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A Study on the development process of a multimedia learning environment according to the ADDIE model and students' opinions of the multimedia learning environment

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Summary

In this study, the development process of the environment was examined according to the Analyze, Design, Develop, Implement, Evaluate, Instructional Design Model (ADDIE) and the effect on achievement of the environment and students' opinions on the learning environment was observed. The study group was composed of 85 fourth grade primary school students, consisting of 50 females and 35 males. To be able to measure the effect on achievement, pre-test and post-test procedures were applied. In conclusion, it was discovered that the multimedia learning environment positively effects achievement.

Keywords

Learning environment; multimedia learning environment; ADDIE instructional design model; achievement.

1. INTRODUCTION

The human profile required by today's societies has changed according to the needs of the current era. Globalization and improvements in science and technology are the main factors which determine the manpower profile required by information society. Today, students are exposed to information in very

different ways and the amount of information is rapidly increasing. What lay at the core of this explosion is the continually renewed efforts exerted for research and development purposes.

While facilitating the development of individuals, it should also be ensured that people have the information, the attitude and are equipped with the skills, which are necessary for them to closely monitor contemporary developments, then to make necessary adaptations in their life and from this experience gain further knowledge. The understanding, which focuses on the individual, is oriented towards globalization from sociality and cooperation and team work have become indispensable components of contemporary life. In this context, education systems, besides constantly developing to meet the needs of the current era, have been obliged to focus on the future and to go beyond the needs of the current era. Today, the dimension emphasized in the definition of the concept of education is the process of assisting students in acquiring the skills to access and use information more than conveying the knowledge from teacher to student. This traditional method not only fails to meet the needs of modern society but also excludes, or at least neglects adult education (which is emphasized in informal training process but excluded at the definition level) should be expanded to include lifelong and unlimited education.

Life-long learning has gained importance in the 21st century, the phrase denotes that learning is a process which should be seriously addressed at any age from birth to death. Life-long learning can be described as the provision of opportunities of education and professional training, which enable individuals to update their current knowledge, skills and competencies and when needed to acquire new knowledge, skills and competencies. This process brings about learning that is independent of age, time and place, that is, unlimited learning. The process is learner-centered rather than dependent on the teacher. All these developments necessitate a change in the education system and this has required action on the part of Ministry of National Education (MoNE) to modify existing primary education programs and, in turn, MoNE has developed new curriculum.

Eight common skills have been determined for all courses included in New Primary Education Curriculum. These skills are: *Critical thinking, creative thinking, communication, researching-questioning, problem solving, using information technologies, entrepreneurship and using Turkish language correctly and efficiently.*

The skills for Using Information Technologies include those related with using technology in searching, finding, processing, presenting and evaluating information (MONE, 2004). In this scope, effective and efficient use of "Information and Communication Technologies" in line with the objectives gains importance. Moreover, great importance has been given to using Information Technologies in courses for the acquisitions to be obtained and activities to be carried out. By focusing on learning, the emphasis is on creating environments where learning can be more lasting through the support of each developed technology. When new instruction programs are reviewed, it is observed that they are enriched with activities and they are student rather than teacher centered. Today, it is vital to design different materials in different teaching environments and to use them for different purposes.

Studies conducted in this area have shown that the environments which appeal to more than one sense organ positively affect the durability. It shows that people can remember 20% of what they have only seen, 40% of what they have seen and heard, 75% of what they have seen, heard and done (Neo, Neo, 2001) In a similar research (Bass, 1994), it has been revealed that we remember 10% of what we have read, 20% of what we have heard, 30% of what we have both seen and heard, 50% of what somebody has explained to us and 90% of what we have done ourselves. In this context, multimedia which generally uses a combination of text, sound, graph and animation provides a more effective and longer lasting learning experience.

1.1. What is multimedia?

Examining the word *multimedia*, it can be seen that there are two elements; "*multi*" meaning having more than one form, and "*media*" meaning the environment where the information is conveyed (Marmara University, 2003). In a simple way, those items which appeal to the eye, ear and sense of touch can be described as multimedia. According to Heath (2000) using or presenting the data in two or more forms is called multimedia. Similarly, Mayer (2001) describes it as supporting the presentation of information with graphic and text. Jonassen, Peck and Wilson (1999) state that when multimedia is mentioned, learning environments come to mind. While Newby et al., (2000) describes multimedia as environments which are compiling systems composed of many tools in the computer environment; Smith (2002) explains multimedia as the information environment which is formed by combining text, sound and graphics in a digital environment. According to Heinich, Molenda, Russell and Smaldino (2002), multimedia presents various tools simultaneously or uses them in one program in a similar way. Roblyer (2003) describes multimedia as "multi tools" or "combination of tools". Graham and Hussain (2006) emphasize that multimedia is integrating text, sound, any kind of graphic and a learning environment coherently in one digital information environment. McCauley (2000) reports that multimedia provides information for the learners in a simple way; however, interactive multimedia gives the control of information to the users and ensures their participation. Heinich et al., (2002) also describe interactive multimedia as a multimedia which allows students to make implementations and receive feedback.

Taking into account the definitions given above it can be seen that, in the most general meaning, multimedia can be summarized as *ensuring communication through various ways*. This can be one way as well as multi-way communication. However, when the communication gains more than one aspect, the component of interaction becomes a part of the action, thus the communication is interactive. Interactive multimedia learning environments used in education present information that can be seen and heard by the learners who can also control aspects of the environment, and allow a non linear progression through the learning experience. Heinich et al., (2002) summarize the advantages of using interactive multimedia and refer to the participation of the user; the importance of individuality and the opportunity for simulation and flexibility, in that the user has choices and is not forced into only one path through the material presented.

Briefly, today, information and technology has rapidly developed and spread all over the world through all parts of society. This has affected both the education systems and learning environments, and the instruction materials and methods used in these environments have changed. With the creation of long lasting learning, interactive experiences have gained importance.

When the design process of the instruction environments is examined, it can be seen that there are various approaches which differ according to the learning theory they are based on. For example, the designs which depend on behaviourist and cognitive learning theories are considerably structured, in other words, the teacher of the subject is given importance and the activities aim to convey the information and skills to be acquired by the learner are created accordingly. The designs which depend on structural approach are student oriented, they support co-operation in learning, are flexible, can be adapted to different teaching/learning environments and the learner is active in the learning environment and has responsibility for their own learning. Models such as ADDIE, which systematically addresses the instructional design and is based on the approaches mentioned above, have an implementation oriented structure (Leshin et al, 1992).

1. 2. ADDIE Design Model

ADDIE is an instructional design model which is valid for any kind of education and despite the fact that ADDIE comprises the components of all other design models it is a relatively simple model. Its name is an acronym of the capital letters of the words: **A**nalyze, **D**esign, **D**evelop, **I**mplement, and **E**valuate which comprise the five steps as follows (McGriff, 2000; Kaminski, 2007).

Analysis: This step is the description process of what is going to be taught and forms the basis of all other steps. In this step, the designer determines the needs and the difference between knowledge, skills and behaviors, which the learners presently have, and behaviors which they must have or they are expected to have. In other words, needs analysis is conducted. The system is analyzed and the problem and the roots of the problem are described. The constraints are determined and the possible solutions for the problem are found.

Design: This is the determination process of how the information is going to be learnt. In this step, the development strategy is determined in accordance with the data obtained during the analysis phase and how the objectives will be reached is clarified. In other words, it is the part where the instruction method, learning activities and evaluation process become clear. During the analysis process, the tasks are separated into learning steps, thus, the design can be implemented in a more accurate and easy way.

Development: All of the components of multimedia are prepared during this phase. This is the process of producing the instruction materials, all the tools which will be used during instruction and any kind of support materials. The product is created during this phase and an evaluation, which is mostly for correction, is made and modifications are carried out if necessary. The detailed plan

prepared during the phases of analysis and the design is implemented and all the components of the learning environment are developed and the environment is prepared for the test.

Implementation: Regardless of whether the end use will be in the classroom, laboratory or on a computer, it is necessary to put the design into practice with the actual learners. The purpose of this part is to introduce the designed instruction in a way that it will be effective and efficient. During this phase, the students should be supported to ensure that they understand the material and they are aware of the objectives and there should be no doubt that the information is being transferred to the learner.

Evaluation: This is the process of determining the instruction is sufficient and measuring the effect in order to check to what extent the design meets the learning objectives and the needs of learners. The evaluation is directly related to all of the previous four stages, and it may be necessary to return to any one of the previous stages at the end of this phase. Moreover, at the end of the each of the stages an evaluation is made to ensure that the process is being carried out in a more sound manner than at the end of each evaluation, modifications, if necessary, are made for the next implementation.

As stated above, the information technologies are given importance in terms of its role in the learning-teaching process in the revised Primary School Curriculum. Information technology is included in different curriculum such as Mathematics, Turkish and Social Sciences. However, it has been realized that resources and implementations appropriate for the understanding of this new way of learning are still limited. Therefore, it is necessary to further develop multimedia learning environments and this study aims to contribute to this need to some extent.

Within the scope of this study, multimedia learning environments were developed according to the ADDIE Design Model, for a 4th grade Mathematics course and each phase of the development is explained through the following questions. By doing so, it aims to contribute to the development of computer-based multimedia or learning environments.

- a. What was done during analysis phase?
- b. What was done during the design phase?
- c. What was done during the development phase?
- d. What was done during the implementation phase?
- e. What was done during the evaluation phase?
- f. What are the opinions of students about the setting created by the multimedia learning environment which has been developed according to the ADDIE design model?

2. METHOD

2.1. Study group

The study group was composed of 85 students in the fourth grade in primary schools.

2.2. Data Collection Tools

In this study the data was collected through,

1. The multimedia learning environment, developed by the researcher,
2. A multiple choice test, prepared by the researcher in order to determine the effect of developed learning environment on student's achievement,
3. An evaluation form to determine the opinions of expert judgments on the learning environment,
4. An evaluation form to determine the opinions of teachers on the learning environment,
5. A student opinion questionnaire and interview form to determine the opinions of students on the learning environment.

The process followed during the preparation of these tools and the features of the tools was as follows:

- **Multimedia Learning Environment:** By taking into consideration the stages of the ADDIE design model, one multimedia learning environment was developed on the subject of "Column Graphic", which is included in the Mathematics program of fourth grade primary school classes.
- **Achievement Test:** This was created to determine the effect of prepared environment on the student's achievement. This test consists of 18 questions, which examine the acquisitions included in the instruction program concerning the column graphic topic. The opinions of a measurement and evaluation expert were obtained for this test and the necessary modifications to the texts and choices were made. Then, this test (pre-test form) was administered to 46 students who were progressing to the 5th grade class, and had previously been introduced to this subject. Finally, test of 15 items was used as the pre-test and post-test. The KR-20 reliability coefficient calculated according to the item statistics of the chosen items was .89.
- **Evaluation Form on Expert Judgments' Opinion:** This was prepared to obtain the opinions of expert judgments who examined the prepared multimedia learning environment. It consists of 25 questions, with two choices of "Yes" and "No". In addition, there is a recommendation section which was expected to be completed, particularly when the answer given was "No". Before using this form, there was consultation with experts in the field of Computer Education and Instructional Technologies as for the content reliability.
- **Evaluation Form on Teacher Opinion:** This contained of 6 open-ended questions, and was given to the computer and mathematics teachers who were observers during the pre-implementation. The questions were designed to determine whether the environment was student-centered, encourages the students to think, provides the opportunity for co-operative work, facilitates a connection with student's everyday life, develops different perspectives and ensures students make their own evaluation.

- **Questionnaire on Student Opinion and Interview Form:** A multiple choice questionnaire, composed of six questions was given to the students who participated in the implementation during the evaluation phase of the design. The questions included in the questionnaire were about the issues concerning the developed learning environment: "ease-of-use", "ensuring cooperation", "encouraging thinking", "being enjoyable", "ensuring that students can use what they have learnt" and "they make a self evaluation ". The first five questions have 3 choices, which are "Yes", "A little" and "No". For the question concerning self evaluation, the choices were "Weak", "Medium", "Good" and "Very Good". An interview form was developed, composed of open-ended questions which were similar to those in the questionnaire. These questions aimed to detail the student opinions. The interview aimed to collect answers and opinions not specified in the questionnaires.

3. FINDINGS

The findings obtained from the study are presented in the same sequence as the questions were posed,

Concerning the multimedia learning environment developed according to the ADDIE Design Model;

a. *What was done during the **analysis** phase?*

First, the subject field and the target group were determined in the **Analysis** phase of the multimedia learning environment developed according to the ADDIE Design Model. The subject field was Mathematics and the target group was selected as primary school fourth grade classes. The target group was also examined as for the features of development and learning including pre-learning, the degree of readiness concerning the subject and use of technology. Examining the target group as for these features guided the determination of the content and the design of the multimedia learning environment (ease-of-use). When the ages of the learners and the fact that they are continuing to take computer literacy course beginning from their 1st class at school, therefore, they have the prerequisite skills were taken into consideration, it was assumed that they would not face problems in using the multimedia learning environment which is computer based. After the determination of subject field and the target group, the aim(s) this environment would fulfill and for which purposes it would be used were determined. By taking into consideration that there are not many technology based materials available, it was decided that the prepared environment can be used for different purposes. These purposes include ensuring that the students can practice and review materials at their own learning speed, compensating for insufficient learning which occurred during the course and ensuring that what has been learnt during the course can be transferred to everyday life).

During the analysis phase, the technological, economic and durational constraints were determined, which assisted in the decision as to the type of environment to be developed and the duration of that development. In this phase, the determination of subject field, target group and planned environment

contributed to the determination of the objectives and tasks which would guide the Design step and, finally a task schedule was prepared.

b. What was done during the *design* phase?

During the design phase, it was discussed how to teach the subject field by taking into consideration the features of the target group. Thus, the acquisitions concerning the subject in the instruction program were determined. The acquisitions concerning the subject of "Column Graph" were included in the fourth grade primary school Curriculum as follows; "Student creates a column graph" and "Student interprets a column graph". It is therefore necessary to think about the content for these acquisitions and to develop appropriate instruction methods, learning activities and evaluation processes. The features of the environment to be developed were determined. It was decided that the environment, would be prepared according to the determined acquisitions, would be designed taking into consideration the personal characteristics of any individual and in a way that it would demonstrate the differences between individuals. Furthermore, discussion environments would be created to encourage the students to exchange ideas; to ensure communication between students; to give the control to students and; to give guiding role to the teacher during the process. In this context, it emerged that the interaction component of the environment must gain importance. In the design phase, the content was formed and the components of the cycle were determined, thus, the general framework of the design (for example the screen design) was developed. The references, where the subjects chosen for the content design are included, were reviewed and the content concerning the Column Graph topic was determined.

As a requirement of the new curriculum; an event from everyday life that the students can relate to was taken as a basis and, thus, the students were asked to help the organization of a birthday party for one of their friends. The birthday party to be organized can be approached as a problem. Accordingly, there 8 items which students should consider in organizing the party, were determined. These were; *Place, Time, Cake, Drinks, Music, Decorations, Gifts and Games.*

It was decided that column graphs would be used while conveying the data which the students needed in order to make decisions on the stated themes. It was thought that deciding on stated themes and making choices concerning the birthday party would be based on how they interpret the column graph. The environment was designed in a way that the learners would be able to make the choice according to their interpretation, in other words, no choice would be right or wrong. This ensured that what the students' choices were not important as long as they justified their choices. Moreover, it was decided that during the implementation, the students would be provided with the opportunity of returning and changing their choice.

At the end of the implementation, different parties would be possibly created as a result of personal differences because each student would prepare the party content according to his/her choice. Time was allowed for the learners to read the questions and interpret the graphs included in the themes and to make choices, then a discussion environment was created and learners could compare their answers

and the teacher could guide the process when necessary. It was decided that, in addition to the theme section, questions would be included to contribute to learning and here, the teacher would have an active role in checking the answers with the students and explaining any elements not clearly understood by members of the class.

c. What was done during *development* phase?

The components of multimedia, planned in the design phase, were developed in this phase. Prepared texts, graphs and sound components were put together in a balanced way and the texts were supported with sound. In addition, the development level of the students was taken into consideration while preparing the visual materials and the backgrounds, colors, switches, pop-up windows, figures and human characters were designed according to the target group.

After developing the environment, pre-implementation was carried out in order to test the developed environment. The study group for the evaluation of the pre-implementation test was composed of 22 students from a fourth grade class. The students examined the multimedia learning environment which was prepared in a computer laboratory.

At the end of pre-implementation, a multiple choice questionnaire and a questionnaire which included open-ended questions were applied in order to obtain the opinions of students on the software. Moreover, researchers observed the students while they were carrying out the implementation and took necessary notes and tried to determine where they had difficulty while using the software or where they had not understood. As a result of the observations made during pre-implementation, it emerged that the students had not understood only the feedback on the questions and consequently this feedback was improved. In addition, as a result of the observations, it was seen that some students had opinions such as "the environment is noisy". This interpretation was considered as accurate but it is not possible to prevent some degree of noise in the external environment, particularly when there is communication and cooperation in the class.

Concerning the learning environment, different evaluation forms were given to the expert judgment as well as the mathematics and computer teachers in order to obtain their opinions on the multimedia environment. For the similar purpose, a questionnaire and an interview form were also given to the students. Expert judgments gave their recommendations after examining the multimedia learning environment. In the evaluation form, teachers stated that they considered the environment as positive because it ensured that "*students work in cooperation, they can make interpretations and express their ideas comfortably*". Moreover, they stated that "*students are enjoying themselves in the environment*". As a result of all the data, the necessary corrections were made and the environment was prepared for the real implementation.

d. What was done during *implementation* phase?

After the pre-implementation, according to the opinions of students and teachers, the problematic or missing parts of the environment were reviewed and as a result of all the modifications, the multimedia learning environment was prepared for the real implementation. The real implementation was carried out with 85 fourth grade students comprising 50 females and 35 males. During the implementation process which was conducted in computer laboratory, first the pre-test was given to students then they passed to implementation process and the implementation lasted for one class hour. This procedure was carried out for all classes in one day. Researchers acted as the teacher for each class. No problem was experienced during the implementation. The post-test was applied in an appropriate class hour following the implementation, on the condition that there was no Mathematics lesson between these two processes. The results collected from the pre- and post-test, such as the right or wrong answers that the students gave, guided the review of the multimedia instructional environment.

e. What was done during *evaluation* phase?

As a result of implementation phase, in order to evaluate the environment, the effect of multimedia learning environment on achievement levels was examined. The data from the pre and post tests was used and a t-test was used for related samplings. The results are presented in Table 1 which shows that, the difference between the pre-test and post-test is considered to be meaningful ($p = .000$).

Table 1
Results of t-test Concerning the Effect of Environment on Achievement

	n	\bar{x}	ss	sd	t	P
Pre Test	85	12.53	1.763	84	-7.856	0.000
Post Test	85	13.66	1.359			

($p < .05$)

In the literature, similarly, Garnett et. al., (1996) within the scope of chemistry lessons and Chou & Chiu-Hsiang (1998) within the scope of Physics lessons, found differences between pre - and post test scores in the multimedia learning environments they implemented. Results of the researches (Tsou, Wang, Tzeng, 2006; Siskos, Antoniou, Papaioannou & Laparidis (2005) and Amory & Naicker, 2001) results show that the students' achievement increased. The meaningful difference between the pre- and post-test results can be explained by the positive effects of the environment on students, which was also observed by the researchers during implementation. This difference may result from the fact that the students, who participated in the implementation, took the course in an environment using computers which was different from what they are used to, by and also that they had learnt this subject before.

f. *What are the opinions of students on the multimedia learning environment which was developed according to ADDIE design model?*

The opinions of students on the multimedia learning environment, which were collected through multiple choice questionnaires, were examined and are presented in Table 2 and 3.

Table 2
 Opinions of Students on Multimedia Learning Environments

	Yes		A little		No	
	f	%	f	%	f	%
Ease-of- use	80	94.1	5	5.9	0	0
Ensuring cooperation	72	84.7	12	14.1	1	1.2
Encouraging thinking	52	61.2	28	32.9	5	5.9
Being enjoyable	78	91.8	7	8.2	0	0
Ensuring that they can use what they have learnt	76	89.4	6	7.1	3	3.5

Looking at Table 2, it is clear that students did not face any problems concerning the “ease-of-use” of the learning environment. Ease of use in questionnaire has the highest number of “Yes” answers. During the interviews carried out with the students, they typically stated that they did not face any difficulty while using the learning environment through the statements like “I have not had any trouble” or “I have not faced any difficulty”.

When examining the opinions of students on “ensuring the cooperation” in the class, it can be seen that “Yes” answer has a considerably high rate with 84.7%. This shows that students appreciate the cooperation. The statements like “I enjoyed talking to my friends”, “It was good to answer the questions after discussing with my friends”, which were used during interviews also support this finding. Ortega, Burgun & Beux (2003) have also emphasized in the study they carried out the positive effect of cooperation on students.

When the students’ opinions are examined concerning whether the developed learning environment “encourage thinking”, it can be seen that it has the lowest rate of “Yes” of the whole questionnaire with a rate of 61.2%. However, as a result of the observations carried out in class, it was anticipated that some of the students did not completely understand the question and could not understand what was meant by the phrase “encouraging thinking”. It was considered that receiving a “Yes” answer from only 52 of 85 people (61. %) can be related to how the question was posed.

Concerning if the developed environment is “enjoyable”, 91.8% of the students said “yes”. It emerged during the observations that the students enjoyed the learning environment very much. Therefore, the students asked the researcher for a copy of the program and students to have completed the implementation asked to try the program again and again. During interviews, it was observed that students frequently called the implementation a “game”. Additionally, students used statements like “It did not seem like a lesson, what we learnt was included in the game”, “I did not understand that we

were introduced to in the lesson, it was enjoyable". Studies conducted by various authors (Coleman, Rea, Hall, Sawyer & Hemsworth [2001] and Tsou, Wang & Tzeng [2006]) have emphasized that students find multimedia environments enjoyable.

Through the questions like "Can you create the column graphs with the tools and materials in your bag or your clothes after this implementation?", the opinions of students on to which degree they can use what they have learnt or transfer the knowledge were examined. It was seen that students answered this question as "yes", with a rate of 89.4%. Having a meaningful difference between the pre and-post tests concerning learning environment supports this finding.

The last of the multiple choice questions the students were asked was how they evaluate themselves in the scope of this implementation. The answers showed that the most preferred answer was "Very Good" with a rate of 74.1% and the answer "Weak" was never ticked. It is possible to state that in general students consider themselves as successful. In fact, the findings obtained concerning their achievement are consistent with the opinions of students on their own success.

Table 3
How the Students Evaluate Themselves Concerning the Implementation

A questionnaire composed of open-ended questions was also given in order to determine the opinions

	Very Good		Good		Medium	
	n	%	n	%	n	%
Self-evaluation	63	74.1	20	23.5	2	2.4

of students on the multimedia learning environment. The opinions of students were classified and are presented with some examples. One of the open-ended questions was "What did you enjoy in this environment while learning". The answers given to that question were collected under 5 headings. The frequency and percentages are presented in Table 4.

Table 4
The Features that the Students Liked in the Learning Environment

	f	%
All activities were included in the learning environment	41	48.2
The opportunity of choice and being able to see the product	16	18.8
Working on an everyday life experience	10	11.8
Learning in a computer environment	10	11.8
The environment is like a game and enjoyable	8	9.4
Total	85	100

As can be seen in Table 4, 48.2% of the students stated that they liked all the activities carried out in the environment using such statements as "All of them are very good.", "I liked everything, it was great, I want a copy of it.", "I liked this game in all aspects".

For the students, who preferred to focus on one aspect of the environment instead of stating that they liked the whole environment, the feature they most liked was the opportunity to choose and being able

to see the product (16 %). The students liked being given the right of choice, they have the right to decide and this gave them the opportunity to discuss with classmates the reason why they made that decision and to express their ideas freely. They were relieved that none of the choices were considered to be wrong and, in particular, seeing the reflection of their own preferences may have increased their enthusiasm for creating a product. In the studies, it was argued that the situations which provide opportunity of choice for learners and being able to behave independently in the activities will make the activities more meaningful for the learners, will ensure that they adopt them, will increase their motivation and will improve their skills (Alessi & Trollip, 2001). In addition, Chou (1998) and Bolliger (2004) state that the freedom and the provision of choice which is provided for the students in their multimedia learning environment is one of the reasons why they obtain positive results. Statements such as "What I liked most was that I could choose the features of the party", "What I liked was that I could choose the cake, music", which are included in the interviews carried out with students also supports this finding.

Working on an everyday life experience, such as organizing a party, is another feature that students liked and 10% of the students emphasized this fact. The importance of taking everyday life topics for problem solving or projects can be understood at this point. It is possible to state that this may also be the reason why students let themselves get deeply involved in the process. Some students even stated that they would implement some of their choices in their own birthday party. Moreover, even the participation of students who are not normally involved in the lesson is ensured because this implementation provides the opportunity of using examples from their lives. Therefore, Alessi & Trollip (2001) have recommended that learning environments should be designed in a way to enable making connections with daily life and finding many ways of solving problems. In addition, in the study conducted by Garnett et al. (1996), attention was paid to establishing the environment based on the examples from daily life and it was found that restructuring multimedia learning environment has a meaningful effect on achievement.

Another point which was touched upon was the learning/working column graph in the computer environment and students explained their answers through the idea of "having learnt how to create a column graph by this method" in general. After seeing the acquisitions in the prepared environment, maybe the students compared them with other environments where they can learn the same topic and in a sense they emphasized the positive effect of learning the topic in a multimedia learning environment.

The last answer is that the implementation is "like a game" this answer to this question does not have a high rate from all the answers given nevertheless, particularly during interviews, almost all students used the word "game" while talking about the implementation and stated how they enjoyed it. Moreover, the word 'game' was also used in different parts of the questionnaire, where the implementation was defined. Assessing the material as a game can be one of the factors which motivate them. Garris, Ahlers, Driskel & James (2002) stated that adding some specific features of computer games to the curriculum has increased the motivation of the students. In addition Coleman,

Rea, Hall, Sawyer & Hemsworth (2001) and Tsou, Wang, Tzeng (2006) have emphasized the contributions of an enjoyable environment in their studies.

The factors that the students liked and did not like in the learning environment were asked. However, the students did not state any factor that they did not like.

The answers given to another question "What kind of modifications can be made in order to improve the learning environment?" were classified under 3 headings and the results are presented in Table 5.

Table 5
Opinions of Students on What Can be Done to Improve the Environment

	n	%
No need for change	67	78.8
Animation can be added	11	12.9
There can be more choices	7	8.2
Total	85	100

When it was asked what can be done in order to improve the multimedia learning environment; 78.8% of the students stated that they thought there is nothing to add through statements like "It could be better", "There is no need for change" or similar sentences.

12.9% of the students stated that they wanted the children seen on the screen at the end of the implementation to "eat the chosen cake", "play the game" or all of them to be displayed as a video. This was stated by 12.9% of the study group, which can be explained in terms of the developmental features of the students. Most of the students in this age group are at the concrete operational period and animation can provide concrete experiences for them. Moreover, animation can increase the motivation of students. In the study conducted by Kim et al., (2007), it was found that animation increases joy and motivation but its effect on achievement is no different from the use of pictures.

When the opinions of students on the learning environment were examined, 8.2% of them stated that there should be more choices in the environment. With "more choices", 4 of 7 students meant that they want more parts and questions and they recommended that "A dance could be chosen for the party". 3 requested more choices in the questions, such as increasing the choices of place or date. These demands and recommendations can be accepted as the indicators of how much the students were involved in the process and wanted to prolong the process. In fact, no student responded with "Yes" to the question "Did you want to stop the implementation".

The students were asked if they wanted to learn the other subjects in such a learning environment and the results are presented in the Table 6.

Table 6
 Opinions of Students on Learning in Similar Learning Environments

	n	%
Yes	83	97.6
No	2	2.4
Total	85	100

The students stated that they wanted to learn other subjects in similar learning environments (97.6 %). The high rate of “Yes” answer given to this question is consistent with both the positive results gathered in many studies, resources and with the findings of this study. It can be stated that students saw and experienced many of the advantages of multimedia and responded to the questionnaire accordingly. Many researchers (Garcia, Quiros, Santos, Gonzales & Fernanz [2005], Messer, Kan, Cameron & Robinson [2002]) have stated that multimedia arouses considerable interest in learners and they prefer a multimedia learning environment. Speaker (2004) researched the effect of introducing a lesson using multimedia on the preference and selection of this lesson by the learners, and a statistically meaningful difference was found. In other words, it can be stated that students prefer the courses, which use multimedia and would like to attend lessons given by the teachers who use multimedia. The results of this study also support the findings.

4. RESULTS AND CONCLUSION

The necessity of training individuals according to the needs of the current era has raised the need to creating opportunities in the primary schools instruction programs and new instruction programs have been prepared by the Ministry of National Education (MoNE). When the program was examined, it was seen that the Skill for Using Information Technologies is one of the 8 skills specified in the new instruction program. Moreover, using information technologies during learning and teaching was highlighted in the new program. However, it was observed that resources and implementations appropriate for the understanding of this new instruction program remain limited. Within the scope of this study, a multimedia learning environment was developed according to the ADDIE Design Model for a topic in the Mathematics course of fourth grade primary classes and the phases of development were explained one by one. Thus, this work aims to contribute to the development of computer based multimedia or learning environments.

The subject field was determined as Mathematics and the target group as primary school fourth grade classes in the **analysis** phase of the study. The target group was also examined for features of development and learning including; pre-learning, the degree of readiness concerning the subject and use of technology. By taking into consideration that there are not many technology based materials available, it was decided that prepared environment can be used for different purposes such as ensuring the students practice and review according to their own learning speed, compensating for insufficient learning occurring during the course and ensuring that what was learnt during the course are transferred to everyday life.

During the **design** phase, it was discussed how to teach the subject field by taking into consideration the features of the target group. Thus, the acquisitions concerning the subject in the instruction program were determined. Content was developed for these acquisitions and appropriate instruction methods, learning activities and evaluation processes were developed in line with these acquisitions to determine the features of the environment. In addition, the measurement tools were developed.

During the **Development** phase, the components of multimedia, which were planned during the design phase of the study, were developed. The students examined the multimedia learning environment which was prepared in a computer laboratory. Prepared texts, graphs and sound components were put together in a balanced way and the texts were supported with sound. After developing the environment, pre-implementation was made in order to test the developed environment. The study group for the evaluation of the pre-implementation was composed of 22 students from a fourth grade class. At the end of pre-implementation, a multiple choice questionnaire and a questionnaire, which included open-ended questions, were applied in order to obtain the opinions of students on the software. Concerning the learning environment, a questionnaire was given to the mathematics and computer teachers, as well as the students, in order to obtain teachers opinions about the multimedia environment. The opinions of specialists on the issue were also taken. As a result of all these data, necessary modification were made to text and switches and environment was prepared for the real implementation by adding new visual materials in some parts.

During the **evaluation** phase, the effect of the multimedia learning environment on achievement was examined in order to evaluate the environment and the difference between pre- and post-test results was found to be meaningful. The results gathered from the questionnaires on learning environment have contributed to reviewing the multimedia environment which was created for this study.

When the opinions of students on the *ease-of-use* of the learning environment were examined, it was seen that students had not experienced any difficulty in using the software; when the opinions of students on *ensuring cooperation* in learning environment were examined, it is seen that students stated their appreciation concerning activities for cooperation in the learning environment; when the opinions of students on *facilitating thinking* were examined, it is seen that this question has the lowest positive response rate with 61.2%. Concerning having an *enjoyable* learning environment, 91.8% of the students gave the answer "yes". When opinions on whether the learning environment encourages the students to use what they have learnt were examined, 89.4% of students answered "Yes". The students were asked to make self-evaluation according to the result of implementation and 74.1% of the students evaluated themselves as "Very Good". Moreover, the results gathered from the opinions of students and teachers revealed that they want more animation to be included in the multimedia environment.

5. RECOMMENDATIONS

With the experience gained in this study, it is possible to state that using an instruction model during the process of designing instruction material facilitates the process and moreover guides the evaluation of the process. Thus, it is recommended that the designer of the instruction should develop the

material according to a model. As was mentioned previously, multimedia learning environment was tested on primary school students during the Evaluation phase and its effect on achievement was examined. The permanence of learning can be measured by interrupting the delivery of learning materials for 2 to 3 weeks and then making another implementation. The effect of the learning environment on achievement can be examined according to the purpose of use (face-to-face or review and making practice).

Moreover, by taking into consideration the issues that the designer faces during this process, for designers, it is possible to state that ADDIE Model which was described as a linear mode in the literature is a cyclic model when it is considered that each phase can refer back to previous phases or forward to the next phases. Therefore, the ADDIE Model will be more effective in solving the problems if it is utilized in this cyclical way.

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