THE IMPACT OF COMPUTER GAMES ON STUDENTS' MOTIVATION

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

MEMET ÜÇGÜL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
COMPUTER EDUCATION AND INSTRUCTIONAL TECHNOLOGY

DECEMBER 2006

Approval of the Graduate School of Natural and Applied Science

Prof. Dr. Canan ÖZGEN
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science

Prof. Dr. M. Yasar ÖZDEN
Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science

Assoc. Prof. Dr. Kürşat ÇAGILTAY
Supervisor

Examining Committee Members

Assoc. Prof. Dr. Soner YILDIRIM (METU, CEIT) _____

Assoc. Prof. Dr. Kürşat ÇAĞILTAY (METU, CEIT) _____

Assoc. Prof. Dr. Veysi İŞLER (METU, CENG) _____

Assoc. Prof. Dr. Jale ÇAKIROĞLU (METU, ELE) _____

Instructor Dr. Hasan KARAASLAN (METU, CEIT) _____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name :

Signature :

ABSTRACT

THE IMPACT OF COMPUTER GAMES ON STUDENTS' MOTIVATION

Üçgül, Memet

M.Sc., Department of Computer Education and Instructional Technology

Supervisor: Assoc. Prof. Dr. Kürşat Çağıltay

January 2007, 73 pages

This study investigates the impact of computer games on students' motivation. A computer game was created for this study by using Tomb Raider 4 Level Editor. The game covers photosynthesis, vitamins, carbohydrates, proteins and fat subjects of 5th grade science and technology course.

Data was collected from 71 5th grade students of three primary schools. Students have played the game until the end of lesson than they were asked to complete The Instructional Materials Motivation Survey (IMMS).

The study reveals that gender, weekly computer use and weekly game playing do not affect the impact of educational computer games on students' motivation.

Keywords: Computer games, computer games in education, motivation, students' motivation.

ÖZ

BİLGİSAYAR OYUNLARININ ÖĞRENCİ GÜDÜLENMESİNE ETKİSİ

Üçgül, Memet

Yüksek Lisans, Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü

Tez Yöneticisi: Y.Doç.Dr. Kürşat Çağıltay

Ocak 2007, 73 sayfa

Bu çalışmada bilgisayar oyunlarının öğrenci güdülenmesine olan etkileri araştırılmıştır. Bu amaçla, ilköğretim beşinci sınıf fen ve teknoloji dersi; fotosentez, vitaminler, karbonhidratlar, proteinler ve yağlar konularını kapsayan bir bilgisayar oyunu hazırlanmıştır. Oyun Tomb Raider 4 oyun motoru kullanılarak hazırlanmıştır.

Veriler üç ayrı okuldan, 71 ilköğretim beşinci sınıf öğrencisinden toplanmıştır. Öğrenciler bir ders süresince oyun oynadıktan sonra öğrencilerden Öğretim Materyalleri Güdülenme Ölçeğini (ÖMGÖ) doldurmaları istenmiştir.

Bu çalışmada, cinsiyetin, haftalık bilgisayar kullanım süresinin ve haftalık bilgisayar oyunları oynama süresinin, eğitsel bilgisayar oyunlarının öğrenci motivasyonuna olan etkisini değiştirmediği saptanmıştır.

Anahtar Kelimeler: Bilgisayar oyunları, eğitimde bilgisayar oyunları, güdülenme, öğrenci güdülenmesi.

To children

TABLE OF CONTENTS

PLAGIARISM iv

ABSTRACT iv

ÖZ vi

TABLE OF CONTENTS ix

LIST OF TABLES xii

LIST OF FIGURES xiii

CHAPTER 1

1. INTRODUCTION 1

1.1. Background of the Study 1

1.2. Statement of the Problem 3

1.3. Purpose of the Study 3

1.4. Significance of the Study 4

1.5. Definitions of Terms 5

2. LITERATURE REVIEW 6

2.1. Motivation 6

2.1.1. What is Motivation? 6

2.1.2. Types/Models of Motivation 7

2.2. Games 16

2.2.1. Definition of Games 16

2.2.2. Game Types 17

2.2.3. Why do People Play Games 19
2.3. Simulations: 20
2.3.1. Advantages of Simulations: 21
2.3.2. Disadvantage of Simulation: 22
2.4. Games and Learning 23
2.5. Games in Education 24
3. RESEARCH METHODOLOGY 27
3.1. Overall Design of the Study 27
3.2. Development of the Game 28
3.3. “Fen ve Teknoloji” Game 31
3.4. Usability Test 36
3.5. Subjects 37
3.6. Research Design 38
3.7. Instruments 40
3.8. Data Analysis 41
4. RESULTS 42
4.1. Demographical Characteristics of the Subjects 42
4.2. ARCS Scores of the Participants 44
4.3. Gender and Motivation 45
4.4. Computer Use and Motivation 47
4.5. Game Play and Motivation 49
5. DISCUSSION AND CONCLUSION 52
5.1. Gender and Game Motivation 52
5.2. Computer Use and Game Motivation 53

5.3. Game Playing and Game Motivation 53

5.4. Implications of the Research Findings: 54

5.5. Recommendations for Future Research: 55

REFERENCES 57

APPENDICES 63

A. INSTRUCTIONAL MATERIALS MOTIVATION SURVEY (IMMS) 63

B. CONTENTS OF FEN VE TEKNOLOJİ GAME 67

C. ÖĞRETİM MATERYALLERİ GÜDÜLENME ÖLÇEĞİ 69

LIST OF TABLES

4. 1 Game preference (single or multi player)..... 43

4. 2 Game preference (sports, action, war/fight, educational, jigsaw, fantasy) 43

4. 3 ARCS scores of the participants from School A..... 44

4. 4 ARCS scores of the participants from School B..... 44

4. 5 ARCS scores of the participants from School C..... 45

4. 6 Descriptive statistics: ARCS mean scores of girls and boys..... 46

4. 7 Gender and motivation MANOVA result..... 46

4. 8 Descriptive statistics: ARCS mean scores of the three groups of users..... 48

4. 9 Mean differences of three groups of the users..... 49

4. 10 Descriptive statistics: ARCS mean scores of the three groups of users..... 50

4. 11 Game playing and motivation MANOVA result..... 51

LIST OF FIGURES

2. 1. Diagram of Maslow's hierarchy of needs 8

2. 2 Flow Theory (by Gustafson & Steven, 1994) 9

2. 3 Motivational Categories of ARCS Model 14

3. 1 Screenshot from Tomb Raider: The Last Revelation 29

3. 2 Four parts of the “Fen ve Teknoloji Game” 32

3. 3 Screenshot from tutorial level of the “Fen ve Teknoloji Game” 33

3. 4 Screenshot from photosynthesis level of the “Fen ve Teknoloji Game” 34

3. 5 Screenshot from vitamins level of the “Fen ve Teknoloji Game” 35

3. 6 Screenshot from the Yağlar-Karbonhidratlar-Proteinler level of the “Fen ve Teknoloji Game” 36

3. 7 Number of the students from different schools and gender 37

CHAPTER 1

INTRODUCTION

This study aims to explore motivational effects of computer games on elementary school students. For this purpose, a game was developed using Tomb Raider 4 engine and The Instructional Materials Motivation Survey (IMMS) was used to measure the motivational level of the students.

1.1. Background of the Study

Promising features of video games are interactivity, engagement and state-of-the-art computer technologies. As part of their educational potential in nature, video games are lately more and more considered by educators. They have high-quality multi-sensory rendering environment, hence students find the chance to experience "learning by doing" in the environment. However, the main reasons for this increasing interest are the medium's success, players' motivation and their deep engagement while playing games (Denis & Jouvelot, 2005).

It is commonly accepted that computer games have positive effects on players' motivation (Malone, 1981; Garris et al, 2002; Alessi & Trollip, 2001)

Moreover, game-playing has educational value (Crawford,1982). Research on using games in educational settings is relatively new and is rapidly growing (Kirriemuir & McFarlane, 2004).

There are some obstacles implementing games to educational settings (McFarlane, Sparrwhowk, & Heald, 2002). Although there are some research studies on making use of commercial games in school settings, content of such games generally do not match with the curriculum (McFarlane, Sparrwhowk, & Heald, 2002).

One leading study on motivation in games was conducted by Malone to answer the question "what makes computer games so interesting and exciting for children" (Malone, 1980). Malone explained essential characteristics of good computer games and other intrinsically enjoyable situation in three categories; "challenge", "fantasy" and "curiosity." Later with Lepper, he added "control" to this list. (Malone & Lepper, 1987). However, they mainly examined video games for entertainment (Tuzun, 2004).

To identify motivational elements for an online multiplayer educational computer game, Tuzun used Quest Atlantis which is an educational online computer game. In Quest Atlantis, students complete the educational activities (quests) to save the Atlantis from disaster. He found thirteen motivational elements in this respect: identity presentation, social interaction, playing, learning, ownership and control, fantasy, immersive context, curiosity, creativity, achievement, rewards, uniqueness, and context of support (Tuzun, 2004).

1.2. Statement of the Problem

Game generation is simply thinking differently from the previous generations and their educational needs are different from the previous generations' (Prensky, 2001). Marc Prensky developed ten cognitive characteristics of game generation children versus previous generations. Game generation children can process information much faster and do parallel processing. However, teachers lecture in a slow manner to ensure students' understanding. Often the students who play games disrupt the class environment because they get bored. In that sense, students have changed; however, the teachers have not changed to satisfy the new learner as explained (Prensky, 2001).

However, implementing games to educational settings is not that easy. One of the obstacles while using games in schools is the mis-match between the games and the curriculum (McFarlane, Sparrwhowk, & Heald, 2002). There is not much study intending to match educational games with the curriculum and their effects on students' motivation. It is so obvious that there is a need to conduct more and more research on content related games in the schools and their effects on students' motivation.

1.3. Purpose of the Study

Motivation is described as "the reasons that explain or justify actions." (Denis & Jouvelot, p.1, 2005). Since motivation is a key element in education, and in the case of game generation students' needs are different, there is need to understand how computer games effects students' motivation towards courses.

Aim of this study was to investigate whether motivational effects of computer games are related with gender, computer use and game play or not. Therefore, research question of the study was such:

- Is learner motivation in computer game based learning related to students' gender, computer use and game playing?

Sub-research questions are as the following:

- In terms of ARCS scores, is there a significant mean difference between girls and boys?

- In terms of ARCS scores, is there a significant mean difference between the three groups of students divided according to their weekly computer use?

- In terms of ARCS scores, is there a significant mean difference between the three groups of students divided according to their weekly game playing?

1.4. Significance of the Study

Although many educators discuss the motivational effects of the computer games, there is little empirical study on this issue (Gabrielle, 2003; Klein, & Freitag, 1991). This study seeks motivational effects of an educational computer game on elementary students.

The key element of an individual's engagement in an activity is motivation (Asgari, 2005). The best educational software will not make sense if the students are not ready to learn. In other words, it is necessary to motivate students to learn in order for making best use of an educational software. This study aims to explain motivational value of educational computer games and the effects of gender, weekly computer use and weekly game playing on motivation.

1.5. Definitions of Terms

Motivation:

In this study, motivation is defined as the students' interest to the content of the lesson and and willingness to make use of the materials used in this study which are measured by Instructional Materials Motivation Survey (IMMS).

Educational Game:

Educational game is a sub-category of games and it aims to create a change in players' knowledge. In this study game or educational game terms refer to games in the computer environment.

Gameplay:

In computer or video games, all the experiences of the a player during the interaction with the game system is called the gameplay. In this study, the "gameplay" terms is used for that purpose. However "game playing" represents students playing the games.

CHAPTER 2

LITERATURE REVIEW

In order to understand motivational effects of computer games on students, in this chapter, literature about motivation and motivation theories is thoroughly reviewed. Secondly, general meaning of games and computer games are also investigated. Lastly, issues about computer games and learning are reviewed.

2.1. Motivation

2.1.1. What is Motivation?

Motivation is an abstract concept and there is no specific agreement on the definition of the motivation. Motivation neither can be seen nor can be touched. It is not easy to come up with a specific definition of motivation because it can neither be observed nor directly be measured precisely, it can only be inferred from what people provide and do (Wlodkowski, 1999). Wlodkowski (1986, p.12 as cited in Tuzun 2004) defines motivation "as a word to describe those processes that can (a) arouse and instigate behavior; (b) give direction and purpose to behavior; (c) continue to allow behavior to persist; and (d) lead to choosing or preferring a particular behavior." In short, motivation is the reasons that explain or justify actions (Denis & Jouvelot, 2005).

Lumsden (1994) defines students' motivation as "naturally has to do with students' desire to participate in the learning process. But, it also concerns the reasons or goals that underlie their involvement or non-involvement in academic activities" (Lumsden, 1994, p.31)

2.1.2. Types / Models of Motivation

2.1.2.1. Hierarchy of Needs

According to Maslow, human beings are animals whose needs effect their behaviors. Satisfied needs do not affect human behaviors; however unsatisfied needs do. These needs have a hierarchical order and human beings are motivated to satisfy preliminarily lower level of needs. (Maslow, 1970)

Maslow (1970) categorized five types of needs. These are the physiological needs, the safety needs, the belongingness and love needs, the esteem needs, and the self-actualization needs. These needs are hierarchical and when lower level needs are satisfied other higher level needs pop up.(See Figure 2.1)

The Physiological Needs: The physiological needs are at the bottom of the hierarchy, and they include physiological needs of the body such as eating, drinking, sleeping, and having sex. These physiological needs are the most powerful over the other needs that are when a person lacks food, safety, love and esteem would most probably look for food much more strongly than other upper needs.

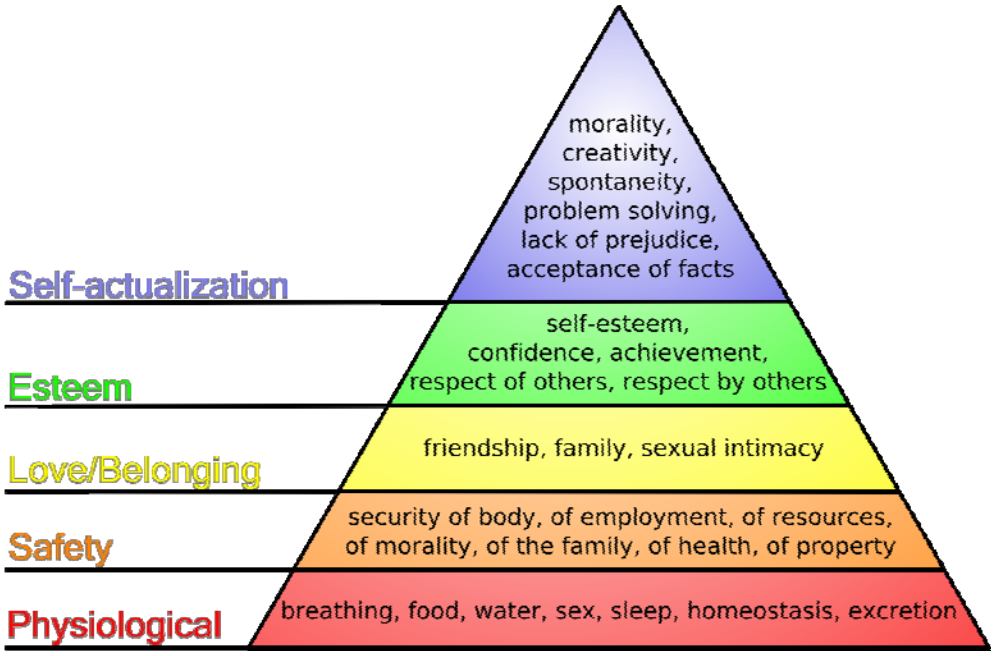

Figure 2. 1. Diagram of Maslow's hierarchy of needs (by Finkelstein, J.)

The Safety Needs: If physiological needs are satisfied, there then new set of needs emerges, which can be categorized as the safety needs including security; stability; dependency; protection; freedom for fear, from anxiety and chaos; need for structure, order, law, limits; strength in the protector; and so on.

The Belongingness and Love Needs: When the first two needs are satisfied, then the belongingness and love needs emerge. People feel the absence of friends, or wife or children at this level. They want to be a part of groups such as a family, a group of friends and even a social class.

The Esteem Needs: The esteem needs are categorized in two sets: the first one is the desire for strength, achievement, adequacy, mastery and competence, confidence in the face of the world, and for independence and freedom. The second one is called the desire for reputation or prestige (defining it as respect of

esteem from other people), status, fame and glory, dominance, recognition, attention, importance, dignity or appreciation.

The Self-Actualization Needs: When all level needs are gratified, then self-actualization need emerges; the tendency for becoming what person wants to be. These needs may vary from person to person; some wants to be a painter, painting pictures, some wants to be a basketball player (Maslow, 1970).

2.1.2.2. Flow Theory

Flow (optimal experience) is developed by Mihaly Csikszentmihalyi. Flow is defined as involvement in an activity completely. When a person is in the flow state, the ego goes away, time sense changes, he gets involved completely in what he/she is doing and the person uses his/her skills to the utmost (Geirland, 1996).

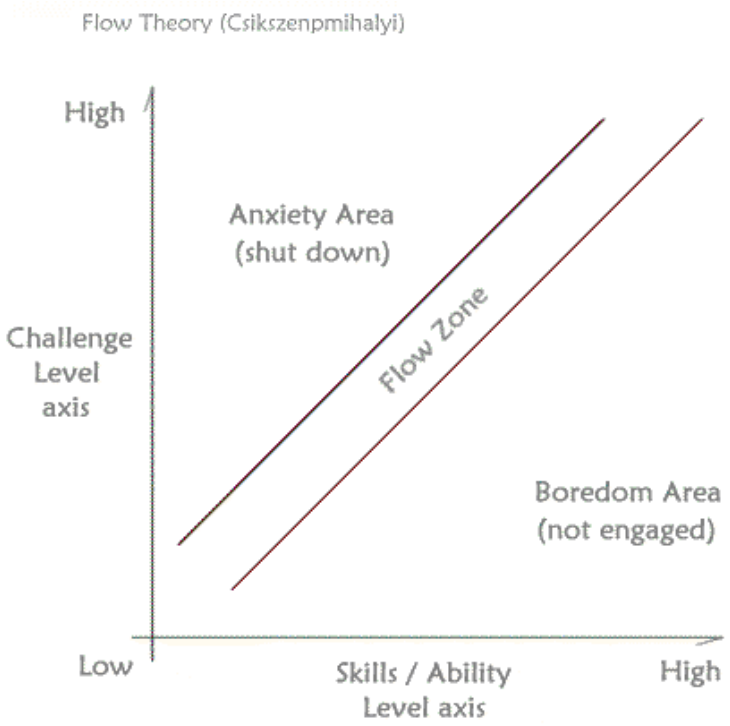

Figure 2. 2 Flow Theory (by Gustafson & Steven, 1994)

For a specific experience, the most important dimension of experience (challenge and skill) is shown in Figure 2.2. If the challenge level is too low against the individual's skill, then the participants will feel boredom. If the challenge level is too high measured against the individual's skill level then the participant will feel anxiety. (Csikzentmihalyi, 1990; Gustafson, 1994)

Csikzentmihalyi (1993) defines eight characteristic dimensions of flow experience:

1. Clear goals and immediate feedback.
2. Suited personal skills and level of challenge.
3. Action and awareness merge.
4. Concentration on the task.
5. Sense of potential control.
6. Loss of self-consciousness.
7. Changed sense of time.
8. Autotelic experince.

2.1.2.3. Taxonomy of Intrinsic Motivation for Learning

Thomas W. Malone and Mark R. Lepper developed Taxonomy of intrinsic motivation for learning. The taxonomy is based on their previous work (Bixler, 2006). They define intrinsically motivated learning as "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." (Malone & Lepper, 1987. p.229). Taxonomy contains two sections; individual motivations

(challenge, curiosity, control, and fantasy) and interpersonal motivations (cooperation, competition, and recognition).

2.1.2.3.1. Individual Motivations

Challenge: If activities are too easy or impossible to achieve, challenge will stimulate little intrinsic interest, however, intermediate level of difficulty in activity, challenge will stimulate the greatest level of intrinsic interest. Challenging activity must provide goals such that goal attainment is uncertain. Moreover it should provide performance feedback concerning goal attainment (Malone & Lepper, 1987.).

Curiosity: Curiosity is the most direct intrinsic motivation for learning and like challenge; it should be kept at optimum level. That is, the learning environments should be neither too complicated nor too simple with respect to the learner's existing knowledge to cause curiosity. Curiosity is divided into two categories; sensory curiosity and cognitive curiosity. Sensory curiosity occurs when attention attracting changes in sound, light, smell etc. Cognitive curiosity occurs when the existence knowledge seem inconsistent, incomplete, or unparsimonious. (Malone & Lepper, 1988; Malone, 1980)

Control: According to Malone and Lepper, control plays an important role in motivation. They explain the success of computer games in that sense providing that games give their players a powerful sense of control. Contingency, choice, and power contribute to the control feature of the learning experience. (Malone & Lepper, 1987)

Fantasy: Fantasy frequently makes computer games more interesting. Games that include fantasy represent physical objects or social situation which is

not actually present in real life. Malone (1980) used the term intrinsic and extrinsic fantasies but later Malone and Lepper (1988) used endogenous and exogenous fantasies. In an exogenous fantasy, the fantasy depends on the learned skills. In an endogenous fantasy, not only the fantasy depends on the skill but also the skill depends on the fantasy. (Malone & Lepper, 1987)

2.1.2.3.2. Interpersonal Motivations

Other types of intrinsic motivation depend on the existence of other people, that is, they are interpersonal. These forms of intrinsic motivation are cooperation, competition, and recognition. Although, cooperation seems good and competition seems bad, both of them provide powerful motivations for learning. These forms of intrinsic motivation are also divided into two types: endogenous and exogenous. To encourage cooperation, scoring of students' achievement can be a total score of each team member, this is exogenous form of cooperation and provides weak form of motivation. Jigsaw method can encourage endogenous cooperation. Competition can be encouraged easily by comparing performance in independent tasks. This form of competition is exogenous competition. To encourage endogenous competition people can work on dependent tasks with conflicting goals. Last form of intrinsic motivation is recognition. It is agreed that in case someone's efforts or accomplishments are recognized and appreciated by others this will increase motivation level of that person. (Malone & Lepper, 1987)

2.1.2.4. Keller's Motivation Theory and ARCS Model

John Keller (1979, 1987a, 1987b) has developed ARCS motivation model which has four categories of motivational conditions: attention, relevance, confidence and satisfaction.

ARCS model has three distinctive features (Keller, 1987a, p.2):

- ARCS model "contains four conceptual categories that subsume many of the specific concepts and variables that categorize human motivation."
- ARCS model "contains strategies to increase the motivational aspects of the instruction".
- ARCS model "incorporates a systematic design process (motivational design) that can be used effectively with traditional instructional design models."

Attention: First step for motivation is attention and it is required for learning. It is important to get and sustain learner's attention. It is easy to get learner's attention, but to sustain learner's attention is a challenge. Keller defined three types of attention; perceptual arousal, inquiry arousal and variability. (Keller, 1987a, 1987b)

Perceptual arousal provides novelty, surprise, incongruity or uncertainty. Inquiry arousal simulates curiosity by questions or problems to solve and variability incorporates methods and media to meet students' needs (Small, 1997).

Categories & Subcategories	Process Questions
Attention	
A.1. Perceptual Arousal	• What can I do to capture their interest?
A.2. Inquiry Arousal	• How can I simulate an attitude of inquiry?
A.3. Variability	• How can I maintain their attention?
Relevance	
R.1. Goal Orientation	• How can I best meet my learner's needs? (Do I know their needs?)
R.2. Motive Matching	• How and when can I provide my learners with appropriate choices, responsibilities, and influences?
R.3. Familiarity	• How can I tie the instruction to the learner's experiences?
Confidence	
C.1. Learning Requirements	• How can I assist in building a positive expectation for success?
C.2. Success Opportunities	• How will the learning experience support or enhance the students' beliefs in their competence?
C.3. Personal Control	• How will the learners clearly know their success is based on their efforts and abilities?
Satisfaction	
S.1. Natural Consequences	• How can I provide meaningful opportunities for learners to use their newly acquired knowledge/skill?
S.2. Positive Consequences	• What will provide reinforcement to the learner's successes?
S.3. Equity	• How can I assist the students in anchoring a positive feeling about their accomplishments?

Figure 2. 3 Motivational Categories of ARCS Model (Keller, 1987b, p.2)

Relevance: Relevance refers to the connection between the instructional content and the needs of the learner. Keller defined three subcategories for relevance; they are goal orientation, motive matching and familiarity (Keller, 1987a, 1987b). Goal orientation refers to presenting the objectives of the instruction to the learners. Motive matching is matching objectives of the instruction to students' needs. Lastly, familiarity is presenting the content in the way that the learner can understand, and can relate learners' experiences (Small, 1997).

Confidence: Confidence refers to learners' positive expectations for success. There are three methods to increase learners' confidence; learning requirements, success opportunities and personal responsibility (Keller, 1987a, 1987b). With learning requirements students are informed about learning, performance requirements and assessment criteria. Success opportunities are providing meaningful challenges opportunities for success. Personal responsibility is linking success of students with effort of students, not by chance or easy task (Small, 1997).

Satisfaction: Satisfaction refers to learners' positive feeling about their accomplishment because of reinforcements. Intrinsic reinforcements, extrinsic reinforcements and equity are strategies to provide satisfaction (Keller, 1987a, Gabrielle, 2003). Intrinsic reinforcement refers to encouraging and supporting intrinsic pleasure of the learning experience. Extrinsic reinforcement is providing positive reinforcement. Equity refers to maintaining consistent standards and consequences for success.

2.2. Games

2.2.1. Definition of Games

Dempsey et al. (1997) define games as “A game is a set of activities involving one or more players. It has goals, constraints, and consequences. A game is rule-guided and artificial in some respects. Finally, a game involves some aspects of a contest or a trial of skill or ability, even if that contest is with oneself.” (cited in Kasvi, p.2, 2000).

Crawford (1982) describes four fundamental characteristics of games; which are representation, interaction, conflict and safety. Games are simplified representation of real life and every game player somehow interact with opponent(s). For example, in chess, the player establishes a relationship with a representation of a battle, moreover, relationship with the opponent. The third characteristic, conflict, arises from the interaction. The player tries to achieve the goal; however the opponent(s) try to prevent the player. The conflict between the player and opponent(s) is inevitable and fundamental to all games. The last characteristic is safety; conflict implies danger, danger implies physical risk of harm. Games permit players to live experiences that in real life could be dangerous, without having the concern of physical danger. Shortly, game is a safe way to live reality (Crawford, 1982).

Egenfeldt-Nielsen (2003) separated simulations and games by the existence of the goals. Games have clearly described goals; however, simulations do not have clearly defined goals. They add that when setting up a goal that will convert simulations to games.

2.2.2. Game Types

Chris Crawford (1982) in his book The Art of Computer Game Design categorized games in five major types.

Board Games: These types of games consist of a playing surface divided into areas that use movable pieces that the player can move according to a set of rules.

Card Games: These types of games utilize 52 symbols generated from 13 ranks and 4 suits. Different combinations of the cards have different values.

Athletic Games: In this type of games primary concern is to use player's physical skills to perform a specific set of actions. Athletic games are different than athletic competitions. In athletic competition the competitors do not have interaction with others.

Children's Games: This type of games can also be associated with the use of physical skills and little mental skills but its primary concern is the use of social skills and interaction with others.

Computer Games: The most common form of this type of games is skill and action game; mostly violent in nature and emphasizing hand-eye coordination.

After defining game types, Crawford (1982) created taxonomy of computer games. He divided computer games into two main categories: skill-and-action games and strategy games. Skill-and-action games emphasize perceptual and motor skills, strategy games emphasize cognitive effort. Skill-and-action games are categorized as combat games, maze games, sport games, paddle games,

race games and miscellaneous games. Similarly, strategy games are categorized as adventures, D&D games, war games, games of chance, educational and children games and interpersonal games.

However, there is no standard categorization of computer games (Kirriemuir & McFarlane, 2004; Crawford, 1982) and they often overlap (Crawford, 1982; Prensky, 2001; Hogle, 1996). Moreover, Marc Prensky mentions about eight genres of computer games which are action games, adventure games, fighting games, puzzle games, role playing games, simulation games, sport games and strategy games.

Action Games: Action games are possibly the most basic and broadest type of the games. This type of games emphasizes actions that the player performs reflexively in time. Fighting, first-person shooters, car races fall into this category

Adventure Games: In adventure games, the player finds the way in the unknown virtual world, pick ups objects and solves a number of logic puzzle.

Fighting Games: In these types of games the player fights with the other character controlled by computer or other player. The classical example is Mortal Kombat.

Puzzle Games: In puzzle games the player should solve logical puzzles or navigate in a maze. Tetris-variants are classical example of this type.

Role Playing Games: Where the player plays a character such as human, orc, elf, wizard etc. with individual characteristics. The player gets experience and equipment via fight and action.

Simulation Games: These types of games are related to constructing cities (Sim City), managing company or pilot a plane (Flight Simulator).

Sport Games: Sports games imitate playing traditional physical sports. Some of this category emphasizes actually playing the sports; however others emphasize the strategy of the sports.

Strategy Games: The player controls the big groups such as army or civilization to evolve the way he wants or recreation of historical battles and wars. Classical example is Civilization.

2.2.3. Why do People Play Games

Most college students in America (n=1162) associated positive feeling with games. 36% students say "pleasant", 34% of them say "exciting" and 45% of them say "challenging" (Jones, 2003). According to Malone (1981) there are four elements contribute fun in games are challenge, curiosity, control and fantasy. People play games because it relieves the stress level of the people and causes emotions to rise (Hostetter, 2002). Marc Prensky, in his book Digital Game Based Learning, states that video games are potentially the most engaging pastime activity and he gives twelve reasons for this (Prensky, 2001)

1. Games are a form of fun. That gives us enjoyment and pleasure.
2. Games are form of play. That gives us intense and passionate involvement.
3. Games have rules. That gives us structure.
4. Games have goals. That gives us motivation.
5. Games are interactive. That gives us doing.
6. Games are adaptive. That gives us flow.
7. Games have outcomes and feedback. That gives us learning.
8. Games have win states. That gives us ego gratification.
9. Games have conflict/competition/challenge/opposition. That gives us adrenaline.
10. Games have problem solving. That sparks our creativity.
11. Games have interaction. That gives us social groups.
12. Games have representation and story. That gives us emotion. (Prensky, 2001, p.106)

2.3. Simulations:

Chess is one of the oldest and most popular games around the world. The game is played by two players on a board. Each player has sixteen chessmen. They battle on the board to beat the opponent. Chess may be the oldest simulation. It was initially devised as means to teach the arts of war - battle strategies and tactics - the origins of educational simulations can be traced back to pre-Christian times (Widdison, Aikenhead & Allen, 1998).

Widdison, Aikenhead and Allen, continue the dictionary definition of simulation which is imitation of the real life conditions. However, it is required to expend this definition. Imitation has meaning of decreased representation of the real world. To have a value, simulation should contain some of the key characteristics of the real life. How much a simulation can be representative, in that degree, it will be useful.

Computer simulation is any software application that gives access to model of a theoretical or physical system. The most important feature of the simulation than any other animation or preprogrammed hypermedia is that simulations are reactive which means changing an input variable changes the behavior and output of the simulation (Thomas, Schnurr, & Tomes, 1998)

Creating a simulation is hard and expensive (it may cost for millions) then any other materials (Aldrich, 2003). Cost, danger, inaccessibility and time are the main difficulties in creating simulations. Simulations are created for scientific and educational purposes. Scientific simulations provide scientists a way to study a dangerous situation in a safe environment such as a meteorologist studying a tornado. Educational simulations are designed to teach someone about the system

by observing the result of actions or decisions through feedback generated by the simulation in real-time, accelerated time, or slowed time (Rieber, 1996).

2.3.1. Advantages of Simulations:

Widdison et. al. summarizes the advantages and disadvantages of simulation in that way:

- Simulations are bridge between the classroom (theory) and the real world (practice) (Gredler, 1994). There is a big gap between the academic world and the real world. Simulation can enable players to experience the real life situations.
- Simulations give chance to the player felling of participation without taking any risks such as injury, upset etc.
- One of the valued learning strategies is trial and error. Simulations give chance to infinite number of trials to the player to find better solutions to the problems.
- Simulations enable the player to get required skills to dealing with unlikely situations. For example, air emergency rarely occurs; however, pilots have received intensive training about these rarely occurring situations. Practically; there is not any other way to give training to the pilots about these situations.
- Simulations are imitations of the real life situations. However, process of the situations can be accelerated or slowed down by using simulations.
- Shy or nervous people may feel more comfortable about the results since they will be secret (Widdison, Aikenhead & Allen, 1998).

Moreover simulations will reveal students misconceptions and understanding about the subjects. Also they give information about the learners' problem solving strategies (Gredler, 1994).

2.3.2. Disadvantages of Simulations:

- "Simulations cannot, in truth, come close to the character and complexity of the real world. We may be seriously deluding ourselves if we believe that simulations can effectively bridge the gap between theory and practice" (Rheingold, 1992) (cited in Widdison, Aikenhead & Allen, p.289, 1998).
- Simulations are the imitation of the real world. However simulations can only represent the real world from the designers' visions. Simulation will be subjective not really represent real world.
- Teachers will need extra time to be trained for using simulation effectively. This requires learning new teaching techniques and applying these techniques will not be so easy. Teachers' workload will increase.
- Syllabuses should be revised for accommodating simulations. There is no complete consensus on the question whether simulations are superior to any other teaching methods or not. Is it worth to change existing teaching methods with simulations?

There are some suggestions abou the value of simulations depending on enhancement of students' motivation. It causes improvement in low motivated students. What about the eager, motivated learners?

2.4. Games and Learning

Computer games are seen as excellent learning tools because the computers give chance to the learner to adjust the difficulty of the game and challenge. Moreover, the user also can access to the game whenever he/she want and can play many times to get the higher scores (Hostetter, 2002).

Recent Home Office study shows that children who play computer games are more intelligent than the average and go on to university and higher-ranking jobs (Travis, 2001). Moreover, there are many researchers emphasizing the advantages of computer games and the skills player acquired.

Game players gain some cognitive skills while trying to achieve the objectives of the game. These cognitive skills are "organizational strategies (paying attention, self-evaluating, and self-monitoring), affective strategies (anxiety reduction and self-encouragement), memory strategies (grouping, imagery, and structured review), and compensatory strategies (guessing meaning intelligently) (Jacobs & Dempsey, 1993; Oxford & Crookall, 1988.)." (cited in Hogle, p.11, 1996).

Prensky (2001) argue that game generation is different than previous generation in cognitive characteristics. Prensky (2001) compared two generation and defined ten different cognitive traits:

a. Twitch speed vs. conventional speed
b. Parallel processing vs. linear processing
c. Graphics first vs. text first
d. Random access vs. step-by-step
e. Connected vs. standalone
f. Active vs. passive
g. Play vs. work
h. Payoff vs. patience

i. Fantasy vs. reality
j. Technology-as-friend vs. technology-as-foe´ (Prensky 2001, p. 52).

2.5. Games in Education

According to Kirriemur and McFarlane (2004) there are two common reasons for development of games for education. First, to use motivational power of the games that makes learning fun. Second, learning by doing in games offers a powerful learning tool. Garris, Ahlers, and Driskell (2002), claim that computer games captured the attention of educational professionals because; first, there has been shift from traditional didactic model of instruction to a learner-centered approach, which emphasize more active learner role. Second, there is some empirical evidence that games can be effective tools for increasing learning and understanding of complex subjects. Lastly, "…the intensity of involvement and engagement that computer games can invoke. There is a large cohort of individuals, youth and young adults sometimes referred to as *generation.com*, for whom computer games provide an immensely compelling and rewarding experience" (Garris, Ahlers, & Driskell, 2002, p.441). According to Alessi and Trollip (2001) games have many advantages for learning environments, one of the important one is they can motivate learners. Kirriemur and McFarlane (2004) divided three types of learning outcomes of the games in school settings: learning from the simulated task, knowledge built through the content of the game and skill improvement result from playing games.

Academic games are used for "(a) practicing and/or refining already-acquired knowledge and skills, (b) identifying gaps or weaknesses in knowledge or skills, (c) serving as a summation or review, and (d) developing new relationships among concepts and principles"(Gredler, 1994, p.28).

Gredler adds five design criteria for well-designed games which is challenging and interesting at the same time it requires implementation of particular knowledge or skills. These criteria are:

1. Winning should be based on knowledge or skills, not random factors

2. The game should address important content, not trivia.

3. The dynamics of the game should be easy to understand and interesting for the players but not obstruct or distort learning.

4. Students should not loose points for wrong answers.

5. Games should not be zero-sum exercises (Gredler, 1994)

However, according to Kirriemur and McFarlane (2004) most educational games do not meet the expectations, because:

- The games are too simple when compared with video games
- The tasks in the game are repetitive and this quickly results in boring of the players and excessive 'work' on them.
- Poorly designed task, they do not support progressive understanding.
- The activities in the games are limited.
- The player realized that the games force them to learning.

Although using games in the lessons was motivating, there are some obstacles in implementing games in school settings. There are many technical obstacles to be overcome and fixed length of lesson is another constraint (Standford, et al. 2006). One of the important obstacles to use games in schools is the mis-match between games contents and the curriculum (McFarlane, Sparrwhowk, & Heald, 2002).

CHAPTER 3

RESEARCH METHODOLOGY

This chapter presents overall design of the study, development phases of "Fen ve Teknoloji" game, participants, data collection instruments, data collection procedure, data analysis procedure and limitation of the study.

3.1. Overall Design of the Study

The aim of this study was to investigate the motivational effects of computer games related with computer use and game play preferences of students. Therefore research question of the study was:

- Does learner motivation in computer game based learning relate to students' gender, computer use and game playing?

In this study, students' motivation was measured with the Instructional Materials Motivation Survey (IMMS) (see Appendix A). IMMS measures attention, relevance, confidence and satisfaction dimensions of motivation and total motivation of the learners. Participants of this study was divided in to three groups namely "little", "average", and "high" according to their computer use and game play time at week. Therefore; the sub questions of the research question were:

- In terms of ARCS scores, is there a significant mean difference between girls and boys?

- In terms of ARCS scores, is there a significant mean difference between the three groups of students (little, average and high) divided according to their computer use in a week?

- In terms of ARCS scores, is there a significant mean difference between the three groups of students (little, average and high) divided according to their game play in a week?

3.2. Development of the Game

Actually Fen ve Teknoloji game was new levels of Tomb Raider 4 game by designed Tomb Raider Level Editor. Tomb Raider Level Editor is free level editor tool for non-commercial use. Tomb Raider Level Editor comes with Tomb Raider 4 game engine and other tools to create new levels. It can be downloaded from its' official web site.

Tomb Raider: The Last Revelation which is the forth game of the Tomb Raider series is a Third-person action/adventure game. The Player controls the actions of the female character Lara Croft in the view of third-person perspective (See Figure 3.1). The actions are running, jumping, walking, climbing, crawling, shooting etc. The game involves frequent jumping of Lara from platform to platform. Jumping distance is often precise and measured by blocks which are the units in the game. The game involves series of quest for various objects and the

player can get these objects after overcoming the obstacles which are either puzzles or enemies. The emphasis is largely on the use of range of weapons. (Atkins, 2003)

Figure 3. 1 Screenshot from Tomb Raider: The Last Revelation

Process of creating level was started with interview with the principle of a private school in Ankara (School A).Capabilities of the game engine was shown to the principle. These small game components were related to eclipse, and volcano which were created by using Tomb Raider Level Editor. The principle was formerly a biology teacher and she directed the researcher to the biology teachers of the school.

After observing these pieces of the game, biology teachers picked units from the curriculum that subjects can be given to the students in the game environment. While deciding these subjects, they concentrated on which subjects are hard to understand and abstract for the students. Photosynthesis is one of the

subjects where the students have problems with understanding. Then the other two subjects; vitamins, and “carbohydrates, fat and proteins” were chosen.

Biology teachers prepared a document containing the main points of these five subjects (See Appendix B). The document was sent to the researcher via e-mail also the researcher warned about the points which the students have difficulty to understand.

Based on this content the scenario of the game was prepared and the levels were created. From these subjects three levels were created. The three levels in the game was a) photosynthesis, b) vitamins and c) carbohydrates, fat and proteins. The teachers evaluated these levels and gave some feedback. According to their feedback, levels were improved and also tutorial level was added to the game.

Each created versions of the levels was shown to the teachers, according to their feedback, levels were improved. Final beta version of levels was evaluated by biology teachers from different schools.

Download link and four questions were sent to a group of biology teachers via e-mail. After playing the game, they were asked to answer the following questions:

-Can this application be used in biology lesson?

-Can this application increase students’ motivation?

-Does this application have some parts causes misconception?

-Does this application have some parts needs to be improvement?

-Can you evaluate it in general?

According to their evaluation, the game was revised again. Lastly, the usability test of the game has done with five sixteen years old students in a Summer Computer Camp. Hence, the game was evaluated by the target group.

They played the game in a computer laboratory with headsets. While they were playing game, they encouraged talking about the game and their behavior and talk with each other were recorded by video camera. When they finished the game, they are asked about the educational value of the game, which parts of the game was too easy or too difficult for them and any other suggestion to improve the game.

Major aim of the usability test was

- To evaluate the educational value of the game
- To evaluate motivational effects of the game on the children
- To determine which parts of the game need to be improved

3.3. "Fen ve Teknoloji" Game

As mentioned before Fen ve Teknoloji game was created by using Tomb Raider Level Editor. However, some features of Tomb Raider game were also changed for the educational purposes of Fen ve Teknoloji game. Firstly, in the original game Lara Croft uses various guns. This characteristic of the game was not suitable for students. Therefore, the guns were removed from the game. Also, in original game Lara Croft is mostly adult, only in few parts of the original game the character was a child Lara. In Fen ve Teknoloji game child Lara character was used.

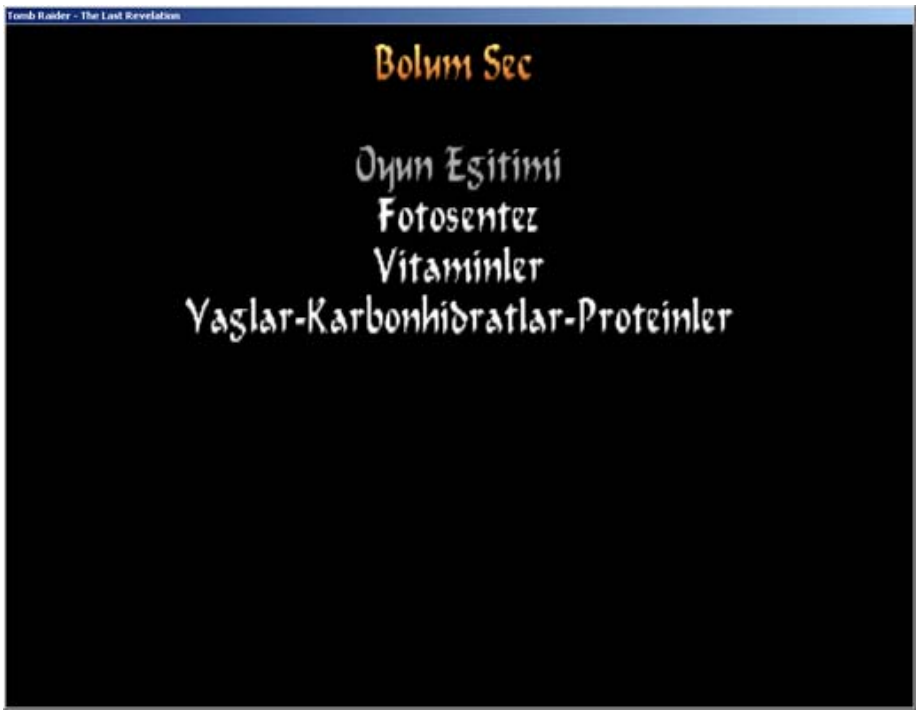

Figure 3. 2 Four parts of the "Fen ve Teknoloji Game"

Fen ve Teknoloji game consisted of four levels; a) Oyun Eğitim b) Fotosentez c) Vitaminler d) Yağlar-Karbonhidratlar-Proteinler. (See Figure 3.2) The first level of the game "Oyun Eğitimi" was the tutorial level of the game. This level is designed to teach the player to move or actions such as jumping, swimming, climbing etc. In this level, the player hears verbal instructions to overcome some obstacle. These verbal instructions explain which key on the keyboard responsible for specific actions. For example when the player reached water, the player was instructed as "You should press the "Alt" key on the keyboard to swim. When you reached the edge, you should press the "Ctrl" key on the keyboard to leave the water." At the end of the level the player got the basic requirements to game and the second level "Fotosentez" will start automatically. Figure 3.3 is a screenshot from "Oyun Eğitimi" level.

Figure 3. 3 Screenshot from tutorial level of the "Fen ve Teknoloji Game"

The second level of the game is "Fotosentez". Actual game starts at this level. In this level, the character Lara falls in to a place and the player is verbally instructed as to escape from this place he/she has to find three crystal keys. After that the first door opens. When the player passes the door again the player is instructed as to reach the green crystal key the player should make the trees photosynthesis. When the player supplies water and sun light to the trees he/she can get the first crystal key. Figure 3.4 is a screenshot from this level.

Figure 3. 4 Screenshot from photosynthesis level of the "Fen ve Teknoloji Game"

The third level of the game is "Vitaminler" level. When the first crystal key placed its place, the second door opens. Behind that door there is a huge room. In that room there are six vitamin blocks, each block represents one vitamins and represented vitamin name on the blocks and these vitamin blocks are movable. Also, there are six cavities on the walls; surroundings of each cavity have clues of one vitamin. Moreover, on one wall there are six torches each torch responsible from one vitamin. When one vitamin is placed to its' cavity, responsible torch will lit. This is a feedback mechanism for the correct placement of the vitamins. One of the vitamins has already placed its own cavity and its' torch is burning as an example. When the player placed the rest five vitamin blocks to correct cavities, he/she can get the second crystal key. Figure 3.5. is screenshot from this level.

Figure 3. 5 Screenshot from vitamins level of the "Fen ve Teknoloji Game"

When the second key is placed its place, the last level's door opens. The last level of the game is Yağlar-Karbonhidratlar-Proteinler and related to carbohydrates, proteins and fat. In this level the player should correctly answer to the questions which appear in front of him/her. These questions are multiple choice type questions and answer is one of carbohydrates, proteins and fat. To answer the question the player should jump to the correct square. The player should jump to K square, for carbohydrates; P square, for proteins and Y square, for fat answer (see Figure 3.6.). If the player can answer all questions correctly, then he/she can get the last crystal key. If any of the question's answer is wrong, then the player has to start from the beginning.

When the last crystal key is placed, a gate opens and stairs to the gate appear. When the player reached the up, the game finishes and "congratulations you finished the game" notes appears on the screen.

Figure 3. 6 Screenshot from the Yağlar-Karbonhidratlar-Proteinler level of the "Fen ve Teknoloji Game"

3.4. Usability Test

Major aim of the usability test was

- To evaluate the educational value of the game
- To evaluate motivational effects of the game on the children
- To determine which parts of the game need to be improved

The usability test of the game has been performed with five sixteen years old students in a Summer Computer Camp. They played the game in a computer laboratory with headsets. While they were playing game, they encouraged talking about the game and their behavior and talk with each other were recorded by

video camera. When they finished the game, they are asked about the educational value of the game, which parts of the game was too easy or too difficult for them and any other suggestion to improve the game.

3.5. Subjects

Two private schools (School A and School B) and one public school (School C) participated to this study. These three schools are located in Ankara. All participants from the schools are 5th grade students.

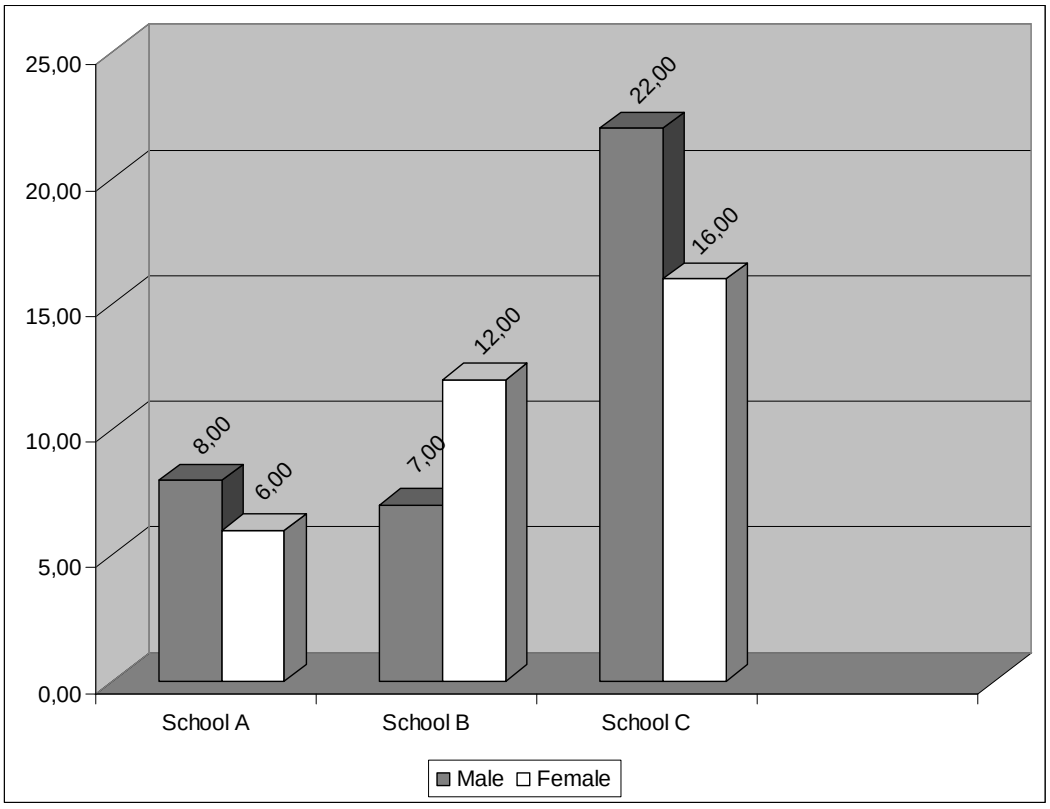

Figure 3. 7 Number of the students from different schools and gender

From School A 8 male and 6 female, from School B 7 male and 12 female, from School C 22 male and 16 female, totally 37 male (52.1 %) and 34 female (47.8 %) students participated to this study. Figure 3.7 is graphical representation of students and their gender.

24 (33.8 %) of the students are ten, 42 (59.2 %) of the students are eleven and 1 (1.4 %) of the students is twelve years old and 4 students did not indicate their ages.

63 (88.7 %) of the students indicated that there is a computer at their home. 6 (8.5 %) of them have not computer at home and 2 (2.8 %) of the students did not answer this question.

When the game preferences considered, 24 (33.8 %) of the students preferred single player games, 17 (23.9 %) of the students preferred multiplayer games and 30 (42.3 %) preferred both single player and multiplayer games.

Most liked game types was adventure games; 49 of the students like adventure games, 31 of them like sports games, 30 of them like fantasy games, 25 of them like war/fight games, 16 of them like educational games and same number (16) of the students like jigsaw games.

3.6. Research Design

All three schools had already finished the nutrition chapter at fifth grade. Therefore, the students who had participated to this study were knowledgeable about the topics in the game. To conduct the study in all three schools, students attended the computer laboratory and each student used one computer. From

School A and School B only one fifth grade classes attended however from School C two fifth grade classes attended to the study.

There were 20 computers and projection in all schools' computer laboratory. While playing the game students had to hear vocal instruction in the game, and sound of the game can cause noise in laboratory therefore each student used a headset.

At the start of the lesson the researcher introduced the game to the students and gave instruction about how to play the game by using projection. It took 5-10 minutes. Then students played the game individually until the last ten minutes of the lesson. At the end of the lesson students asked to fill Instructional Materials Motivation Survey (IMMS). Most of the students had not played Tomb Raider game before. Therefore, some of the students had some problem while playing the game such as when they enter the water they could not remember the swim key and they was worried about killing the character. In similar cases, the researcher helped them to overcome that specific obstacle to keep the students in flow state.

In School A and School C students filled the survey just after they played the game. However, in School B, because of an administrative problem the students filled the survey two days after they had played the game. In School A and School C, before they filled the survey, the researcher explained them how they fill the survey. While the students filling the survey, the researcher answered the students' questions if there still were unclear parts, or questions. In School B (the last school the study conducted) the researcher explained to the teacher who would conduct the survey how she would conduct the survey. In the next lesson, she implemented the survey.

3.7. Instruments

3.7.1. Instructional Materials Motivation Survey (IMMS)

The Instructional Materials Motivation Survey (IMMS) is a Likert-type scale with 36 items. Participants were asked to reply to each statement, according to the materials they had just studied. Each response of the participants is between 1 (Not True) and 5 (Very True). The minimum score of the scale is 36 and maximum scare is 180 with midpoint of 108. There are 5 scales, 4 of them for ARCS components (Attention, Relevance, Confidence, Satisfaction) and 1 of them for ARCS total score. There are 10 reversed items. There are 12 questions for attention, 9 questions for relevance, 9 questions for confidence and 6 questions for satisfaction. (Keller, 1993) (See Appendix A).

During his visit to METU, after seeing the game and research design, John Keller who is the developer of IMMS approved that IMMS could be used in this study.

In this study, "Öğretim Materyalleri Güdülenme Ölçeği (ÖMGÖ)" (See Appendix C), which is Turkish version of Instructional Materials Motivation Survey (IMMS) was used. IMMS was translated to Turkish by Jale Balaban Salı and she evaluated its cronbach alpha value as 0.90 (Salı, 2004, p.190).

To collect demographical information from the students 9 question added to "Öğretim Materyalleri Güdülenme Ölçeği (ÖMGÖ)". These questions are related to the students' gender, age, computer use, game play and game preferences. Moreover, "page" words in the ÖMGÖ had been changed with "screen" words at the questions 7, 15 and 31. Because, ÖMGÖ was used to

measure the effect of the game on students motivation, using page for the game would be nonsense for the game.

3.8. Data Analysis

In this study, effects of the students' computer use and students' game play on motivation in computer game based learning were examined. Therefore, students' computer use at week and game play at week grouped as little, average and high. Their effects on total motivation and sub dimensions (attention, relevance, confidence and satisfaction) were examined. Data were analyzed using one-way multivariate analysis of variance (MANOVA) to examine if the mean differences were significant.

CHAPTER 4

RESULTS

This chapter presents findings regarding the research question of the study. The questionnaire used in this study consisted of two parts; demographics and Instructional Materials Motivation Survey (IMMS). In this chapter, firstly demographics of the subjects were presented and then the relation between the ARCS scores and gender, computer use and game playing were presented.

4.1. Demographical Characteristics of the Subjects

Data was collected from 3 primary schools. Two of the schools were private schools (School A and School B) and one was a public school (School C). 8 male and 6 female students from School A, 7 male and 12 female students from School B and 22 male and 16 female students from School C participated to this study.

When the students were asked where they use computer, (they could choose more than one places) they rated “at home”; highest (97.2 %) and it was followed by “at school” (47.9 %), “at internet café” (12.7 %) and “other” such as at relatives’ or friends’ home (18.3 %).

Of the 33.8 % participants preferred single player games, whereas 23.9 % of them preferred multiplayer games and 42.3 % of them chose both of single and multiplayer games. Table 4.1. summarizes the game preference of the students.

Table 4. 1 Game preference (single or multi player)

	Frequency	Percent
Single Player	24	33,8
Multi Player	17	23,9
Both (Single and Multi player)	30	42,3

Table 4. 2 Game preference (sports, action, war/fight, educational, jigsaw and fantasy)

	Frequency	Percent
Sports	31	43,7
Action	49	69
War/Fight	25	35,2
Educational	16	22,5
Jigsaw	6	8,5
Fantasy	30	42,3

Game preferences of the participants according to game types are presented in Table 4.2. (In this question, the participant could choose more than one types of game.) Most students preferred action types of games (69 %), and sports (43,7 %), fantasy (42,3 %), war/fight (35,2 %), educational (22,5 %) and jigsaw (8,5 %) types of games came respectively.

4.2. ARCS Scores of the Participants

The Instructional Materials Motivation Survey (IMMS) measures participants' ARCS (attention, relevance, confidence and satisfaction) score and total motivation score. However, number of the questions related these four dimensions are not equal. There were 12 attention related, 9 relevance related, 9 confidence related and 6 satisfaction related questions and the scale was Likert-type scale with 1 (Not True) and 5 (Very True). Therefore, maximum score for attention was 60, for relevance and confidence were 45, for satisfaction was 30 and for total was 180. Table 4.3, Table 4.4 and Table 4.5 show ARCS scores of the participants from different schools.

Table 4. 3 ARCS scores of the participants from School A

	N	*M*	*SD*
Attention	14	50,43	5,18
Relevance	14	36,50	4,18
Confidence	14	36,93	5,68
Stisfaction	14	27,86	3,16
Total	14	151,71	13,45

Table 4. 4 ARCS scores of the participants from School B

	N	*M*	*SD*
Attention	19	50,16	7,36
Relevance	19	36,26	4,81
Confidence	19	39,16	4,51
Stisfaction	19	27,26	3,54
Total	19	152,84	17,41

Table 4. 5 ARCS scores of the participants from School C

	N	*M*	*SD*
Attention	38	45,45	5,94
Relevance	38	34,37	3,75
Confidence	38	35,47	5,87
Stisfaction	38	26,21	2,97
Total	38	141,50	12,83

A t test was performed on ARCS scores of all 3 groups to test homogeneity of the groups. The t test results revealed that three groups (School A, B, C) come from the same population and there was no significant difference among the mean scores of the three groups on the ARCS scores. (t test results between School A and School B was $t(22)= 0,162$, $p>0,05$, School B and School C was $t(37)= 1,711$, $p>0,05$ and School A and School C was $t(41)= 1,437$, $p>0,05$) As a result of this analysis, data from three groups were combined.

4.3. Gender and Motivation

To examine, if there were any difference between girls' and boys' motivation, girls' and boys' ARCS mean scores was compared by using one way multivariate analysis of variance (MANOVA). Although, girls' ARCS total score and attention, confidence, satisfaction sub-scores were slightly higher than boys'

(See Table 4.6), however the results of MANOVA revealed that these differences were not significant. Table 4.7 summarizes that there were no significant differences between girls' and boys' ARCS mean scores.

Table 4. 6 Descriptive statistics: ARCS mean scores of girls and boys

	Gender	*M*	*SD*	*N*
Attention	Girl	48,50	6,98	34
	Boy	46,95	6,22	37
	Total	47,69	6,59	71
Relevance	Girl	35,18	4,37	34
	Boy	35,41	4,09	37
	Total	35,30	4,20	71
Confidence	Girl	37,09	5,71	34
	Boy	36,43	5,65	37
	Total	36,75	5,65	71
Satisfaction	Girl	27,26	3,24	34
	Boy	26,41	3,14	37
	Total	26,82	3,20	71
Total	Girl	148,03	16,09	34
	Boy	145,19	14,25	37
	Total	146,55	15,12	71

Table 4. 7 Gender and motivation MANOVA result

	df	*F*	*p*
Attention	2	0,98	0,36
Relevance	2	0,05	0,82
Confidence	2	0,24	0,63
Satisfaction	2	1,29	0,26
Total	2	0,62	0,43

4.4. Computer Use and Motivation

To answer the research question, the participants' weekly computer use and game playing in a week were investigated. The participants were divided into three groups according to their weekly computer use mean scores. The participants who use a computer less than 5 hours at week were grouped as "little" users, the participant who use computer between 5 to 10 hours at week were grouped as "average" users and the participants who use computer more than 10 hours were grouped as "high" users. These three groups of users' ARCS scores were compared by using one-way multivariate analysis of variance (MANOVA). Table 4.8 shows the mean scores of "little", "average" and "high" computer user.

Table 4. 8 Descriptive statistics: ARCS mean scores of the three groups of users

	Weekly computer use	*M*	*SD*	*N*
Attention	Little	47,44	7,11	16
	Average	47,10	5,61	31
	High	48,63	7,55	24
	Total	47,69	6,59	71
Relevance	Little	34,38	5,12	16
	Average	35,94	3,71	31
	High	35,08	4,17	24
	Total	35,30	4,20	71
Confidence	Little	35,25	4,81	16
	Average	37,00	5,44	31
	High	37,42	6,42	24
	Total	36,75	5,65	71
Satisfaction	Little	25,06	3,75	16
	Average	27,39	2,81	31
	High	27,25	2,97	24
	Total	26,82	3,20	71
Total	Little	142,13	16,17	16
	Average	147,42	12,94	31
	High	148,38	16,99	24
	Total	146,55	15,12	71

Three groups of the students' (the little, average and high computer users) motivation towards the game was analyzed by one-way MANOVA. The results showed that there were no significant difference at total motivation scores of the these three groups $F(2,71) = 0,91$, $p>0,05$. When looked at the four sub-scales of (attention, relevance, confidence and satisfaction) the motivation, only significant differences was at satisfaction sub-scale between little and average computer user.

Subsequent to the MANOVA, the Tukey's HSD method was used to make comparisons between group means for motivation. As presented in Table 4.9; the mean scores of the average computer users were slightly higher than the mean scores of the little computer user (p=0,45).

Table 4. 9 Mean differences of three groups of the users

	Weekly computer use (I)	Weekly computer use (J)	Mean Difference (I-J)	*p*
Attention	High	Little	1,19	,845
		Average	1,53	,677
	Little	Average	0,34	,985
Relevance	High	Little	0,71	,861
		Average	-0,85	,738
	Little	Average	-1,56	,456
Confidence	High	Little	2,17	,466
		Average	0,42	,960
	Little	Average	-1,75	,577
Satisfaction	High	Little	2,19	,080
		Average	-0,14	,985
	Little	Average	-2,32(*)	,045
Total	High	Little	6,25	,412
		Average	0,96	,971
	Little	Average	-5,29	,495

Based on observed means.
* The mean difference is significant at the ,05 level.

4.5. Game Play and Motivation

The other sub research question of the study tried to discover whether there were any relationship between the students' weekly game playing time at week and their motivation towards games. Therefore, the participants' weekly

game playing time was collected and the participants divided into three groups (little, average, high) according to time they spend on games.

Table 4. 10 Descriptive statistics: ARCS mean scores of the three groups of users

	Game play at week	*M*	*SD*	*N*
Attention	Little	48,22	6,60	23
	Average	47,41	6,25	22
	High	44,38	5,42	13
	Total	47,05	6,30	58
Relevance	Little	35,00	4,02	23
	Average	36,05	4,16	22
	High	34,92	4,15	13
	Total	35,38	4,06	58
Confidence	Little	37,22	4,66	23
	Average	35,91	6,10	22
	High	36,69	7,06	13
	Total	36,60	5,74	58
Satisfaction	Little	26,74	2,82	23
	Average	26,82	3,43	22
	High	26,62	3,59	13
	Total	26,74	3,18	58
Total	Little	147,17	13,68	23
	Average	146,18	15,55	22
	High	142,62	16,32	13
	Total	145,78	14,85	58

The participants who spend less then 5 hours at week on games were grouped as “little” players, the participants who spend between 5 to 10 hours at week on games were grouped as “average” players and the participants who spend more than 10 hours at week on games were grouped as “high” player. The

motivation mean scores measured by IMMS of these three groups were given in Table 4.12.

The ARCS motivation scores of the “little”, “average” and “high” players were compared by using a one-way MANOVA. As presented in Table 4.12, there were not any significant differences at either total motivation score, or the four dimensions (attention, relevance, confidence and satisfaction) of the motivation scale.

Table 4. 11 Game playing and motivation MANOVA result

	df	*F*	*p*
Attention	2	1,63	0,21
Relevance	2	0,47	0,63
Confidence	2	0,29	0,75
Satisfaction	2	0,02	0,98
Total	2	0,40	0,68

CHAPTER 5

DISCUSSION AND CONCLUSION

This chapter discusses the major findings of the research. Implications of the research findings and recommendations for future research are also addressed.

5.1. Gender and Game Motivation

The research showed that in terms of ARCS scores; there was no significant difference between male and female students. The result was not significant however girls' total motivation score slightly higher than boys' total motivation score.

Although, computer games are a more embedded part of boys' leisure time activity than girls and boys choose computer games as first choice activity, whereas girls choose computer games when there is noting better to do. (McFarlane et. al.). It was expected that boys' ARCS scores would be higher than girls'. There were two reasons explain this result; the character used in Fen ve Teknoloji game and the differences in boys' and girls' game preferences. Lara Croft was the first female 'cyberstar' Schleiner (2001). The main character in the game was young version of Lara Croft. Playing with female character could be

more interesting and attractive to girls than boys. Angela McFarlane et al. (2002) found that graphics, color, use of characters, gameplay, fun and challenge were characteristics of the games both girls and boys preferred independent of gender. The only clear difference was that boys more frequently preferred the games including fighting, violence or shooting. At the stage of Fen ve Teknoloji game creation, these components (fighting, shooting) was extracted from the game because of age of students and its' educational purposes. Therefore, the attractive components for boys were extracted from the game. That might be reasons why girls' ARCS mean scores was slightly (not significant) higher than boys' ARCS mean scores.

5.2. Computer Use and Game Motivation

This study reveals that there were no significant difference between three groups' (little, average and high computer user) mean total ARCS score and three sub-scales (attention, relevance and confidence). There was only significant difference at satisfaction sub-scale between little and average computer users (p=0.45) even this difference is statistically significant, there is not enough evidence to explain how this difference occurred.

5.3. Game Playing and Game Motivation

Another result of the study was that; there was no significant difference between three groups' (according to their weekly game playing; little, average and high game players) mean ARCS scores (attention, relevance, confidence,

satisfaction and total). In other words, there was no relation between weekly game playing and motivational effects of the game.

This result can be explained by the nature of the game and implementation of the study. At creation phase of the game, it was assumed that players of the game had no or little game experiences. The game was created accordingly; therefore, the game could be played easily at that age of the children without prior game experiences. Moreover, at the start of the study, the researcher explained the game and how participant would play the game, which keyboard keys they would use and function of these keys in the game. Therefore, when participants playing the game they had already know how to play the game and which keyboard keys they should use. They only concentrated on how to solve problems in game environment. Also, while students playing the game, if they had problem passing the obstacles or solving the problems, the researcher or the teacher gave them same clues to keep them into flow state. Thus, they prevent them to get bored or frustrated.

5.4. Implications of the Research Findings:

The purpose of this study was to investigate effects of computer games on students' motivation. It is generally argued that computer games have positive effects on students' motivation (Denis & Jouvelot, 2005; Klein & Freitag, 1991). Therefore, the main reason of using computer games on educational settings is getting benefit from the games' motivational aspects (Gredler, 1994; Garsis et al, 2002; Kirriemur & McFarlane, 2004). This study reveals that motivational benefit of games does not depend on gender, computer use and game playing. While

creating educational computer games, game designer can consider findings of the study. This study indicated that educational games could be introduced to students in various educational contexts without considering their computer usage experience and background. If the game is designed in a way that appeals student's attention and presents concepts in a meaningful and experience-based learning environments, student's engagement with the game and naturally with the content increases regardless of their computer use and game play background.

This study was creation and implementation of an educational game to the school context. This study can be base to the future research on educational computer games at school context.

5.5. Recommendations for Future Research:

There is little research about using computer games in the schools context to teach regular instructional contents (Rosas et. al, 2003). There is needed to creation and implementation of educational games in to school context. The game used in this study covers only three subjects in "Science and Technology" course, the research can be done with a covering all units of a course. Therefore, not just motivation, other effect of educational games can be studied.

This research was applied only three schools and fifth grade students. The research can be extended by applying different levels of the students. Different age of the students' motivation toward games can be examined.

This study was one shot study; therefore cause of the students' interest to the game could be because of novelty effect. In a long term study novelty effect of the game should be investigated. It is important to think carefully the negative

effects of the games such as aggression, violence, gender-bias and addiction on long term studies.

REFERENCES

Akıllı, G. (2004). A proposal of instructional design/development model for game-like learning environments: The fid2ge model. Middle East Technical University, Ankara, Turkey.

Aldrich, C. (2003). *Simulations and the Future of Learning. An Innovative and Perhaps Revolutionary Approach to e-learning*. Jossey-Bass/Pfeiffer.

Alessi, S. M., & Trollip, S. R. (2001). *Multimedia for learning: Methods and Development* (third ed.). Needham Heights, Massachusetts: Allyn & Bacon.

Asgari,M. (2005). A Three-factor Model of Motivation and Game Design http://www.gamesconference.org/digra2005/papers/04dfedc34a3a4b8b1284f74b8a79.doc. Retrieved December 8, 2006.

Atkins, B (2003). *More Than a Game.* Manchester University Press

Balaban-Salı, J. (2004). Öğrenmede Güdülenme. In Eğitimde Bireysel Farklılıklar (167-197) Ankara: Nobel Yayınları

Csikszentmihalyi, M. & Geirland, J. "Go With the Flow," Wired Magazine (1996).http://hotwired.wired.com/collections/web_development/4.09_csik_pr.html. Retrieved October 12.

Crawford, C. *Art of computer game design*. McGraw-Hill, Osborne, 1984

Denis, G. & Jouvelot P.(2005), Motivation-Driven Educational Game Design: Applying Best Practices to Music Education.

http://www.cri.ensmp.fr/classement/doc/A-365.pdf. Retrieved October 8. 2006

Egenfeldt-Nielsen, S.(2003) Review of the research on educational usage of games. http://www.it-c.dk/people/sen/papers/Reviewing%20the%20literature%20on%20simulations%20and%20games%20for%20learning_v0.5.doc. Retrieved October 8, 2006.

Finkelstein, J. (2006) Diagram of w:Maslow's hierarchy of needs. http://en.wikipedia.org/wiki/Image:Maslow%27s_hierarchy_of_needs.png. Retrived December 12, 2006.

Gabrielle, D.M (2003).The Effects Of Technology-Mediated Instructional Strategies On Motivation, Performance, And Self-Directed Learning. http://etd.lib.fsu.edu/theses/available/etd-11142003-171019/unrestricted/gabrielle.pdf. Retrieved October 12, 2006.

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming*, 33(4), 441-467.

Geirland, J. (1996), Go with the flow. http://www.wired.com/wired/archive/4.09/ czik_pr.html. Retrieved December 8, 2006.

Gredler, M.E. (1994). *Designing and evaluating games and simulations: a process approach.* Houston : Gulf Pub. Co.

Gustafson, S. R. (1994) Facilitation; Do It With Style. http://www.ebl.org/flow_article.html Retrieved December 8, 2006.

Hogle, J. G. (1996). Considering games as cognitive tools: In search of effective

"Edutainment". http://twinpinefarm.com/pdfs/games.pdf. Retrieved December 10, 2006

Hostetter, O. (2002). Video Games - The Necessity of Incorporating Video Games as part of Constructivist Learning. *Game Research: The Art, Business and Science of Computer Games*. December.

Jones, S. (2003). "Let the Games Begin. Gaming Technology and Entertainment among College Students". Pew Internet and American Life. http://www.pewinternet.org/reports/pdfs/PIP_College_Gaming_Reporta.pdf. Retrieved January 23, 2004.

Kasvi J.J.J. (2000). Not Just Fun and Games - Internet Games as a Training Medium. In Kymäläinen P. & Seppänen L. (eds.) Cosiga - Learning With Computerised Simulation Games. HUT: Espoo. pp.23-34

Keller, J.M. (1987a). Development and use of the ARCS model of instructional design. *Journal of Instructional Development*, 10(3), 2-10.

Keller, J.M. (1987b). The systematic process of motivational design. *Performance Instruction,* 26(9), 1-8

Keller, J. M. (1993). Manual for Instructional Materials Motivational Survey (IMMS). Tallahassee, FL.

Kirriemuir, J. & McFarlane, A. (2004). Literature review in games and learning. Report No. 8, *NESTA Future Lab Series*. http://www.nestafuturelab.org/research/lit_reviews.htm. Retrieved September 11, 2006

Klein, J. & Frietag, E. (1991). Effects of using an instrumental game on motivation and performance. *Journal of Educational Research*, 84(5), 303-308.

Lumsden, L.S. (1994). *Student motivation to learn* (ERIC Digest No. 92). Eugene, OR: ERIC Clearinghouse on Educational Management. (ERIC Document Reproduction Service No. ED 370 200)

Malone, T. W. (1980). *What makes things fun to learn? Heuristics for designing instructional computer games.* Paper presented at the Joint Symposium: Association for Computing Machinery Special Interest Group on Small Computers and Special Interest Group on Personal Computers, Palo Alto, California.

Malone, T. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science*, 5(4), 333-369.

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (Eds.), Aptitude, learning, and instruction: Vol. 3. Conative and affective process analysis (pp. 223-253). Hillsdale, NJ: Erlbaum.

Maslow, A. H. (1970). *Motivation and Personality*, (2nd. ed.), New York, Harper & Row.

McFarlane, A., Sparrowhawk, A. & Heald Y. (2002). Report on the educational use of computer games. Teachers Evaluating Educational Multimedia report. http://www.teem.org.uk/resources/teem_gamesined_full.pdf27/11/03. Retrieved September 11, 2006.

Means, T. B., Jonassen, D. H., & Dwyer, F. M. (1997). Enhancing relevance. Embedded ARCS strategies vs. purpose. *Educational Technology, Research & Development,* 45, 5-17.

Papert, S. (1998). Does Easy Do It? Children, Games and Learning. *Game Developer Magazine,* 87-88.

Prensky, M. (2001). *Digital Game-Based Learning*. New York, NY: McGraw-Hill.

Rieber, L. P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational Technology Research and Development*, 44(2), 43-58.

Rosas, R., Nussbaum, M., Cumsille, P., Marianov, V., Correa, M., Patricia F., Valeska G., Francisca L., Ximena L., Vero´ nica L., Patricio R. & Marcela S. (2003). Beyond Nintendo: design and assessment of educational video games for first and second grade students. *Computers & Education,* 40 (2003) 71-94.

Schleiner, A.M. "Does Lara Croft Wear Fake Polygons? Gender and Gender-Role Subversion in Computer Adventure Games", Leonardo: 2001(v34 no3) : 221-6.

Small, R.V. (1997). Motivation in instructional design. (ERIC Document Reproduction Service No. ED 409 895) http://www.ericfacility.net/databases/ERIC_Digests/ed409895.html Retrieved November 18, 2004.

Song, S.H. & J.M. Keller. Effectiveness of Motivationally Adaptive Computer-assisted Instruction on the Dynamic Aspects of Motivation. *Educational Technology Research and Development,* 49(2): 5-22, 2001.

Thomas, R., Schnurr, C., & Tomes, N. (1998). Simulations for Education: the Potential and the Reality. *Active Learning* 9. 65-66.

Travis, A. (2001). Zap! Go to the Top of the Class. The Guardian Saturday March 24, http://www.guardian.co.uk/uk_news/story/0,3604,462243,00.html. Retrieved September 11, 2006.

Tuzun, H. (2004). Motivating Learners in Educational Computer Games, Unpublished doctoral dissertation, Indiana University.

Widdison R, Aikenhead M & Allen T, (1997) *Computer Simulation in Legal Education*, 5 International Journal of Law and Information Technology 279-307. http://www.bileta.ac.uk/98papers/widdison.html. Retrieved January 24, 2004 from

Wlodkowski, R. (1999). *Enhancing adult motivation to learn*. (Rev. ed.) San Francisco: Jossey-Bass

APPENDIX A

INSTRUCTIONAL MATERIALS MOTIVATION SURVEY (IMMS)

1. Instructional Materials M. Scale

- The instructions and items for the IMMS are as follows (Tables 6 and 7):

Instructions

Instructional Materials Motivation Survey

John M. Keller
Florida State University

1. There are 36 statements in this questionnaire. Please think about each statement in relation to the instructional materials you have just studied, and indicate how true it is. Give the answer that truly applies to you, and not what you would like to be true, or what you think others want to hear.
2. Think about each statement by itself and indicate how true it is. Do not be influenced by your answers to other statements.
3. Record your responses on the answer sheet that is provided, and follow any additional instructions that may be provided in regard to the answer sheet that is being used with this survey. Thank you.

Table 6. Instructions for the *Instructional Materials Motivation Survey*

Instructional Materials Motivation Survey
John M. Keller
Florida State University

1 (or A) = Not true
2 (or B) = Slightly true
3 (or C) = Moderately true
4 (or D) = Mostly true
5 (or E) = Very true

1. When I first looked at this lesson, I had the impression that it would be easy for me.
2. There was something interesting at the beginning of this lesson that got my attention.
3. This material was more difficult to understand than I would like for it to be.
4. After reading the introductory information, I felt confident that I knew what I was supposed to learn from this lesson.
5. Completing the exercises in this lesson gave me a satisfying feeling of accomplishment.
6. It is clear to me how the content of this material is related to things I already know.
7. Many of the pages had so much information that it was hard to pick out and remember the important points.
8. These materials are eye-catching.
9. There were stories, pictures, or examples that showed me how this material could be important to some people.
10. Completing this lesson successfully was important to me.
11. The quality of the writing helped to hold my attention.
12. This lesson is so abstract that it was hard to keep my attention on it.
13. As I worked on this lesson, I was confident that I could learn the content.
14. I enjoyed this lesson so much that I would like to know more about this topic.
15. The pages of this lesson look dry and unappealing.

16. The content of this material is relevant to my interests.
17. The way the information is arranged on the pages helped keep my attention.
18. There are explanations or examples of how people use the knowledge in this lesson.
19. The exercises in this lesson were too difficult.
20. This lesson has things that stimulated my curiosity.
21. I really enjoyed studying this lesson.
22. The amount of repetition in this lesson caused me to get bored sometimes.
23. The content and style of writing in this lesson convey the impression that its content is worth knowing.
24. I learned some things that were surprising or unexpected.
25. After working on this lesson for awhile, I was confident that I would be able to pass a test on it.
26. This lesson was not relevant to my needs because I already knew most of it.
27. The wording of feedback after the exercises, or of other comments in this lesson, helped me feel rewarded for my effort.
28. The variety of reading passages, exercises, illustrations, etc., helped keep my attention on the lesson.
29. The style of writing is boring.
30. I could relate the content of this lesson to things I have seen, done, or thought about in my own life.
31. There are so many words on each page that it is irritating.
32. It felt good to successfully complete this lesson.
33. The content of this lesson will be useful to me.
34. I could not really understand quite a bit of the material in this lesson.
35. The good organization of the content helped me be confident that I would learn this material.
36. It was a pleasure to work on such a well-designed lesson.

Table 7. Items of the Instructional Materials Motivation Survey

- Scoring

As with the CIS, the survey can be scored for each of the four subscales or the total scale score (Table 8).The response scale ranges from 1 to 5 (see Table 7). This means that the minimum score on the 36 item survey is 36, and the maximum is 180 with a midpoint of 108. The minimums, maximums, and midpoints for each subscale vary because they do not all have the same number of items.

An alternate scoring method is to find the average score for each subscale and the total scale instead of using sums. For each respondent, divide the total score on a given scale by the number of items in that scale. This converts the totals into a score ranging from 1 to 5 and makes it easier to compare performance on each of the subscales.

There are no norms for the survey. As it is a situation specific measure, there is no expectation of a normal distribution of responses. As data become available from a variety of applications of the scales, descriptive statistical information will be published.

Scores are determined by summing the responses for each subscale and the total scale. Please note that the items marked reverse (Table 8) are stated in a negative manner. The responses have to be reversed before they can be added into the response total. That is, for these items, 5 = 1, 4 = 2, 3 = 3, 2 = 4, and 1 = 5.

Attention	Relevance	Confidence	Satisfaction
2	6	1	5
8	9	3 (reverse)	14
11	10	4	21
12 (reverse)	16	7 (reverse)	27
15 (reverse)	18	13	32
17	23	19 (reverse)	36
20	26 (reverse)	25	
22 (reverse)	30	34 (reverse)	
24	33	35	
28			
29 (reverse)			
31 (reverse)			

Table 8. IMMS scoring guide

- Psychometric testing: The survey was administered to a total of 90 undergraduate students in two undergraduate classes for preservice teachers at Florida State University. The internal consistency estimates, based on Cronbach's alpha, were satisfactory (Table 9).

- Reliability estimates

Scale	Reliability Estimate (Cronbach α)
Attention	.89
Relevance	.81
Confidence	.90
Satisfaction	.92
Total scale	.96

Table 9. IMMSS reliability estimates

- IMMS Validity Test

Validity was established by preparing two sets of instructional materials covering the concept of behavioral objectives. These materials were part of a unit of work on lesson planning and instructional design. Both lessons had the same objectives and technical content. The lesson for the control group was prepared according to standard principles of instructional design, but was not enhanced in any way to make it interesting. The experimental lesson was enhanced with strategies to stimulate curiosity, illustrate the practical relevance of the content, build confidence, and provide satisfying outcomes. Students were randomly assigned to the two lessons which they completed during one class period, including testing. Scores on the experimental lesson were significantly higher than for the control lesson.

APPENDIX B

CONTENTS OF FEN VE TEKNOLOJİ GAME

FOTOSENTEZ:

Klorofil taşıyan canlıların; ışık enerjisi , karbondioksit ve su kullanarak organik madde sentezlemesine fotosentez denir. Fotosentez sonucunda besin (glikoz) ve su oluşur.Foto ışık, sentez ise birleşme anlamına gelir.

Fotosentezde ışık enerjisi kimyasal bağ enerjisine dönüştürülerek bütün canlıların kullanabildiği enerji biçimi elde edilmiş olur.

Fotosentez kloroplastlarda meydana gelir.

Fotosentez sadece gündüzleri yapılabilir.

Fotosentezin kimyasal formülü;

Su + Karbondioksit + Güneş ışığı + Klorofil ……> Glikoz + Oksijen

KARBONHİDRATLAR

Canlıların yapısında bulunan organik maddelerdendir.

Canlıların yapısına katılan ve enerji sağlayan bileşiklerdir.

Yapılarında karbon, hidrojen ve oksijen elementleri bulunur.

En küçük yapıtaşları GLİKOZdur.

Glikozun bitkilerdeki depo şekli nişasta, hayvanlardaki depo glikojendir.

Bitkiler tarafından fotosentez yoluyla üretilir.

Tahıllarda, patateste, pirinçte, ekmekte , şekerli besinlerde, meyvelerde bol miktarda glikoz bulunur.

YAĞLAR

Canlıların yapısında bulunan organik maddelerdendir.

Yapılarında karbon, hidrojen , oksijen ve azot elementleri bulunur.

Vücutta yakıldıklarında karbonhidratlara göre daha çok enerji verirler. Ancak yağların yıkımları çok daha zor olduğu için karbonhidratlardan sonra ikinci enerji kaynağı olarak kullanılırlar.

Suda çözünmezler.

En küçük yapıtaşları gliserol ve yağ asitleridir.

Tereyağı, mısır yağı, soya yağı, ayçiçeği yağında,fındık gibi kuruyemişlerde bol miktarda bulunurlar.

PROTEİNLER

Canlıların yapısında bulunan organik maddelerdendir.

Yapılarında karbon, hidrojen, oksijen ve azot elementleri bulunur.

En küçük yapıtaşları aminoasitlerdir.

Hücrenin esas yapısını oluştururlar.

Vücutta yapım ve onarım görevi üstlenirler.

Hormonların, antikorların ve enzimlerin yapısında bulunurlar.

Süt ve süt ürünlerinde, et, tavuk, balıkta, yumurta ve baklagillerde, tahıllarda bol miktarda bulunurlar.

VİTAMİNLER

Canlıların yapısında bulunan organik maddelerdendir.
Sindirilmelerine gerek yoktur. Hücre zarından geçebilecek büyüklüktedirler.

VİTAMİN	SAĞLIĞA ETKİLERİ	BULUNDUĞU BESİNLER
A	Göz,deri,kemik,saç sağlığında etkilidir	Süt,yumurta,balık,karaciğer,yeşil sebzeler,havuç
B	Sinir sisteminin gelişmesi,cilt sağlığı ve büyüme için gereklidir.	Meyve,sebze,süt,yumurta,tahıllar
C	Bağışıklık sistemi için çok önemlidir.diş ve diş eti sağlığı için önemlidir.	Turunçgiller,şalgam,lahana,çilek,maydonoz, kuşburnu
D	Diş ve kemik gelişimi için çok önemlidir.	Süt,peynir,karaciğer,yumurta,balık yağı
E	Karaciğer,kalp ve damar hastalıklarını ve kısırlığı önler.	Bitkisel yağlar,tahıllar,süt,balık,sebzeler
K	Kanamalarda kanın pıhtılaşmasını sağlar	Yeşil sebzeler,karnabahar,kırmızı et

APPENDIX C

ÖĞRETİM MATERYALLERİ GÜDÜLENME ÖLÇEĞİ

Prof. Dr. John M. Keller, Florida State Üniversitesi
(Çev: Jale Balaban, Anadolu Üniversitesi)

YÖNERGE

1. Bu ankette 36 madde vardır. Lütfen her maddenin çalışmış olduğunuz eğitsel materyallerle ilişkisini düşününüz ve doğruluk derecesini belirtiniz. Doğru olmasını istediğiniz ya da diğer insanların duymak isteyeceği yanıtları değil, size göre gerçekten doğru olan yanıtı işaretleyiniz.

2. Her maddeyi kendi içinde düşünerek doğruluk derecesini belirtiniz. Diğer maddelere verdiğiniz yanıtlardan etkilenmeyiniz.

3. Yanıtlarınızı size verilen yanıt kağıdına yazınız, yanıt kağıdı ile birlikte verilebilecek ek yönergeleri izleyiniz. Teşekkürler.

1 (ya da A) = Doğru değil
2 (ya da B) = Biraz doğru
3 (ya da C) = Orta derecede doğru
4 (ya da D) = Oldukça doğru
5 (ya da E) = Çok doğru

1. Bu derse ilk baktığımda, benim için kolay olabileceği izlenimini edindim.

2. Dersin başında dikkatimi çeken ilginç bir şeyler vardı.

3. Bu materyalin anlaşılması, beklediğimden daha zordu.

4. Giriş bilgisini okuduktan sonra, bu dersten ne öğrenmem gerektiği konusunda emindim.

5. Bu dersteki alıştırmaları tamamlamak bana başarı duygusunun sağladığı doyumu verdi.

6. Bu materyalin içeriğinin önceden bildiklerimle olan ilişkisi benim için açık görünüyor.

7. Sayfaların çoğu o kadar fazla bilgi içeriyordu ki önemli noktaları yakalamak ve hatırlamak zordu.

8. Bu materyaller göze hitap ediyordu.

9. Bu materyallerin, bazı insanlar için nasıl önemli olabileceğini gösteren öyküler, resimler ve örnekler vardı.

10. Bu dersi başarıyla tamamlamak benim için önemliydi.

11. Yazının kalitesi dikkatimi toplamaya yardım etti.

12. Bu ders konuya dikkatimi veremeyeceğim kadar soyut.

13. Bu dersi çalışırken, içeriği öğrenebileceğimden emindim.

14. Bu dersten öyle keyif aldım ki, konu hakkında daha çok şey bilmek istiyorum.

15. Bu dersin sayfaları sıkıcı ve çekici değil.

16. Bu materyalin içeriği, benim ilgi duyduğum şeylerle ilişkilidir.

17. Bilgilerin sayfalardaki düzenlenme biçimi dikkatimi toplamama yardımcı oldu.

18. İnsanların, bu dersteki bilgiyi nasıl kullanacaklarına ilişkin açıklamalar ve örnekler var.

19. Bu dersteki alıştırmalar çok zordu.

20. Bu derste merakımı uyaran şeyler vardı.

21. Bu dersi çalışmaktan gerçekten zevk aldım.

22. Bu dersteki tekrarların miktarı bazen sıkılmama neden oldu.

23. Bu dersteki içerik ve yazım biçimi, içinde bilmeye değer bilgiler olduğu izlenimini uyandırdı.

24. Şaşırtıcı ve beklenmedik şeyler öğrendim.

25. Bir süre bu ders üzerinde çalıştıktan sonra, konuyla ilgili bir testi geçebileceğimden emindim.

26. Bu ders gereksinimlerimle ilgili değildi çünkü zaten içeriğinin çoğunu biliyordum.

27. Bu derste alıştırmalardan sonraki geribildirim cümleleri ya da öteki yorumlar, gösterdiğim çabanın ödüllendirildiğini hissetmeme yardım etti.

28. Okuma parçalarının, alıştırmaların, resimlerin vb. çeşitliliği, bu dersteki dikkatimi toplamaya yardımcı oldu.

29. Yazı biçimi sıkıcı.

30. Bu dersin içeriğiyle, kendi yaşamımda gördüklerim, yaptıklarım ve düşündüklerimin ilişkisini kurabildim.

31. Her sayfada canımı sıkan çok sayıda sözcük var.

32. Bu dersi başarıyla tamamlayınca kendimi iyi hissettim.

33. Bu dersin içeriği benim için yararlı olacak.

34. Bu dersteki materyalin bir kısmını gerçekten anlayamadım.

35. İçeriğin iyi biçimde yapılandırılmış olması, bu dersi öğrenebileceğim konusunda kendimi emin hissetmeme yardımcı oldu.

36. Bu kadar güzel tasarımlanmış bir dersi çalışmak bir zevkti.

ÖMGÖ Puanlama Kılavuzu

Komutlar: Tepki ölçeği 1'den 5'e değişmektedir. Bunun anlamı 36 maddelik ankette en düşük puan 36, en yüksek puan 180 ve ortalama puan 108 olabilir.

Minimumlar, maksimumlar ve orta noktalar her alt ölçek için farklıdır çünkü hepsinin aynı sayıda maddesi yoktur.

Alternatif bir hesaplama yöntemi ise, toplamları kullanma yerine, her alt ölçek ve toplam ölçek için ortalama puanı bulmaktır. Her yanıtlayıcı için verilen ölçekteki toplam puan o ölçekte madde sayısına bölünür. Bu işlem, toplamları 1'den 5'e kadar sıralanan bir puana dönüşür ve her alt ölçekteki performansı karşılaştırmayı kolaylaştırır.

Bu ankette normlar yoktur. Duruma özgü bir ölçüm olduğundan, yanıtların normal dağılım göstereceği beklentisi yoktur. Ölçeklerin çeşitli uygulamalarından veriler elde edildikçe betimsel nitelikli istatistiksel bilgi yayımlanacaktır.

Puanlar, her alt ölçek ve toplam ölçek için yanıtlar toplanarak belirlenmektedir. Ters olarak işaretlenen maddeler negatif biçimde ifade edilmektedir. Bu yanıtlar eklenmeden önce ters çevrilmelidir.
Şöyle ki, bu maddeler için 5=1, 4=2, 3=3, 2=4, 1=5

Öğretim materyalleri güdülenme ölçeğinin Türkçe geçerlik ve güvenirlik çalışmaları Jale Balaban (2002) tarafında yapılmış ve Cronbach Alpha güvenirlik katsayısı .90 olarak saptanmıştır.

Dikkat			**İlişki**		
2	15 (ters)	24	6	18	33
8	17	28	9	23	
11	20	29 (ters)	10	26 (ters)	
12 (ters)	22 (ters)	31 (ters)	16	30	
Güven			**Doyum**		
1	13	35	5	32	
3 (ters)	19 (ters)		14	36	
4	25		21	27	
7 (ters)	34 (ters)				