they were doing and how. He also analyzed the activities to see how they were simulated. Moreover, he assessed the price and the missions to earn as much money as he could due to his belief that time and money were the most important thing in mining. On the other hand, Manny, Johnson and Claire only assessed their performance and activities. Manny assessed only her performance to decide whether she was successful. To be sure about her performance, she wanted to be given feedback but not guidance. She wanted to be successful by herself. Johnson assessed only his performance because he put himself in the place of the avatar and acted as he owned the quarry. Thus, he believed his success showed him whether he was going to be successful in reality or not. And finally, Claire assessed whether she was successful and whether she obeyed the rules or left the mine tidy due to being obedience and tidy girl.

The third construct that shaped the experiences of all the participants was *hypothesis testing*. It was seen that generally all the participants used trial and error method during game playing. Hence, they came up with hypothesis and tested them. Kim, Claire, Johnson and David tried to finish the missions as quick as they could so they generally built hypothesis to increase the efficiency and effectiveness of their activities. But, Manny tried to implement what she learnt. She saw the game as a big opportunity to do what she was curious about. So, she developed hypothesis based on her assessments, knowledge and experiences. Although she focused on being successful, she generally built her hypothesis to satisfy her curiosity. And also, Michael built his hypothesis and implemented them to investigate how realistic the game responded to the action of the players. In addition to hypothesis testing, it was seen that some participants also tested the rules of the game. Manny, David and Michael made mistakes intentionally to determine their boundaries, what the game allowed them to do. Manny identified her boundaries to satisfy her curiosity whereas David tried to expand his boundaries to be successful. Finally, Michael searched for his boundaries to determine to find how realistically the game acted when he made any tiny mistake.

Decision making also affected all the participants in this study. All of them gave several decisions such as what to do next, where to start, what to use during their game playing sessions. Generally their observations assessments and knowledge affected their decision making process. Curiosity and emotional change also had a huge effect on the decision making of some participants.

The final construct identified in this study is the *emotional change*. However, its effect on the participants was varied. Although some participants were not affected by this construct, some participants were affected strongly. Johnson, Claire and Michael were calm during the game playing whereas the moods of Kim, Manny and David could be changed rapidly. Especially when they made a mistake, they got angry but when they did something in a way they want, they became so happy. Their emotional instability could force Kim and Manny to leave the task unfinished whereas David insisted on finish what he started to do and be succesfull. When Kim and Manny got angry or disappointed, they stop what they were doing and decided to do something else. After they calmed down, they came back and finished the task they left unfinished before.

CHAPTER 5

DISCUSSION & CONCLUSION

5.1 Opinions of Participants about the Usage of Simulation Games for Education (Research Question 1)

One purpose of this study was to investigate how the opinions of participants related with the usage of simulation games in educational settings were changed based on their game play experiences.

The interview results of pre-opinions of the students showed that students had *positive feelings* about the usage of games in their learning processes Thus, at the beginning of the study, they supported the integration of games to the educational settings. This was consistent with previous studies conducted by Whitton (2007) and Gibson, Halverson, and Riedel (2007). The survey study of Whitton (2007) with 200 higher education students showed that 65.5% of the participants believed that games would be motivating for learning. On the other hand, Gibson, Halverson, and Riedel (2007) survey study with 228 pre-service teachers related with their attitudes and perceptions towards games and simulations revealed that 65% of the participants thought that games and simulations could be an important learning tool. The results of these studies show that educational games still hold a great value for education among the learners especially in higher. They support the integration of games to the educational settings. Since they are the main user of the games, their support is crucial and it may encourage the educators to design, develop and integrate the games to their curriculum.

This study showed that before gameplay although students advocated the usage of games in their department, they listed few benefits of their usage. Previous gameplay experiences of gamer participants helped them to identify the potential benefits of game thus; gamer participants came up with more benefits than non-

gamer participants at the first interview. *Visualization, learning by doing, motivation, fun* and *K12 level* were the general themes mentioned by the participants as the benefits of the game before game play. After game play sessions, it was seen that students were generally enjoyed their experiences like the participants in the previous studies conducted in mining field (for example; Mallett & Orr, 2008; Brnich, Mallett, Reinke & Vaught, 2004; Peters, Vaught & Mallett, 2007). Moreover, their opinions about the usage of games in educational settings changed in similarly. After game play, *visualization, learning by doing and motivation* were the major themes given by all the participants as the possible benefits of the integration of games to the educational settings. In addition, *fun,* and *self-confidence* were also mentioned by some participants.

Before game play, four out of six participants stressed the importance of visualization in their field and listed visualization as the possible benefits of the game. The pre-interview data revealed that participants need visualizations in their courses. Similar to finding of this study about visualization, Fei and Anbi (2011) indicated that students generally have problems in understanding the high theoretical information in mining engineering department. For instance, they generally have problems to understand the structure and procedure of various mining methods. They stressed that high imagination ability is necessary for students to comprehend them deeply. Before game play, the participants in this study also mentioned the drawbacks of some visual materials they used such as video and pictures and compared these materials with game. They indicated that videos were lack of interactivity, recorded by the camera with predetermined angle in foreign language and photographs were generally retouched which reduced their realism. On the other hand, students explained that the technology used in the games and the capabilities offered by the game such as *interaction*, *high quality representations* might help them more compared to other visual materials such as pictures or videos.

Similarly, in post-interviews all six participants stressed their needs for visual materials in their learning process. Their continued emphasis on visualization shows the importance of visual materials on their learning. As stated by Abulrub, Attridge and Williams (2011), the education in engineering department is generally complex

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and descriptive. According to the participants, especially in mining engineering department, students learnt the things they had never known before. Wu and Chen (2009) stress that it is difficult for mining engineering students to comprehend highly professional knowledge such as stope or mining methods by just attending specialized courses in the department. Fei and Anbi (2011) suggest that visiting a real mine is a good way to satisfy the visual needs of the students but they stress that field trip cost high, includes high risks and it is time consuming and low efficient. Ebner and Holzinger (2003), claim that visualizations and animations are suitable in education of engineers. Animations are found to be more effective compared to graphics to present situations (Tversky, Morrison, & Betrancourt, 2002) but, they bring some problems. According to Schnotz and Grzondziel (1999), animations are generally fast and complex so that they do not perceived correctly and students perceive as animations include sequence of individual steps whereas they present continuous events. To overcome these problems, Schnotz and Grzondziel (1999) think that interactivity can be used. Participants in this study also considered *interactivity* as important and wanted to use more interactive visual materials in their lessons. Holzinger and Ebner (2003) state that students give great importance on interactivity. According to Castro, Colmenar, and Martin (2010), new generation requires more interaction. They request for more engaging and interactive learning materials because, in their daily life this is how they acquire their cultural knowledge. They surf various contents on the internet, watch attractive contents on TV (Castro, Colmenar & Martin, 2010). As stated by Mallett and Orr (2008), being as recipients of information is not an appropriate way to prepare miner students in their future career. For instance, participants in this study stated they did not feel that they could lead the projects in mine effectively and efficiently. Therefore, as Mallett and Orr (2008) claims new technologies and methods might be implemented to the education in mining field and realistic simulations such as computer-based virtual environment can be integrated to solve those problems. In his study Squelch (2001) showed the effectiveness of simulations for the education in mining field. These kinds of educational materials can help students to acquire the necessary information more easily. By the help of virtual reality technologies, students can be introduced to

virtual scene of mine and they can both interact with scenes and be assisted in the planning, designing and management of mine (Wu & Chen, 2009). As said by Taradi, Taradi, Radic and Pocrajac (2005) the features of the games encourage the students to go beyond the boundaries of the given materials. These kinds of technologies may help mining engineers to be prepared for their profession more than other visual materials such as videos or graphics.

Before game play, four out of six participants, after the game play all participants mentioned that games could provide *learning by doing* in addition to *visualization*. It is found that at the beginning of the study, participants were aware of the importance of practice and stressed their needs for practice their knowledge in real life situations. They indicated that being active learner instead of passive learner and having chance to practice what they were taught was important for their learning as well as for their professional development. At the beginning of this study, while two non-gamer students did not imagine how mine environment could be simulated in game environment, based on their experiences they started to think game could allow learning by doing. They stressed that especially the missions provided by the game forced players to perform specific actions and this helped students to learn by doing. As stated by Rickard and Oblinger (2004), students can experience the events and situations firsthand via role-play to complete the field related missions in the game environment and participants in this study believed that this enhanced their learning. Students' emphasis on learning by doing before and after game play showed that participants in this study gave importance to analyzing, manipulating and observing in addition to reading for their learning process. They needed to apply their knowledge and developed their skills for their future career.

Hitch (2011) describes the mining engineering as "involves the design, planning and management of operations for the development, production and eventual rehabilitation of resource extraction" (p.103). He indicated that these activities require variety of skills, and they cannot be developed without practicing them. Knobb and Grayson (2012) point out the fact that doing takes an important role in the area of mining field and doing and knowing skills complete each other. For instance, Fei and Anbi (2011) highlighted that students' manipulations on the mining

device are important but it is difficult to create the environment in which they can perform it. Participants in this study notified the same issue. They mentioned the importance of manipulating the environment, conducting experiments to practice and expend their knowledge and after the game play experience, they believed that games could create a safe environment to conduct experiments. They stated that they could only practice their knowledge in laboratory sessions. As Abulrub, Attridge and Williams (2011) indicated laboratory demonstrations are used as a common technique to increase the practical knowledge of the students. The laboratory sessions are generally organized to help students to enhance both the ability of the students to examine and solve engineering problems by using appropriate levels of creativity and independent thought and their ability to report technical information (Abulrub, Attridge and Williams, 2011). However, participants stated that at some point these laboratory sessions did not help them as they wanted due to the reason that in laboratories, the processes and equipment might be *context independent*. This might decrease the educational value of the laboratory sessions and the realism of the work in laboratory since everything in laboratory was *miniature version and under control*. Participants in this study believe that realism increased the educational value of learning materials. The findings of this study direct that games can be used for this purpose.

Similarly, Winn (2002) believes that games are more successful to simulate real life experiences than traditional educational materials. They also allow students to participate in realistic simulated environment safely (Ebner, Holzinger, 2007; Winn, 2002) and experience difficult events that cannot be experienced directly (Winn, 2002). These advantages of game become important to create risk free training especially for the dangerous jobs like mining. As stated by the participants, a tiny mistake might cause big problems even death in mining. So, simulated environments can be used affectively in engineering education, and create an environment in which students can apply theoretical information to real life problems (Mallett & Orr, 2008; Brnich, Mallett, Reinke & Vaught, 2004; Peters, Vaught & Mallett, 2007, Nikolic, 2011). Abulrub, Attridge and Williams (2011) state that these technologies allow experiential learning, shows consequences in real-life settings and

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encourage active participation. As indicated by the participants of this study, being allowed to do what they learnt and seeing the consequences of their actions helped them to gain the information more easily and made it more durable. After the game play, participants also mentioned that games could create *realistic context in mining* thus they believed that realistic games and simulations could hold a great value in the education of engineers. According to Kiili (2007), games help the students to perceive the things as a whole. The participants in this study also explained that games represented the mine and the vehicles and equipment as a whole. There was interaction between player, equipment, vehicles and mine in game environment. They believed that games could allow students to practice safely in realistic mine context. With the realistic simulation games, participants believed that students could do the processes and investigate them from the angle they wanted. Since games can create a realistic mine context with interaction, they can fulfill the needs of the participants for their education.

In regard to *motivation* and *fun*, at the beginning of the study, all gamer participants and a non-gamer participant believed that games could affect the motivation of students positively whereas only one gamer participant believed that learning via games could be fun. This showed that participants in this study had concerns related with the entertainment value of educational games at the beginning of the study. After game play experience, it was seen that all of the participants indicated that games had the potential to increase the motivation of the students but half of them considered learning from game as fun. After their experience, half of the participants still believed that some people might not enjoy playing but they agreed that these people would be motivated to play due to its benefits such as visualization, learning by doing. The game experience of all participants made them to believe that games could affect the motivation of students positively. The game has potential to help students to develop positive attitude towards the school and learning (Durkin & Barber, 2002) and increase their motivation to gain knowledge (Abulrub, Attridge & Williams, 2011). Participants also mentioned this issue during the interviews. As stated by the participants, game could increase the motivation of the students towards

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the lessons and even to the profession they would be. The activities simulated in game might increase the motivation of students towards the subject area.

In addition to motivation, after game playing experiences, four participants believed that realistic games could positively affect the *self-confidence* of the students. Although self-confidence was not given by any of the participants at the beginning of the study, after game playing experiences four students started to think that self-confidence of the players would be increased based on their experiences. According to Garris, Ahlers and Driskell (2002), games help to create safe environment in which players can do tasks without worrying the real-life consequences of failure. This might enhance the confidence of trainee especially the ones who perform stressful, complex or dangerous jobs (Garris, Ahlers & Driskell, 2002). Students also mentioned this issue and indicated that in realistic game environment seeing what they could face in real life setting while they would work and what they could capable of, helped the students to increase their self-confidence. This finding is consisted with previous studies conducted by Squelch (2001) and Wu and Chen (2009) and can be given as an important outcome of simulations and games. The study conducted by Squelch (2001) with 30 miners showed that miners reported their self-esteem was increased by the usage of simulation compared to the other group attended to video-based training. In the study of Wu and Chen (2009), mining engineering students reported that their self-confidence and their interest to professional knowledge are increased by using the simulation developed by the researchers in their lessons. These studies show that simulations can help the educators to prepare self-confident motivated students by allowing them applying their knowledge in safe environment in fun way.

After game experience, it was also found that one student changed his mind related with the usage of the game in university level. At the beginning of the study, only one non-gamer participant taught that game could not be helpful for university students; it could just be used for *K12 level*. He could not imagine how the contents could be taught via the games due to the difficulty of the lessons in the university level. Thus, he had some concerns about the integration of games to the university levels although he supported its usage in K12 level. However, after game playing

sessions, he changed his mind and believed that the high technology used in games could help the educators to design and develop educational games that could even cover the difficult concepts in university level.

This study also showed that in addition to the benefits, half of the participants especially, non-gamer participants had concerns related with the usage of games in their department. *Addiction, underestimation* and *misleading* were the major themes given by three participants as the possible problems. After game play, it was seen that addiction was not considered as problem whereas *underestimation, time management* and *misleading* were given by two participants. It was seen that before game play participants' negative observations related with gamers and classmates and after the game play, their experiences in game environment played a significant role on identifying possible problems. On the contrary, most of gamer participants' positive experiences in game play before and after the study prevented them to identify any possible problem. At the beginning of the study, addiction was given as a problem by one participant based on the observation about how people could be easily addicted to the games in general. But, after game playing, she changed her mind and started to believe that simulation games that would be designed and developed for mining engineering education could be different than commercial games that played by teenagers and adults. Her experience in game environment made her believe that the scope of these games was limited and different, so they did not cause addiction among the students. Another finding was that the problem *underestimation* was given both before and after the game playing experiences by two different non-gamer participants. The positive experience of one non-gamer student in game playing made her think that students would realize the benefits of games such as visualization, learning by doing and interaction and they would focus on games rather than underestimate it. On the contrary, after the game experiences one participant started to think that students might focus on having fun instead of learning while they were playing. This shows the importance of informing the students before asking them play any educational games. Brief information about the game might be given to the students before game play to eliminate the possible concerns of the target group. Emphasizing the importance of game playing and what

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students would gain by the game might motivate the students to play the game and help them to focus on the information provided by the game rather than making fun of game. Additionally, time management was given by the same participant since she spent huge time on completing one mission due to being non-gamer. Based on her experiences, she indicated that performing the necessary actions in game play might take long time of some students so they preferred to study from the books rather than playing games. This shows the importance of creating simple educational games for students. In the study of Bringelson, Lyth, Reck, and Landeros (1995) with industrial engineering students, it was found that students complained about the much time they spent to learn the games used in that study. In this study, especially non-gamer students complained about the same issue. As stated by Ebner and Holzinger (2007), creating simple educational games were important in order to sustain the motivation of students. They indicated that students should not need to read complex instructions to play the game. Similarly, this study showed that this was also true for the tasks of the game. The tasks that require much time and effort of the players might affect the motivation of students negatively. Hence, effective design of the tasks that take the capability and experiences of the students into consideration might help the students to motivate the game and find necessary time for playing. The final problem mentioned was misleading students. It was indicated by one gamer student both before and after the game play. He highlighted that showing unrealistic events might mislead the students. In order to prevent wrong interpretation game must be realistic as indicated by the same student. Although the game used in this study did not show unrealistic event indicated by the participants, it was observed that some students focused on success more than educational side of the game. This finding showed the importance of instructor guidance in game based learning to prevent misleading as well as to make the students to focus on important parts of the game instead of just success. Garris, Ahlers and Driskell (2002) stated that debriefing is the most important and critical part in the simulation and gaming experience. They defined the debriefing as the analysis and review of the actions and events happened in the game environment. Debriefing with the instructor might help the students to analyze their experience in detail. The reflection of students on their game

experiences with their instructors may eliminate the possible misunderstandings of the students and helped them to reconsider the educational aims of the game.

The opinions of the participants related with the games based on their experience show that games can be an effective learning material in engineering education, especially in mining engineering education. Participants believed that simulation games could help them to prepare for their future career effectively due to the reasons such as interactivity, learning by doing, visualization. The literature supports this finding by showing successful integration of simulations and games in the training of the active workers in mining field (for example; Mallett & Orr, 2008; Brnich, Mallett, Reinke & Vaught, 2004; Peters, Vaught & Mallett, 2007). This study showed that simulation and simulation games could also be useful in the education of the students in mining engineering department.

5.2 Strengths and Weaknesses of Simulation Game Used in This Study (Research Question 2)

The interview results showed that participants identified strengths and weaknesses of the simulation game used in this study can be listed in three categories; game as learning environment, authenticity and game characteristics. Similarly, it was found that non-gamer participants came up with more strength whereas gamer participants found more weaknesses. This might be caused by the previous experiences of gamer participants. It was seen that during the game play gamer participants compared the game with the commercial ones they usually played. They generally focused on game characteristics of the simulation game used in this study more than the non-gamers and identified the weaknesses based on their previous game play experiences. But, non-gamer participants just focused on their game play experience instead of game characteristics and came up with more strength. This finding can lead us to state that the characteristics of the players and their interest played a significant role in identifying strengths and weaknesses of simulation game. Thus, it was seen that one participant might identify some attributes of the game as weakness whereas the others could consider it as strengths.

For the learning environment category, *visualization, learning by doing, guidance and hints, feedback* and *technical information* were the common themes identified by the participants.

It was found that *visualization* and *learning by doing* were the main strength of the game used in this study according to the participants. In this study, participants mentioned that they had problems related with understanding some processes, concepts and terms related with mining. Participants in this study confirmed that these kinds of simulation games could help students to visualize the main concepts, processes, events effectively. As indicated by Gee (2005), meaning of any words without the context is hard to learn. People need to relate the words with something they know about, they relate to like actions, images etc. and games can provide situated meaning by showing the words in context. The students indicated that game helped the students to learn some of the actions and concepts about the quarrying in context. Similarly, Mallett and Orr (2008) stress that by the help of virtual reality technologies, trainees can engage in learning in a way that was impossible with more passive methods. Since virtual technologies allow the learner to take some roles in stories and their decisions have an impact on the outcome of the events, learner develops a deeper understanding of concepts instead of repeating the definitions. This issue was highlighted by the participants. They not only see the main processes in quarrying in three dimensions, but also they could conduct these processes by themselves. They believed that this helped them to develop better understanding of quarrying. This is another important finding of this study. This showed that students wanted to learn in context and they considered this property as strength. Like the study conducted by Bringelson, Lyth, Reck and Landeros (1995), participants in this study liked to see the relationship between the course concepts and real-word in game environment. Related with *learning by doing*, Gee (2005) states that a good game provide interaction which helps the learner in their learning process. He complains that books cannot be reflective to the students but games "do talk back" (pg.34). The participants of this stdy also complained about the lack of interaction in books and highlighted that game included high interactivity. they indicated that doing all the things, taking all the decisions by themselves increased the interaction

and engagement with the game environment and so it was strength of the game. This finding indicates that participants want to have high interaction in educational games. They wanted to be active during their learning process and want the learning material "do talk back".

In this study, it was seen that contradictory finding related with guidance and hints were found. While a non-gamer participant see *lack of guidance and hits* as strength of the game, some see that as weakness of the game based on their knowledge and beliefs. This finding indicated that individual differences, preferences and beliefs played an important role in the perception of students about the games. While some students think that lack of guidance makes the students more responsible, let them to make their decisions, others think that gudaince is needed to remember and to make the right decisions. Similar findings were also addressed in the study of Nikolic (2011). She also highlighted that students had different needs regarding with scaffolding. As suggested by Nikolic (2011), providing the option of turning on or off the guidance and hints and allowing the students to access them whenever they want might help designers to design more suitable games for students in higher education.

The *technical information* was also assessed by the participants and some participants identified it as weakness of the game based on the personal beliefs. Although all the participants wanted the game to cover as much information as it could and believed that there should be *more detailed technical information*, only two participants identified limited technical information as a weakness of the game. This finding was consistent with the previous study conducted by Kiili (2007). He found that students identified the role of the game they used in their lesson like applying previously learnt knowledge instead of studying new contents. The participants in this study also wanted to learn new issues as well as apply their knowledge. For all of these reasons, creating games that allow customization to meet the individual differences such as needed information, guidance and feedback might be more beneficial for the students.

For the second category, authenticity, *realism in the design, mission, vehicles and equipment, roles of the players* were the major themes discussed by the participants.

Realism in the design of the game was found to be considered as important among the participants in this study and it was given as strength of the game by five out of six participants. They believed that a game had to be realistic if it aimed to teach. This finding is consistent with the previous study of Kiili (2007), Nikolic (2011), Mallett and Orr (2008) and Brnich, Mallett, Reinke and Vaught (2004). In these studies, students believed that in educational games, authenticity was very important element. These studies indicated students' need to practice their knowledge and skills in situated learning environments so they evaluated the game about its appropriateness to realism. Mentioning the realism as strength of the game proved that simulations and simulation games can be useful tool to meet this need. Similarly, in a study, Mallett and Orr (2008) found that simulation technologies provided opportunities to improve the realism of the learning material as well as the engagement of trainees that have different work experience in mining field. They highlighted that by using simulations, trainees could gain much experience that could prepare them better to overcome real-world problems they would encounter in their future career and the realistic simulations and practice drills could helped the trainees to transfer their training to their jobs. This study showed that students also tested their knowledge and skills in realistic learning environments. Hence, realism in games might help the students to understand the real-life applications of their field and increase their competence in solving problems they faced in their working environment.

Related with realism, Charsky (2010) identifies two elements; fidelity and context that affect the realism of any simulations. Fidelity describes the level of realism in the simulations (Alessi & Trollip, 2000) and the several elements such as audio, graphics, video, virtual worlds and artificial intelligence can be used to represent reality authentically (Charsky, 2010). These kinds of elements can contribute to creation of realistic and exciting context (Gredler, 2003). According to Alessi and Trollip (2000) fidelity affects both initial learning (the performance of the

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learner in the gameplay) and transfer of learning (application of obtained knowledge or information to the new situation). In addition to the fidelity, they also state that this perceive fidelity affects the motivation of the learners which directly affects initial learning of the players. According to Charsky (2010), the degree of fidelity should be changed based on learning goals. If higher authenticity is need, the degree of fidelity should be high because the authenticity can help the learner to transfer the information to the real world. The majority of the participants in this study stated that the graphics and audio effects used in the game were realistic and made them feel that they really worked in mine. Thus, it might be concluded that the degree of fidelity of the game used in this study was found to be high. According to the participants, it helped them to have authentic experience. And so, they identified the realism as the strength of the game. It also found that especially the gamer participants focused on the details in the game environment due to the belief that realism depended on details. Especially one gamer participant criticized the details of the design because of his personal interest on realism of any game. His special interest on realism made him focus on every tiny detail in game environment and it was found that he did not satisfy with the realism of the game due to *lack of details in design* and identified it as weakness of the game.

Fidelity is the mechanism of the game (Charsky, 2010) whereas context is setting, story, scenario, character etc. which shapes the game play (Dickey, 2005) and as fidelity, context can also increase the realism of the game. Therefore in order to estimate the realism of the game, students were asked to analyze its context. In the game used in this study, students were given a quarry and they were requested run the quarry by completing several missions. It was seen that participants liked the *scenario* and *setting* of the game. Participants also indicated that *roles of the players* and *missions* were main elements that increase the realism of the game and majority of the participants considered them as strength of the game. It was found that in addition to realism, these elements also played an important value in the satisfaction of students in their game playing experience however; it was also found that these elements might be considered as weaknesses by the participants after a certain amount of time. In regard to role, participants indicated that they were willing to be

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assigned in different roles related with their field due to the belief that assigning different roles helped the players to experience the quarrying from different perspectives. They indicated that different roles helped them to see the mining context from different perspectives. But, it was advised that the roles needed to be carefully designed. Although roles were given as strength, being in different roles for a long time might affect the players negatively and turned to be weakness. In regard to mission, some participants pointed out since it not only gave reasons to play but also showed the processes occurred in quarrying so they considered it as strength of the game. As stated by Gee (2005), production is another learning principle that a good game supplies to the students. He states that students co-design the games by giving decisions and taking actions. In the game used in this study production was occurred by giving several decisions and taking actions while completing the missions. However, it was seen that especially gamer participants identified similar missions as a weakness of the game due to the belief that similar missions did not represent the mine environment completely. Hence, the missions should be varied in order to increase the realism of the game and help them to see the complete picture of the quarrying.

In regard to authenticity in the game, some students identified some of the properties of the game as weakness such as *mild punishment, limited vehicles and equipment* independent from their game playing experience. It was seen that especially, non-gamer participants advocated severe punishment whereas gamer participants advised to consider the capability of the non-gamer students in punishments. Their belief that non-gamer students prone to make many mistakes so severe punishment might demotivate them prevented them to listed mild punishment as a weakness of the game. Although, non-gamers advocated the severe punishment, it was observed that they could be easily demotivated while they made mistakes. Hence, providing severe punishment might affect them negatively as indicated by gamers in this study. In addition, the limited vehicles and equipment included in the game was given as a weakness of the game by a gamer participant. His interest on seeing different vehicles and equipment made him to think in that way.

As the final category namely game characteristics, it was seen that they had an effect on the perception of the students towards the game. Especially gamer participants focused on game characteristics and identified weaknesses related with them. *Lack of saving options, lack of character growth* and *pace of the game* were the major themes given as weaknesses of the game. Gamer participants believed that they decreased the educational value of the game and affected their motivation negatively since they used to these characteristics in most of the commercial games.

Lack of saving option was indicated by two gamer participants. It was revealed that since they were used to be provided saving option in other commercial games, they felt the necessity of the game in order to be more comfortable during their actions. This finding was inconsistent with the study of Nikolic (2011). She found that saving option was necessary for the simulation games. Civil engineering students in his study pointed out their fears of not being able to "re-do" and "go-back" once they started the simulation. However, in this study majority of participants did not identify it as weaknesses. They indicated that they did not feel the necessity of it due to the design of the game but they suggested if the design was changed, it would be better to add that option.

Additionally, *character growth* was suggested by most of the participants. They indicated that character growth helped them to develop different identities, prevented the game to be monotonous and increased their motivation. This indicated that character growth might be an important motivational factor and might increase the playability hence the effectiveness of the game.

Finally, it was found that due to personal characteristics, one participant did not like the *pace of the game*. His desire to be successful forced him to complete the tasks quickly and see the results of his actions immediately. Therefore, slow pace of the game demotivated him to play and negatively affected his experiences. Although the other participants did not identify it as weakness, they also indicated that the pace of the game might change based on the preferences of the students. This finding shows the importance of the speed of the educational games. The pace of the game should be designed carefully based on the characteristics and needs of the students. The game should not be slow or fast. As Kiili (2007) stated, the fast tempo of the

game might cause the players not to find enough time to reflect on the consequences of their actions. But as stated by one gamer participant, slow tempo might demotivate students to play. Nikolic (2011) states that the speed of simulation can provide opportunities for students to test different approaches in a short time and increase sustained attention of students. Hence, Nikolic (2011) suggested controllable simulations to meet the difference needs and experiences of learners. Speed control provides opportunities for students to focus either on the final outcomes or information during the simulation process (Nikolic, 2011). It might help the designers to create an educational game that meet the difference need of the students regarding with the pace of the game.

5.3 Motivational Elements in Simulation Games Used in this Study (Research Question 3)

In this study, it was found that participants were motivated to play the game by similar elements which are *challenge, curiosity, control, field of study, mission, realism in the design* and *roles of the player*. However, the textural descriptions of the participants experience revealed that these motivational elements affected them in different way for different reasons. It is believed that these elements may help designer in creating attractive educational games for the engineering students especially mining engineering students. In other words, the findings of this study provide a flexible model for designing engaging educational games which foster intrinsic motivation by several elements such as challenge, curiosity, control, mission, realism and roles to the players.

The interviews with the participants of this study revealed that *challenge, curiosity* and *control* were common motivational elements that affected all the participants regardless they were non-gamer or gamer. These factors played an important role in the motivation of the participants in this study. As indicated by, Malone and Lepper (1987) they are intrinsic motivational elements that can be found in any learning environments including games. It was seen that these elements were also found in the game used in this study. In addition, all the participants listed *challenge* and *curiosity* and *control* as the most effective motivators on them. They pointed out that these factors gave reason to play the game. This finding was

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consisted with the previous study conducted by Hainey, Connolly, Stansfield and Boyle (2011). They showed that regardless of gender, being multiplayer or single game player and online or offline player, the challenge and curiosity are the top ranking motivators among the players. Hence, it might be said that challenge, curiosity and control are important motivational elements and they should be considered in detail in the design of any educational game.

Related with *challenge*, it was found that challenge affected the participants in different ways. According to Csikszentmihalyi (1990), players accept the challenge when they believe that the challenge match their capability. If they think that the challenge over their capabilities, frustration occurs. However, in this study it was found that participants had different opinions about challenge. Only two participants indicated that they quitted the game if the challenge above their capabilities whereas four participants stated that they took the challenge without comparing it with their skills. This showed that personal characteristics played an important role in accepting the challenge. Some people may frustrate with the level of challenge whereas others may be motivated. Thus, the level of challenge is important factor and the designers should carefully arrange it considering the characteristics of the target group.

It was also found that *curiosity* was vital for participants in this study. They played the game till they convinced that they had seen everything. This shows that players need to be provided richness in regards to the elements such as objects, processes, missions, roles in the game environment to sustain their curiosity during game playing. It was also found that curiosity in the simulation game used in this study was aroused by two factors; curiosity for the design of the game and curiosity about the educational aims of the game. Firstly, all the participants were curious about the design of the game so they analyzed how the vehicles, equipment and the processes were designed in the game environment. Then, it was seen that participants were curious about how they could do the activities in quarrying effectively which suited the educational goals of the game. These two factors may help designers to come up with things that can arouse the players' curiosity. It was also found that rules of the game increased the curiosity of the some participants. They searched for

what they were permitted to do in the game environment due to their curiosity. Thus, the rules of the game should be determined clearly and all the possible actions and appropriate reactions should be considered. Additionally, participants in this study mentioned that curiosity could have bi-directional effect on the players. The curiosity to their field could arouse their curiosity how they were simulated in the game and whether they became successful in the game environment. As opposite, the game could increase their curiosity in some area that forced them to be curious about how they were done in reality or why they were done in that way. Their curiosity to some events may motivate the players to investigate the reasons, theorems for those specific actions. This effect of curiosity may help the educators to achieve the motivated, self-regulated learners they dream of.

In regard to *control*, the interview results revealed that participants gave importance on the sense of control. Malone and Lepper (1987) believe that the sense of control plays a role in motivation of the players towards the game and the participants in this study highlighted that the sense of control and their motivation were positively correlated. Malone and Lepper (1987) highlighted that the activities which allow players to determine and control their own future motivate them to the game. Klug and Schell (2006) indicated that players want to feel that their decision make a difference in the game environment, they have control on it. The participants also indicated this issue. They pointed out that they wanted to have full control on the game environment. They indicated that the simulation game used in this study was responsive to their actions and allowed them to make decisions on activities or vehicles. Moreover, it gave power to the players by allowing them to do powerful affect such as drilling or blasting the ground so their motivation was increased. But, they also highlighted that they were given choice to make mistakes in the game environment. They indicated that being restricted in the game environment decreased their sense of control even though their actions might cause big problems in game playing. This showed the importance of control for the participants. It is also found that the sense of control could be affected by some variables. Deciding many variables increased the sense of control of the participants. For example, deciding

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how to use equipment and how long increased the sense of control and the motivation of the students.

In this study, it was also revealed that games that were related with *field of study* took the attention of participants, especially non-gamer participants. The textural description of their experience showed that their motivation to their department and their desire to improve themselves in order to be successful mining engineers affected their motivation to play. They indicated that once they realized that game could help them to develop themselves by providing firsthand experience related with their field of study, they were motivated to play. This showed the importance of informing the students about the educational value of any game. Informing the students about why they should play the game might increase their motivation to play.

Realism in the design of the game is another motivational element that affected players positively. Participants in this study indicated that the game had to be realistic if it was designed for education and they wanted to play realistic games. Hence, this finding might indicate that students were aware the importance of realistic simulation games for their professional development. In realistic simulation games, students are not just observers, they are given opportunity to see the consequences of their decisions or the processes they applied (Torres & Macedo, 2000), they can comprehend the relation between the decisions and consequences more easily (Adobor & Daneshfar, 2006). Hence, participants stressed that especially in dangerous jobs such as mining engineering, people needed to be aware of their actions and decisions and this could be supplied by realistic games. As pointed out by Klug and Schell (2006), when the realism of the world simulated in the game is increased, the influence of the players' over that world is also increased as well as the importance of their decisions. The participants in this study also indicated this issue and they were motivated by altering the variables in real life settings and observing the consequences. They indicated that they needed such kind of environment to test their knowledge and skills and they were motivated to participate on any event that created this environment for them.

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Finally, it was found that *missions* and *roles of the players* in the game environment affected the motivation of the players. The textural description of the participants' experience showed that when a mission was given to the participants, completing the mission became their goal and this gave reason to them to play. This finding is consistent with the previous studies and mentioned by the researchers. Clark (2007) indicated that goals direct the students and cause them to continue to play until they reach those goals and Lieberman (2006) stress that they increase the interest of the players. Similarly, the study of Eseryel, Law, Ifenthaler and Miller (2014) showed that the motivation, engagement and problem-solving activities affected by the design and the nature of the game tasks. As stated by the participants, the missions helped them to reconsider their knowledge about the subject and roles caused them to see the subject from different perspectives. Hence, it might be said that missions and tasks play an important role in the motivation of players as well as in their learning process. In this study it was also found that missions and roles might be demotivating factor based on the characteristics of the students and time spent on the game. For instance, one non-gamer participant was motivated when she assigned to produce high kilograms of specific rocks. However, another non-gamer complained about this situation and mentioned that he was demotivated in such situations. Similarly, all the participants were demotivated by doing similar missions and roles changing after certain amount of time. For all of these reasons, it might be suggested that game tasks and roles should be designed carefully for both educational goals and characteristics of the target group otherwise these elements might decrease the motivation of students rather than increasing it.

5.4 Suggestions to Improve the Effectiveness of Educational Simulation Game Used in this Study (Research Question 4)

The suggestions of the students improve the effectiveness of educational simulation game used in this study can be categorized under three main categories; *learning environment, authenticity and game characteristics*.

In order to increase the effectiveness of the game as learning environment, participants in this study gave suggestions about the *technical information* covered in the game, *feedback* and *guidance*. First of all, it was found that participants in this

study wanted to use and be given *more detailed technical information* during game play. Their textural descriptions showed that this information could include the mathematical equations, vehicles and equipment used in mining or occupational safety rules. This study showed that the more detailed technical information was covered by the game, the more students satisfied with their game experience. This finding is consisted with the study of Nikolic (2011). She found that the simulation game used in her study increased the civil engineering students' interest and motivation in learning. In this study, it is also found that due to the some attributes of the game such as visualization, high interaction participants were motivated to learn and so they wanted to receive more detailed technical information regarding with their field of study. As stated by Léger (2006) realistic simulation games combine theory and practice that increase the understanding of the students about the given subject. The participants in this study also indicated that game could help them to combine theory and practice so they advised to be given more detailed technical information and apply theory to practice.

In this study, it was found that students want to be given more detailed *feedback* after their actions immediately. This was consistent with the study conducted by Bringelson, Lyth, Reck and Landeros in 1995. In their study, students in industrial engineering also complained about the limited feedback provided by the game used in that study. Both the participants in that and this study mentioned that they needed more detailed feedback about both their decisions and the impact of the decisions. As stated by Peixoto, Possa, Resende and Pádua (2011) feedback is an important element in simulation games. It allows the player to understand the game, support their decisions and supplies information during the learning process (Peixoto, Possa, Resende & Pádua, 2011). Instant and contextual feedbacks decreases uncertainty (Baer, 2005), arouse the curiosity of the players and encourage the players for exploration, experimentation (Kirriemuir, 2002) as well as improve their performance (Kiili, 2005). Denholm, Protopsaltis and de Freitas (2013) state that feedback plays a central role in experiential learning and decreasing the complexity and increasing the frequency of feedback affect learning positively. Thus, they suggest that frequent clear feedback is better in experientially-oriented educational

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games (Denholm, Protopsaltis & de Freitas, 2013). All participants in this study highlighted that explicit feedback related with their performance and decisions eliminates their concerns about their performance and helped them to be sure of their decisions so they gained more benefits from the game. This finding indicates that providing explicit, informative feedback both increases the satisfaction of students and the effectiveness of the game.

Finally, in order to increase the effectiveness of game as learning environment, participants gave few suggestions about the *guidance*. Five out of six participants in this study wanted to be given guidance during game playing. In a study conducted by Nikolic (2011), students needed tips and explanations in their decision making processes while they used simulation games and this situation was also seen in this study. Although a non-gamer participant wanted to gain no guidance due to her belief that guidance prevented her to estimate her knowledge and success in the game environment accurately, others thought that guidance helped the students to focus on the important aspects of the game and decide their actions more easily. This indicated that personal beliefs also played an important role to accept the guidance so it can be suggested that providing guidance and allowing students to turn it on and off might meet the difference needs of the students.

Related with Authenticity, participants gave advices related with design of the game such as *punishment, missions and roles of the players* in order to increase the realism of the game as well as its effectiveness.

Punishment in the game environment was one of the most discussed game elements by the participants. Half of the participants indicated that severe punishment should be given to the players since it could show the students the importance of being careful in mine. Especially non-gamer participants advocated severe punishment even though they made many mistakes. Even though they were aware that some students might demotivated with severe punishment, they insisted on the importance of severe punishment to make them prepared for their profession. This showed that participants gave great importance to being careful in mine environment and they wanted to gain this habit as soon as possible.

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Missions and *roles* in the game environment also played an important role in the effectiveness of the game from the view of the participants. It was seen that participants in this study wanted to have real life experience so they gave suggestions related with missions and roles to increase their effectiveness. As stated Charsky (2010), simulation games help the players to learn high order complex thinking skills by simulating context and characteristics of real world. Participants believed that these kinds of realistic simulation games could help them to gain the expertise the need for their career so designing the missions and the roles of the player that similar to real life helped them in that way. According to Squire and Jan (2007) role playing encourage players to involve in the given scenario and complete the missions assigned to the roles they play. Thus, they suggest that role playing should be integrated to the syllabus in the curriculum of engineering and science subjects. They state that this will create opportunity for students to play managerial roles which will help them not only to understand fundamental logical concepts during problem solving and thinking but also develop the basic abilities they require in science and engineering subjects. Moreover, they add that when players try to complete different stages in games by overcoming various challenging and gathering information, they go through step-by-step thinking process which is also required in science subjects. According to participants, roles and missions should be given in game environment to the players in order to help them see the whole picture of their field of study. The reflection of what mining engineers do in mine might increase the effectiveness of the game according to the participants. As stated by Wu and Chen (2009), mining engineering students should gain the professional knowledge accurately and should be able to use it flexibly and participants in this study thought the same way. Wu and Chen (2009) indicated that mining engineering students should be able to solve cases with appropriate derived from actual problems in mining engineering. Designing the missions and the roles of the player that reflect the actual problems in mining engineering might increase the authenticity as well as the effectiveness of the game.

As the final category namely game characteristics, c*ontrol, saving option, multi-player option,* and *character growths* were the general themes that participants gave suggestion about.

Participants in this study wanted to be given *full control* on the game environment. They saw the game as test environment in which they could conduct experiments safely and explore what they wondered. Thus, they wanted to be given the chance to do whatever they wanted, even severe mistakes. It was seen that control held important value for the participants. In his study, Kiili (2007) found that the participants in his study were reflectors because they built playing strategies and hypothesis, tested them and analyze the consequences of their actions. The participants in this study can also be considered as reflectors so they wanted to be given full control on the game environment to perform several dangerous activities such as bench drilling in order to analyze the consequences.

Saving option was another element suggested by especially gamer participants. One reason for that the game used in this study did not allow students to make vital mistakes. Hence, the non-gamer students believed that they could repair their mistakes so they did not need to save their progress. On the other hand, gamers were more tended to test different strategies to be successful and they used to save their progress in other games so they felt its absence. But, based on the observations it would be better to provide saving option to the students. Even though non-gamer students did not need in this study, it was observed that their mistakes might make them to start from the beginning and this cost much time to students. Moreover, as stated by Gee (2005), by saving option, players are promoted to take risks and try new things. In this study, it was seen that the participants generally used trial and error method in order to be successful in the game like the participants in the study of Kiili (2007) and Nikolic (2011). Hence, in order to find the best method, they tested several methods. Providing saving option during the game playing might fit the playing strategy of the students and increase the effectiveness of the game.

In this study, *multiplayer* option was also one of the most discussed game elements by the participants. It was found that participants in this study wanted to play with their friends. They wanted to work together with their friends in order to learn from each other. In his study Kiili (2007) found that all players found to play the game in teams more beneficial. They indicated that knowledge sharing during game playing increased learning. Students in this study felt the necessity of

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knowledge sharing with their friends especially when they faced difficulties or the missions that required much time.

Finally, character growth was given as a suggestion to increase the effectiveness of the game by participants. It was observed that lack of character growth made the players especially gamer players to perceive that game was monotone and made them easily bored. Dickey (2007) state that in MMORPGs, character development is one of the elements that increase the intrinsic motivation of the players. There is no loss or victory conditions in those games hence players may spent hundreds of hours in game environment and develop their character. Since they put great effort in the development of their character, players often feel emotional intimacy with their character. It becomes their representations in the gameplay environment. This situation can be applied to the simulation games for engineering department. This property in MMORPGs game might be integrated to the game by allowing them to growth their character such as promoting them in game environment.

5.5 Structural Description of the Experiences

The structural description of the participants revealed that *information seeking, observation, assessment, hypothesis building* and *decision making* were the major constructs that shape the experiences of the participants. Similarly, it was found that the game used in this study also supported the phases of experiential learning theory and the phases discussed by Kim, Park and Baek (2009). Kolb (1984) identify four main stages in experiential learning model namely "concrete experience" in which learner participate to an activity, "reflective observation" in which they reflect on their experience, "abstract conceptualization" in which learner make generalizations and develops hypothesis, models or theories based on their observations and experiences and "active experimentation" in which they test their hypothesis, models or theories. It was revealed that participants in this study went through of these stages during the game period. In addition, Kim, Park and Baek (2009) indicated the learner in the game environment goes through several steps which are *information seeking, selecting appropriate information, building strategies for discussion, resolving conflict and exercising the decision making process and*

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negotiation and it was found that participants in this study also went through these stages except *building strategies for discussion and exercising negotiation* due to the reason that the game was designed for single player.

This study showed that all the participants went through iterative phases in the game environment while playing. In addition, it was seen that personal characteristics of the learners played significant role in the experiences of the players. It affected their experiences differently in each step. The phases started by accepting the mission given by the game and continued till students completed it. Students participated in several activities while completing the missions and during the activities, they conducted *reflective observation, built hypothesis based on their observations* and *tested* them in order to see whether they helped them or not.

It was seen that *information seeking* kept an important part in their experiences. The non-gamer players generally sought information about game playing and selected the information which could help them to use the equipment and vehicles more effectively and efficiently whereas gamer-participants got used to use them in a short time. Moreover, it was seen that both non-gamer and gamer participants sought for the reasons to play the game so they tried to find information related with quarrying. It was observed that non-gamers spent huge amount of times to perform one simple task hence, they wanted that the time they spent on game should be worth it so they wanted to be given more detailed technical information in the game environment. On the other hand, gamer participants indicated that there were many high technological games to play in the market so the game should provide more detailed technical information for players in order to motivate them to play it among the other commercial games. Due to these findings, it is recommended that more detailed information related with the subjects the game covered and the gameplay should be provided to the players.

Secondly, it was found that *assessment* and *observation* was also an important constructs in the experiences of participants. All the participants did the assessment and conducted observations in their game playing for different reasons and in these activities, personal characteristics and needs played a significant role. For instance, while a gamer participant assessed her activities to be sure whether she violated any

rule and kept the place tidy, a non-gamer student just focused her own success in the game environment. Similarly, it was seen that some participants not only assessed their performance but also observed the other workers simulated in the game and their jobs. Their curiosity and the need of guidance forced them to observed the other workers and what they were doing and how in detail.

As given the third and fourth steps in experiential learning theory, based on their different needs and characteristics, participants *built their own theories and methods* while they were participating activities and *tested* them in the game environment. While four participants built and tested their hypothesis to increase the effectiveness of their activities, a non-gamer participant attended these steps to satisfy her curiosity and a gamer participant tested the realism of the game. Also it was also found that some participants tested the rules of the game to understand their boundaries in the game environment.

Finally, participants came up with *decisions* based on their observations, assessments, hypothesis and experiences. They came up with strategies that may help them to be successful in the game environment. It was also found that *emotions* affected some participants seriously in their decision process. Their emotional changes identified what they would do. While some participants faced difficulties while they doing anything, they got angry, stopped what they were doing and decided to do something else, some participants became more ambitious and tried to be successful no matter what it cost.

Regarding with the satisfaction of the students in game environment, the study of Mayer, Warmelink and Bekebrede (2013) with 1000 students in higher education in Netherlands revealed that learning satisfaction of the students in game based learning was affected by the *attitudes* and *the motivation of students towards game based learning before gameplay*, *their enjoyment and their own and collective efforts during the game and the quality of instructor*. In addition, the learning satisfaction of the students was determined by *the degree that game experiences were transformed back into underlying theories*. This study also showed that these constructs played an important role in the satisfaction of students in game playing. It was revealed that their motivation towards game based learning and their efforts

during game play forced them to seek for more detailed technical information related with subject and when their game experienced helped them correlate their experiences with theories, they satisfied with their game experience. In addition to the findings of that study, this study added that personal characteristics and needs of the students and the feedback mechanism of the game also affected their satisfaction. The structural description of the experiences of the participants showed that these elements also played an important role in the experiences of each participant. For instance, special interest in details, curiosity about the rules of the game or events, informational needs, emotional changes affected the participants' decisions or actions which also affected their enjoyment, motivation as well as satisfaction. Thus, it is suggested that the target group should be analyzed in detailed before designing any educational game and their preferences, needs and interest should be considered in the design of the game.

In their study with 121 civil engineering students Ebner and Holzinger (2007) identified the necessary characteristics of the game. According to them, the game must be simple and it must be playable in a short time. It must be available at any time and any place and finally it should foster competition. It was observed that these characteristics were also important for the games developed for mining engineering students due to several reasons. It was observed that students could be easily distracted in the game environment. Even a tiny detailed could take their attention and they stopped what they were doing and sought what it was. Thus, the game should be designed in detailed and factors or elements that may distract the students or not related with the aim of the game should be extracted. As stated by Denholm, Protopsaltis and de Freitas (2013), too many distractions in the game environment that does not fit the aim of the game or too fast pace may reduce the reflection and process of learning. For this reason, extracting the unrelated elements or processes with the aim of the game would have positive contribution on the learning process of the students. Secondly, it was seen that students especially non-gamers could spent huge amount of time to finish one mission. This can pose a problem both to the students and instructors. Spending much time on a single task might demotivate the students like the non-game participants in this study. Hence, playability in short time

might affect the experiences of students better and motivates them to play. Additionally, a study conducted by Wu and Chen (2009) indicated that playing games under the guidance of instructor might increase the effectiveness of the game. In their study, the instructors were surveyed in order to estimate the performance of mining engineering students who used simulation under the guidance of instructor. The instructors stated that the ability of students to solve the practical problems in mining engineering and their research ability was increased when they used simulation under their guidance (Wu & Chen, 2009). If the game is difficult to play or the tasks require much time of the students, students might not come to the intended part of the game in a lesson time and instructor might not provide the necessary guidance to the students. This might prevent instructor to integrate the games and simulations to their courses. Thirdly, the availability of the game at anytime and anywhere might increase the playability of the game. The meta-analysis conducted by Sitzmann (2011) revealed that students that used simulation games learnt more than comparison group when they could use the simulation games as many times as they want. This finding also shows the importance of availability of simulations and games. Finally the findings of this study showed that playing with friends could increase the effectiveness of the game. As indicated by participants it could increase the motivation of the students and educational value of the games by enhancing encouraged learning from each other.

Finally, it was observed that feedback and guidance played an important role for both motivation and learning process of the participants. In experiential learning theory, direct experiences and reflective observations are given great importance (Kiili, 2005) and feedback and guidance might help students to reflect on their experiences more effectively. This finding was consistent with the study of Nikolic (2011) and Denholm, Protopsaltis and de Freitas (2013). In her thesis, Nikolic (2011) found that immediate feedback and goal-driven exploration change the role of the students from passive to active learners complementing instructor feedback and causing to produce more questions and more in-class discussions. The survey study of Denholm, Protopsaltis and de Freitas (2013) with 80 students showed that the participants rated the value of feedback highly and indicated that it increased

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motivation. Students mentioned that feedback was the main contributor to affective learning process. Especially they valued tutor feedback important. In another study conducted by Beal (2005) with totally 479 participants who were Infantry leaders and students in The U.S. Army Infantry School, it was reported that according to Infantry leaders, when instructor provided feedback during completing the missions and discussed about the actions in detail after, the value of training was increased. These findings shows that producing highly detailed feedback related with the performance and actions of the students in the game environment will increase the effectiveness of the game as well as the satisfaction of students about their learning process. Especially, usage of simulation and games under the supervision of instructor and discussing about the key points in the game environment can contribute the learning process of the students positively.

5.6 Implications of the Findings

This study aims to reveal the experiences of gamer and non-gamer mining engineering students while they use a simulation game for educational purpose. It tries to investigate whether these technologies should be implemented in engineering department especially mining engineering department in higher education from the students' perspective and if so what they want from an educational game. Their general opinions about the integration of games to the educational settings and their suggestions to improve the effectiveness of the game are presented. Additionally, in this study, the factors that affected the experiences of students in game based learning are defined and how these factors affected them is listed in detail. Their suggestions and opinions for each factor are also given. Finally, the steps that students went through in the experientially oriented educational game are given briefly. Although the findings of this phenomenological study cannot be generalized due to the limited number of participants, the findings might help researchers and educators to gain insight about the experiences of mining engineering students while they use a simulation game for educational purpose.

The researchers and educators who are interested in game based learning can benefit from the results of this study. The findings of this study might shed light on the experiences of students in game environment and might inspire the researchers

for detailed investigation of students' needs and suggestions such as feedback mechanism, group work or evaluating system in game environment.

The instructors who want to use simulations and games in their courses can benefit from the results of this study. This study shows that control, challenge and curiosity were the main motivators that affected the participants in this study. Students wanted to play games that included realistic visuals, high interaction, detailed feedback and detailed information about the subject area. Additionally, games that assigned different roles and missions to the players and allow playing with their friends motivated the participants to continue to play. Participants wanted to apply their knowledge, conducted experiments by altering the variables and observed the consequences.

The detailed explanation of the opinions and the concerns of the students about the games and their needs during game play can inspire the instructors how they can benefit from them and how they can integrate these kinds of technologies in their curriculum. Moreover, the results may help the instructors especially in mining engineering department to understand the factors of effective and efficient educational gaming and help them to make better decisions in the selection of games used in their lessons. Educators might evaluate the games whether they include these properties and decide how to use them in their courses.

Finally, this study might help the researchers and educators to discover the essential design and development elements of simulation games specifically to mining engineering education. The designers and the educators can use the findings of this study in order to create more effective and attractive games for engineering department especially mining engineering education. Moreover, in deciding an educational game, the instructors can consider these findings to make the decisions about which game to integrate.

5.7 Recommendations for Future Research

This study examines the experiences of the mining engineering students in using simulation games for educational purpose. Thus, they were asked to play a commercial simulation game and share their experiences. Moreover, they were asked to give suggestions about how the educational value of the game used in this study

could be increased. Based on their experiences and suggestions, a simulation game can be designed and may be tested whether it helps the mining engineering students as it intended to be. Its results can be compared with this study and the differences and similarities of the experiences of the students can be identified. Moreover, the experimental study with more students can be conducted to see whether games significantly affect the learning outcome of the students. Also, the opinions of the participants about the usage of games for education can be investigated with more participants. Analyzing the differences in the learning outcome and in the attitudes of the students in mining engineering department who use and not use the game may help the instructors to decide how they can integrate these kinds of technologies in their syllabus.

Secondly, similar studies can be conducted for specific engineering departments. Analyzing the experiences and the needs of students in different engineering departments might help both researchers and educators to design more effective educational games for the target group and show how the games can be integrated to those fields. In addition, similar studies can be conducted in different countries. Its results can be compared with this study and the differences and similarities of the experiences of the students can be identified in order to identify whether culture affects the experiences of the students or not.

Thirdly, the essential design and development elements identified in this study can investigated in detail. The feedback mechanism of the game, the assessment in the game environment can be investigated in detail, and the best method that fit the necessity of the students can be searched. Additionally, several games that based on essential design and development elements identified in this study can be developed and applied in mining engineering department. Students can be asked to play these games and their perspectives related with game attributes and their value hierarchy can be analyzed in detail. Moreover, the gamer and non-gamer opinions about the game value can be compared in order to see the differences in their values.

Finally, the similar study can be conducted with the instructors and engineers working in mining field. Their opinions regarding with the usage of the games in

mining field can be investigated deeply and the barriers to use these kinds of games in the field can be identified in detail. Furthermore, their suggestions to improve the effectiveness of the game can be gathered to develop more educative games for the mining field.

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APPENDIX A

SURVEY FOR PARTICIPANT POOL

DİJİTAL OYUN OYNAMA ALIŞKANLIKARI

Bu anket, maden mühendisliği öğrencilerinin oyun oynama alışkanlıkları hakkında bilgi edinmek amacıyla hazırlanmıştır. Anket yaklaşık olarak 10 dakikanızı alacaktır.

Kişisel bilgileriniz ve cevaplarınız kesinlikle gizli tutulacak ve sadece araştırma amaçlı kullanılacaktır.

Katılımınız için teşekkür ederim.

Ar. Gör. Neşe Sevim

ODTÜ-BÖTE Bölümü

Lütfen soruları eksiksiz doldurunuz.

1. Adınız Soyadınız:

2. Mail adresiniz:

3. Telefon Numaranız:

4. Yaşınız :……………

5. Cinsiyetiniz:☐Kadın ☐ Erkek

6. Maden Mühendisliğinde kaçıncı dönemdesiniz?: …………………….

7. Genel Not Ortalamanız (GCPA):

8. Kendinize ait kişisel bir bilgisayarınız var mı?☐ Evet ☐ Hayır

9. Kişisel bilgisayarınız yoksa genelde nerede bilgisayar kullanırsınız? ………………………

10. Kaç yıldır bilgisayar kullanıyorsunuz?...............................

11. Bilgisayar oyunu oynar mısınız?

☐ Evet

☐ Hayır (Bu seçeneği işaretlediyseniz 15. soruya geçiniz.)

12. Ne kadar süredir bilgisayar oyunu oynuyorsunuz/oynadınız?

☐ .... ay/yıl oynuyorum.

☐ .... ay/yıl oynadım ama artık oynamıyorum.

13. Bilgisayar oyunlarını genellikle aşağıdakilerden hangisinde oynuyorsunuz / oynadınız (Birden fazla seçenek işaretleyebilirsiniz)?

☐ Internette (İnternet Explorer, Firefox vb. İnternet tarayıcıları üzerinden)
    Ne kadar süredir?…………… Haftada Kaç Saat?...........

☐ Bilgisayarlarda kurulu (Masaüstü bilgisayar, dizüstü bilgisayar, netbook, Ipad,vb.)
    Ne kadar süredir?…………… Haftada Kaç Saat?...........

☐ Konsol (PlayStation, Wii, Xbox, vb.)
    Ne kadar süredir?…………… Haftada Kaç Saat?...........

☐ Taşınabilir Konsol (Tetris, PSP, Nintendo DS, vb.)
    Ne kadar süredir?…………… Haftada Kaç Saat?...........

☐ Mobil Cihazlar (Cep Telefonu/Akıllı telefonlar, ipod touch, vb.)
    Ne kadar süredir?…………… Haftada Kaç Saat?...........

14. Genellikle ne türde bilgisayar oyunlarını seversiniz/ severdiniz? Birden fazla seçeneği işaretleyebilirsiniz.

☐ Aksiyon Oyunları: Süratli ve ani oyunlardır. Örneğin, labirent oyunları, ateş ettiğiniz oyunlar, araba yarışları, ve takip oyunları bu kategoridedir. (Örnek oyunlar: Super Mario, Doom, Half-Life, Unreal Tournament, Counter Strike, Need for Speed, GTA, vs.)

☐ Macera Oyunları: Bilinmeyen dünyada yolunu bulma, nesneleri toplama ve bilmeceleri çözme oyunlarıdır. (Örnek oyunlar: Zork, Myst and Riven, Indiana Jones, Zelda, vs.)

☐ Dövüş Oyunları: Hızlı ve atletik hareketlerin olduğu oyunlardır. (Örnek oyunlar: Mortal Kombat, Street Fighter vs.)

☐ Bilmece Oyunları: Çözülmesi gereken problemler içerir. Genellikle görseldir. (Örnek oyunlar: Tetris, Sudoku vs.)

☐ Rol-Oynama Oyunları: Bu oyunlarda, kendinizce belirlenen özellikleri ve kendine has özellikleri olan roller (insan, peri, büyücü vs.) oynanır. (Örnek oyunlar: D&D, Knight Online, Sherwood, vs.)

☐ Simulasyon Oyunları: Bir aracı kullanmak, uçurmak, ya da dünyalar kurmakla alakalı oyunlardır. (Örnek oyunlar: Sim City, The Sims, Flight Simulators vs.)

☐ Spor Oyunları: (Örnek oyunlar: FIFA, PES, NBA, Skating, Tennis, Baseball, Skiing oyunları vs.)

☐ Strateji Oyunları: Büyük bir şeylerin sorumluluğunu almak (örneğin bir ordu, ya da bir uygarlık) ve onu istediğiniz şekilde geliştirmekle ilgili oyunlardır. (Örnek oyunlar: Civilization,Tycoon, Age of Empires, Travian, World of Warcraft, vs.)

☐ Bunların dışında farklı türde bilgisayar oyunu oynuyorum.
Lütfen belirtiniz:....................................

15. Eğitim hayatınız süresince herhangi bir ders konusunu (matematik, fen bilgisi, sosyal bilimler vb.) destekleyici herhangi bir bilgisayar oyunu oynadınız mı?
☐ Evet oynadım
      Lütfen Oyunu Belirtiniz:
☐ Hayır, hiç oynamadım

16. Madencilikte oyun yolu ile ögrenmeyi denediniz mi? ☐Evet ☐Hayır

17. Dijital oyunlarla ilgili bir araştırmaya katılmak ister misiniz? ☐Evet ☐Hayır

INTERVIEW SCHEDULE

İlk Görüşme Soruları:

Merhaba,

Ben Neşe Sevim. ODTÜ Bilgisayar ve öğretim teknolojileri bölümünde doktora öğrencisiyim ve aynı zamanda araştırma görevlisiyim. Öğrencilerin dijital oyunları öğrenme amacıyla oynarken yaşadıkları hakkında bir araştırma yapıyorum.

Öncelikle belirtmeliyim ki; soracağım soruların kesinlikle doğru yada yanlış cevapları yoktur. Sadece oyun esnasında neler yaşadıklarınızı araştırmaktayım. Ayrıca, cevaplarınızı benden başka kimse görmeyecektir. Eğer sizinle ilgili bir bilgi vermem gerekirse bilgileriniz takma ad kullanarak yazacağım.

Eğer sizin için de bir sakıncası yoksa görüşmemizi kaydetmek istiyorum. Görüşmemiz yaklaşık 30-40 dk. Sürecektir. Görüşmeye başlamadan önce bana sormak istediğiniz bir şey var mı? Görüşmenin herhangi bir noktasında ara vermek isterseniz veya görüşmeyi bırakmak isterseniz bana söylemeniz yeterli.

O zaman görüşmeye başlayabiliriz......

1. Maden mühendisliği bölümü kaçıncı tercihinizdi?
2. Bu bölümü tercih ederken bölüm hakkında araştırma yaptınız mı?
    a. Kimden duydunuz?
    b. Gelmeden önce bölüm hakkında neler biliyordunuz?
3. Neden bu bölümü tercih ettiniz?
    a. İş olanakları hakkında ne düşünüyorsunuz?
    b. Maddi imkanları açısından ne düşünüyorsunuz?
    c. Zorluğu açısından ne düşünüyorsunuz?
4. Bölüme geldikten sonra bölüm hakkında düşünceleriniz nasıl değişti?

a. Olumlu olarak nasıl değişti? Neden, bir örnek verebilir misiniz?

b. Olumsuz olarak nasıl değişti? Neden, bir örnek verebilir misiniz?

5. Bölümde dersleriniz genelde nasıl işleniyor? Özellikle introduction to mining engiinering, surface mining dersleri nasıl işleniyordu? Bana o derslerde bir ders süresince yaşadıklarınızı anlatır mısınız?

 a. Derste öğretim elemanlarınızın konuyu nasıl anlatıyor? Sizce nasıl bir eğitim yöntemi uyguluyor?

 b. Öğretim elemanlarınızın dersi işleme yaklaşımı hakkında ne düşünüyorsunuz?

6. Nerelerde staj yaptınız?

 a. Stajdaki bir gününüzü anlatır mısınız?

 b. Yaptığınız stajın sizin mesleğinizde ne gibi etkileri olaçağını düşünüyorsunuz?

7. Sizce bir maden mühendisi neleri bilmelidir?

8. Sizce bir maden mühendisinin hangi bilgi ve becerileri gelişmiş olmalıdır?

Şimdi de dijital oyunlarla ilgili sorular sormak istiyorum.

9. Dijital oyunlar hakkında ne düşünüyorsunuz?

 a. Dijital oyun oynamanın sizce ne gibi olumlu yönleri olabilir?

 b. Dijital oyun oynamanın sizce ne gibi olumsuz yönleri olabilir?

10. Dijital oyunların eğitimde kullanılması hakkında ne düşünüyorsunuz?

 a. Dijital oyunların derste kullanılmasının sizce olumlu etkileri olabilir mi? Ne gibi?

 b. Dijital oyunların derste kullanılmasının sizce olumsuz etkileri olabilir mi? Ne gibi?

 c. Dijital oyunların derste kullanılmasının akademik motivasyona nasıl etkisi olur? Neden?

 d. Dijital oyunların öğrenmede etkinliği hakkında ne düşünüyorsunuz?

 e. Dijital oyunların akademik bilgi ve beceriye katkısı hakkında ne düşünüyorsunuz?
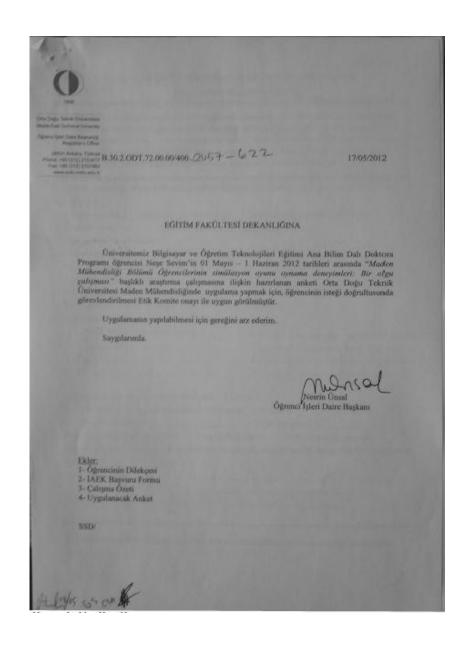
Oyun Oynadıktan Sonra Soulacak Sorular:

1. Bu oyun seansında neler yaptınız?

a. Bu aktiviteleri yaparken neler hissettiniz?

2. Şu anda oyunu oynamış biri olarak kendinizi nasıl genel olarak nasıl hissediyorsunuz (yorgun, mutlu, rahatlamış ....)

3. Bu oyunu oynadığınız sürede zor görevleri gerçekleştirirken ne kadar çaba sarf ettiniz? (Cevap hyr ise neden?)

    a. Biraz anlatabilir misiniz?

    b. Bu zor görevleri başarınca neler hissettiniz?

    c. Başaramayınca ne hissettiniz?

4. Bu oyunu oynarken oyunun hangi özellikleri sizin merakınızı uyandırdı?

    a. Bu özellikler oyun oynamanızda etkili miydi? Nasıl?

5. Bu oyundaki grafikler, sesler veya efektler hakında ne düşünüyorsunuz? Neden?

    a. Bunlar oynama isteğinizde etkili miydi? Nasıl?

6. Bu oyunu oynarken kontrolün sizde olduğunu hissettiniz mi? Neden, açıklar mısınız?

    a. Tüm bu özellikler bu oyunu oynamanı nasıl etkiledi?

7. Oynadığınız oyunun fantastik boyutu hakkında ne düşünüyorsunuz?

8. Bu öğeler sizin oyun oynamanızı nasıl etkiledi? Açıklar mısınız?

9. Bu oyunla diğer oynadığınız oyunları karşılaştırdığınızda benzerlikleri ve farklılıkları nelerdir? Açıklar mısınız?

    a. Bu benzerlikler ve farklılıklar sizin oyun oynamanızı nasıl etkiledi? Neden, açıklar mısınız?

10. Oyun oynama süresince ne gibi problemler yaşadınız?

    a. Bu problemler oyun oynama isteğinizi nasıl etkiledi?

11. Bu oynadığınız oyunun oyuncu olarak en çok hangi yönlerini beğendiniz? Neden, açıklar mısınız?

12. Bu oynadığınız oyunun oyuncu olarak en çok hangi yönlerini beğenmediniz? Neden, açıklar mısınız?

13. Maden mühendisliği öğrencisi olarak oyunda dikkatinizi neler çekti?

a. Stajdaki deneyimleriniz ile bu oyundaki deneyimlerinizi karşılaştırır mısınız?

14. Maden mühendisi olarak oyunu nasıl buldunuz?

a. Oyunda meden mühendisinin sahip olması gereken hangi bilgi ve becerilerilere değiniliyor?

b. Bu oynadığınız oyunun maden mühendisi olarak en çok hangi yönlerini beğendiniz? Neden, açıklar mısınız?

c. Bu oynadığınız oyunun maden mühendisi olarak en çok hangi yönlerini beğenmediniz? Neden, açıklar mısınız?

15. Sizce bu oyunun etkisini artırmak için neler yapılabilir? Neden, açıklar mısınız?

16. Sizce bu tarz oyunların bölümünüzde kullanılmasının bölümünüzdeki eğitime nasıl etkisi olur?

a. Sizce bu tür oyunlar bölümünüzdeki derslerde nasıl kullanılabilir?

b. Bu tarz oyunları bölümünüzdeki eğitimde kullanılmasının ne gibi yararları olur?

c. Bu tarz oyunları bölümünüzdeki eğitimde kullanılmasının ne gibi zorlukları olur?

APPENDIX C

RESEARCH PERMISSION

THE LIST OF MEANING UNIT

Table 21 *The List of Meaning Unit*

	Non-Gamer Participants			Gamer Participants		
	Kim	Manny	Johnson	Claire	Michael	David
Visualization	x	x	x	x	x	x
Learning by Doing	x	x	x	x	x	x
Motivation	x	x	x	x	x	x
Self-confidence		x	x	x	x	
Fun		x			x	x
K12 Level			x			
Addiction		x				
Underestimation	x			x		
Time Management	x					
Misleading					x	
Realism in Design	x	x	x	x	x	x
Mission	x	x	x	x		x
Role of the Player	x	x	x		x	x
Lack of Guidance	x	x				
Mild Punishment	x	x	x			
Simiar Missions		x	x	x	x	x
Feedback	x	x	x	x		x
Limited Technical Information			x	x		
Lack of Saving Option					x	x
Limited Vehicles & Equipment					x	
Lack of Details in the Design					x	
Pace of the Game						x
Lack of Character Growth						x
Curiosity	x	x	x	x	x	x
Challenge	x	x	x	x	x	x

Table 21 (continued)

Control	x	x	x	x	x	x
Field of Study	x	x	x			
Detailed Technical Information	x		x	x	x	X
Vehicles and Equipment	x	x		x	x	
Guidance	x		x	x		
Problem Based Design	x	x				
Occupational Safety Rules	x		x			
Multi-Player Option		x	x	x	x	
Severe Punishment		x	x			X
Full Control		x	x		x	
Character Growth			x	x	x	X
Variety of Missions			x		x	X
Saving Option					x	X
Assessment of Activities	x		x	x	x	X
Assessment of own Performance	x	x	x	x		
Hypothesis Testing	x	x	x	x	x	X
Game rules testing		x	x		x	X
Information Seeking about Game Play	x	x				
Information Seeking about Subject Area	x	x	x	x	x	X
Decision Making	x	x	x	x	x	X
Emotional Change	x	x				X

CURRICULUM VITAE

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EDUCATION

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WORK EXPERIENCES

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LANGUAGES

- English (Advanced)
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PUBLICATIONS

- Yıldırım, Z., Sevim, N.,Duman, M., Gök, A., Tufan, D., Erdoğmuş, F., & Kara, N., (2011) *Araştırma Görevlilerinin Öğretim Üyesi Olma Sürecindeki İhtiyaçları Nelerdir?*. 20. Ulusal Eğitim Bilimleri Kurultayı, s.638.
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SCHOLAR SHIPS & AWARDS

- Honour List of METU: 2003–2004 (Spring), 2004–2005 (Fall), 2005–2006 (Fall)
- High Honour Lists of METU: 2004 –2005 (Spring), 2005–2006 (Spring), 2006–2007 (Fall) 2006–2007 (Spring)
- TUBİTAK Graduate Scholarships