The effect of network based science teaching on students problem solving skills and science attitudes (Izmir sample)

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Abstract. The purpose of this research is to investigate the effect of network-based teaching on the problem-solving skills of high school first year students and their attitudes towards science. For the purpose of the research, a website has been developed which aims to attain the goals and behaviours of the "Cell Division" unit from the high school first class biology curriculum by the researcher. While developing the pages on the website, attention was paid to supporting the collaboration inherent in network-based education, accessing visual and auditory records, enabling student-student and student-teacher interaction and so on. The research was carried out as an experimental study in accordance with the "control group pre-test-post-test model". In the research, network-based teaching was used in the experimental group and traditional teaching methods were used in the control group. The research was carried out on 64 students studying in a high school in the city centre of Izmir ($N_{Experiment}$ =32, $N_{Control}$ =32). "Problem Solving Inventory" adapted in Turkish by Şahin, Şahin and Heppner (1993) as a data collection tool in the research, "Attitude Scale towards Science" and "Personal Information Form" developed by Baykul (1990) were used. In the analysis of the data, t-test was used to determine the significance of the difference between the experimental and control groups. As a result of the research; it was determined that network-based science teaching significantly improved students' problem-solving skills compared to traditional teaching and positively affected their attitudes towards science.

Keyword: Network-based teaching, problem solving skill, attitude

INTRODUCTION

The change in information and communication technologies affect the cultural, social and economic structure of the countries; as a result of this change, the type of people needed, the structure and needs of the society also change. In developing economies, the new source of the transformation in socioeconomic and social fields emerges as technological developments (Orhan & Genç, 2018).

The rapid change, which started especially in the second half of the 1980s, also changed the conditions of social life, learning-teaching environments and activities, and provided important expansions. The developments in science and technology add new dimensions to the functions of education in parallel with the changes in the life of the society and the responsibility of education to lead the change and development in the society becomes important (Kaya & Odabaşı, 1996).

In an era where information and communication technologies are becoming widespread and used in every area of our daily life, it is of special importance to use information effectively, efficiently, together with modern technology and systematically in the field of education (Alkan, 1995). Societies that can recognize and apply this importance will play an active role in the globalizing world.

Developments in technology and especially communication technologies affect education as well as directly in all areas of society (Odabaş, 2003). Especially with the introduction of computer networks in the field of education, computer, internet and related educational technologies have also developed rapidly. These developments in science and technology cause important and radical changes in education systems in our country and in the world.

The efficient and proper use of information technology in the 21st century is considered to be one of the most important factors for countries in achieving planned economic and social

development levels (Demircioğlu & Geban, 1996). At this point, the training of individuals who know, interpret the information, apply this knowledge, have creative, communication skills, work in cooperation, have a democracy culture, are sensitive to social events, renew themselves, and use qualified information and communication technologies effectively and efficiently.

The concept of "lifelong learning" is becoming more and more widespread for both professional and personal development and thus increases the demand for "continuous education" (Alakoç, 2003). In the 21st century, distance education has become increasingly important in the learning-teaching process, with its knowledge explosion, rapid development in technology, the increase in the number of individuals who want to receive education and the demand for life-long education, making it more than an alternative in terms of time and space.

In general, more flexible educational applications were needed in order to adapt to rapid developments to meet the increasing education demand and to provide education opportunities to individuals in different conditions in the technological and scientific fields in the world and in our country (Alkan, 1997). In addition to traditional educational technologies, the effects of developments in different fields, especially communication, are at the core of these educational practices (Aydın, 2002b). Developments in information and communication technologies have enabled different teaching practices than traditional distance education methods.

Increased need for lifelong education, knowledge to be taught, increased number of learners, new distance education approaches that will provide solutions to problems such as the distance of the people who want to learn from where they are located, the distance from where they are taught, and the learning needs of disabled people (Koçoğlu, 2002). One of these approaches is network-based teaching.

Especially since the late 1990s, with the intensive use of computer networks in learning and teaching activities, it has provided important developments and changes in distance education. According to Schrum, slowness, limited interaction, lack of access to different resources, not being able to receive services where and when needed, focusing on individual differences which are largely eliminated by using computer networks and connected technologies in educational environments (Aydın, 2002a).

Especially, it is very important to use computer and network products in presenting science classes to students. Because 83% of what is learned is learned by seeing, 11% by hearing, 3.5% by sniffing, 1.5% by touching, and 1.0% by tasting. In addition, the more a teaching activity addresses the sensory organs, the more permanent traces of learning are, and the later to forget. According to research results by Philips at the University of Texas in the United States, individuals; they remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they see and hear, 70% of what they say, 90% of what they do and say (Yürütücü, 2002; Demirel, 2003). At this point, in addition to removing the limitations of distance learning and traditional education, network-based science teaching, with its multimedia features such as picture, sound, video and animation, it has a structure that will increase the efficiency of teaching and allow the learning to be more permanent.

As in other teaching methods, the main purpose in network-based teaching is to develop the competences of the student such as being able to do, apply, take responsibility and make decisions. Therefore, the most important point is that the student can apply the knowledge and skills learned. The fact that the knowledge gained can be applicable and permanent in daily life depends on the quality of the individual's attitudes towards the subjects learned or to be learned (Serin, 2001).

Affective domain characteristics; it is about attitudes, interests, values and trends. Attitudes constitute an important part of these features. Attitude is the pre-disposition of a cognitive, affective and behavioural response organized by the individual based on his/her motivation, experience and knowledge about any social subject or event (İnceoğlu, 1993).

In an educational environment where student attitudes are not taken into account, it is difficult to create teaching experiences and therefore, teaching activities cannot be fully realized (Fidan, 1994).

In many studies conducted in different courses such as Science, Mathematics, Social Studies, and Language, there are positive relationships between attitude and success and attitudes affect

success and success affects attitudes (Baykul, 1990; Özkal, 2000; Saracaloğlu, Serin, & Bozkurt, 2000; Aydın & Boz, 2010; Golgeli & Saraçoğlu, 2019; Tabuk, 2019), the positive attitudes of the students increase their academic success. Moreover, it was determined that students' positive attitudes towards science started to occur at primary level and continued in secondary education (Serin, 2001).

Although advances in science and technology have brought many advantages in individuals' lives, they have also raised the problem of adapting people to new situations. Therefore, improving the problem-solving ability of students is among the primary objectives of education.

Problem; it can be defined as the situation that prevents the individual who wants to reach a goal from reaching the goal and leads to conflict. These obstacles make it difficult for the individual to achieve his goal. In such a situation, the individual has to find the best way to overcome the obstacle and reach the goal (Izgar et al., 2004).

Altun (2000) solves problem solving; defines what to do in cases where it is not known what to do depending on the problem concept. The problem-solving process involves doing research with controlled activities in order to achieve a clearly designed but not immediately achievable goal. Problem solving is also defined as an unusual activity in which students develop their own approach to problems, choose their own tools and monitor the progress of their plans.

Problem solving can be defined as the process of overcoming difficulties in achieving a goal. This process is the process of creating favourable conditions to overcome difficulties, getting rid of tension by reducing obstacles and looking for ways to bring the organism to internal balance. It can be thought of as a skill to learn, a skill to acquire, and a skill that needs to be continually improved (Izgar et al., 2004, Bulut Serin, Pehlivan, Serin, Şahin, & Saygılı, 2012).

Oguzkan (1989) solves problem solving; it defines it as a process that includes a series of efforts with cognitive and psychological dimensions to eliminate the difficulties encountered in reaching a certain goal. Senemoğlu stated that his or her problem-solving skills help individuals to actively adapt to the environment in which a group life. For this reason, all people need to learn to solve problems so that they can adapt to the environment they live in effectively. While some problems have corrected answers or exact solutions, others are not. The solution of these problems is a process that requires interdisciplinary knowledge, creativity and multi-faceted thinking (Mertoğlu & Öztuna, 2004). Kilpatrick stated that a student's success in problem solving depends on the development of his skills in the problem-solving process (Karakaş & Güven, 2003). According to Izgar et al. (2004), problem solving skill is a skill that an individual should have in order to maintain a healthy life and protect mental health. Generally, human life is full of daily problems and stressful events. Especially in the 21st century, when technology is so advanced and life becomes more complicated, individuals face different problems day by day. In this regard, it seems quite important for the individual to gain problem solving skills.

Determining the effect of distance learning method, which is an indispensable tool of modern life in the 21st century, on the problem-solving skill of students and their attitudes towards science, and determining the current defects of this teaching method which is used more and more; and it can be transformed into a more effective form by efforts to eliminate them and develop students' positive attitudes.

With the introduction of wireless and mobile technologies into the classroom, the physical environment of the classroom also changes. Wireless/mobile technology has freed the information flow geographically, eliminating the time and actual space limit for individuals' education (Litynski, 2005). Now individuals are in a position to view their homework, download electronic resources, distribution of tasks, exams or read incoming e-mail while walking on the street or sitting in the park. By connecting it to the network (internet and intranet) in this way, the teacher will design better learning activities. Students will be able to form a team with students in different classrooms, schools, cities, and even different countries, so individuals in different settings will work together for the same purpose. However, computer-generated classrooms will be created depending on the common interests of the students (Chan et al., 2000). Teacher-centered education will be replaced entirely by learner-centered education.

In addition to this, it enables students to use materials that are impossible to use, located in different places or that are very expensive. Such applications, which have a very effective use

in art and science, will provide students with the opportunity to participate in events held in different parts of the world simultaneously or asynchronously. For example, visiting a museum online, observing the launch of a spacecraft into space, watching a concert given by a musician.

Considering the development stages of distance education, which arises as a result of the increase in education and training needs and the inadequacy of the face-to-face education system, it is seen that it is largely shaped in parallel with the development of communication and information technologies. Distance education has always been and is affected by the developments in technology (Aydın, 2002a; Balcı, 2002; İşman, Karslı ve Gündüz, 2002; Özonur et al., 2019).

Rapid changes in communication technologies have contributed positively to the development of the global communication network through distance education practices and made it necessary to develop new teaching methods (Çallı et al., 2002). The formal expression of some concepts emerging with computer and communication technologies is given in figure 1 below.
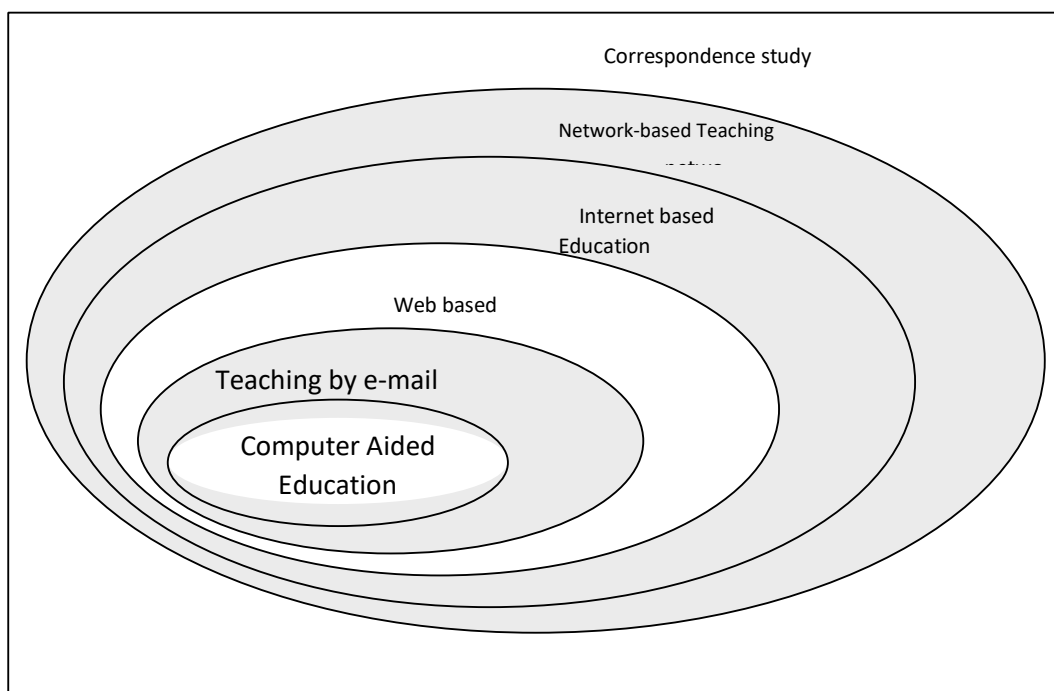

FIGURE 1. *The Relations of some distance education concepts with each other (Adapted from Çukadar & Çelik (2002), citing from Urdan and Weggen).*

As seen in Figure 1, computer aided education has formed the basic step in distance education using computer and communication technologies. Using the computer in distance education can be described as a revolution. The use of computers in distance education has made the time and distance in reaching students a dynamic force that provides an independent and interactive environment (Alkan et al., 2003).

Aim and Importance of the Study

The main purpose of this research is to determine the effect of network-based science education on students' attitudes towards science and problem-solving skills at the high school first year level. Nowadays, rapid developments in information and communication technologies are effective in education as in every field. Computer networks, which cover a significant part of information technologies, provide significant advantages, especially by encouraging individual learning, eliminating time, space limitation, and enabling full use of audio-visual communication (Bayam & Urin, 2002).

Network-based education is an outcome of the need for quality, not quantity, but quality, as well as the increasing need for education, the limits arising from traditional education. Creating

cooperative environments arising from the potential of computer networks, allowing democratic participation and multimedia applications are the solutions to many problems encountered in science education.

As the science curriculum generally includes abstract concepts, different teaching strategies and methods should be included in the courses in which students can participate in different activities. In fact, it can be said that the basis of the students' difficulties in the field of science is that they do not participate in the learning process, that is, they are not active in this process.

According to Yiğit & Akdeniz (2003), the content of science generally includes abstract building blocks, making this education an obligation, full of activities by doing and living in this field. The fact that many efforts in this direction are prevented for reasons such as lack of physical facilities, inadequacy of teachers, results in the search for new approaches.

One of the most important reasons for the difficulties in teaching science related subjects and the low interest of students in this field, the lack of experimental studies for various reasons is due to the inability to conduct a science teaching in which science and technology are in parallel (Cavaş, Kışla, & Twining, 2005). Therefore, the results obtained from this research will form a basis in improving science education programs and increasing the interest in science and technology.

Science, which shows the fastest development in the sciences, will not be difficult for students to understand living things, physical and chemical phenomena and biological foundations when their education is not experiment-centered. As it is today, science lessons (biology, physics, and chemistry) will be perceived as memorizing lessons (Çakmak, 1999). In addition, today's learning approaches require students to keep their interest alive and participate in the lesson in order to learn the information discussed in the lessons permanently (Yiğit & Akdeniz, 2003). At this point, it is thought that multimedia support has been provided, and network-based applications supported by communication environments will bring important expansions in terms of keeping students' interest in the lesson alive and performing experimental studies.

In addition, it is thought that network-based education will contribute to students' cognitive and affective development. Attitudes, one of the important affective characteristics, are important for the learning process. At this point, it is of special importance to investigate the effect of network-based teaching, which is a new teaching method, on students' attitudes towards science.

During the teaching process, the subject of the student, school, teacher, etc. positive attitudes towards items will increase its success (Açıkgöz, 2003). When attitude is considered as the tendency of behaviour, it is one of the important factors affecting success (Serin, 2001). Student attitudes play a very important role on student achievement in the courses included in the education programs and emerge especially in the science teaching-learning process. Therefore, it is necessary to examine attitudes towards science which will affect student success in science classes.

In the literature, Başaran & Tulu (1999), Bodzin (1999), Özturan Egeli, & Darcan (2000), Daş & Varol (2002), Nistor (1996), Chan et al. (2000), Güneş & Ertuğrul (2002), Rudat (2002), Stratton (2003), Usal & Albayrak (2005), Bozkurt (2017) have researches on the use of computer networks for teaching purposes. In the studies conducted by Nistor (1996), Özturan Egeli, & Darcan (2000), distance learning environments using computer networks increased the motivation of the students and the education given in multiple environments was easily and comfortably, "Özturan Egeli, & Darcan (2000), Dikici & Demirli (2003), Feyzioğlu (2002), Rudat (2002), Tongdeelert (2003), Stratton (2003), and Nacar & Tümkaya (2011)" showed that student achievement does not differ or is higher than traditional education. However, it has been determined that the studies examining the effect of network-based teaching on students' problem-solving skills and attitudes towards science are quite limited. Therefore, considering the place and importance of science education in the teaching process, it was thought that the effects of this teaching (network-based) method should be investigated.

Undoubtedly, individuals understand the problems in daily life, solve these problems, think critically, and develop their skills such as creativity. In this context, all these features are also among the general objectives of science education (Serin, 2001). At this point, it has been deemed necessary to examine the effect of network-based education, which is one of the most used distance education applications in the 21st century, on students' problem-solving skills.

This research is expected to be a guide for educational institutions and teachers who will implement network-based teaching. Especially considering the conditions in our country, network-based science teaching may be an alternative solution to this problem because the science lessons are at the beginning of the lessons that students, have difficulties in understanding and fail. In addition, in education, evaluating the effect of students on problem solving skills and attitudes towards the course and investigating applicability are of great importance. With the contribution of network-based applications to the education system and the opportunities it offers in learning. For this reason, the study aims to find out the effects of network-based science teaching on students' problem-solving skills and attitudes towards science with the following study questions.

Problem Statement

The problem of this research; "Does network-based science education have an impact on high school first year students' problem solving skills and attitudes towards science?" question poses the problem of this study. In this context, answers to the following questions were sought.

Sub Problems of the Research

For the purposes of the research, answers to the following sub-problems were sought.

1. Is there a statistically significant difference in the pre-test score averages between the attitudes and problem-solving skills of pre-application science towards the traditional education (control group) and network-based teaching method (experiment group)?

2. Is there a statistically significant difference in the post-test point averages between the attitudes and problem-solving skills of the students who have been applied traditional education (control group) and network-based teaching method (experiment group) after the application?

3. Is there a statistically significant difference in the difference (development level) of the difference between the attitudes towards science and problem-solving skills scores within the experimental group and the control group?

Research's Assumptions

The students answered the measurement tools sincerely.

METHODS

Research Model

In this study, where the effect of network-based teaching method on students` attitudes towards science and problem-solving skills, students' attitudes towards science and problem-solving skills were investigated. In this research, pre-test and post-test control group experiment pattern seen in Table 1 was used. GD experiment group shown in the figure, GK control group; R subjects are assigned neutrally; O_1 and O_3 are the pre-test and post-test measurements of the experimental group; O_2 and O_4 are the pre-test and post-test measurements of the control group; X shows the independent variable (network-based instruction) applied to the subjects in the experimental group.

Table 1. *Pre-test post-test control group pattern* (Büyüköztürk, 2001)

		Pre-test		**Post-test**
GD	R	O_1	X	O_3
GK	R	O_2		O_4

The research was carried out on a control experimental group. Experimental and control groups were randomly assigned. The test pattern is given in Table 2. As can be seen from Table 2, the Attitude Scale for Science and Problem-Solving Inventory were applied to both groups before the experiment. During the experiment, network-based teaching was applied to the experimental group and traditional teaching methods were applied to the control group.

Table 2. *Experimental pattern used in the research*

Group	Before Experiment	**Experiment Processes**	After Experiment
Control Group	Attitude Scale towards Science Problem Solving Inventory	Traditional Teaching Methods	Attitude Scale towards Science Problem Solving Inventory
Experimental Group	Attitude Scale towards Science Problem Solving Inventory	Network-based Teaching Methods	Attitude Scale towards Science Problem Solving Inventory

When the biology curriculum is examined, they have processed the cell division unit for 8 lessons in 4 weeks, for a total of 2 hours per week of Biology lesson. The application was continued for 4 weeks.

Before the application, the subject of "Organic components in living things" selected from the subject of biology lesson in the first semester of the same academic year was delivered to the students for a period of 2 weeks by supporting traditional education through a web page. Students were provided to follow this site. In this way, it was tried to prevent the results to emerge from just using a new method.

For the experimental part of the research, the web page shown in Figure 2 was prepared by the researcher. Biology lesson was chosen from science lessons in the training given as a network.

As the subject, mitosis and meiosis were selected in biology curriculum. The basis of the selection of this subject lies in the fact that cell divisions are among the subjects that students may have difficulty in concretizing and constructing concepts in their minds as they occur at a microscopic level (Altıboz, 2004).

Participants

This research was carried out on high school first year students who are studying in a public high school with a middle socio-economic level within the borders of the province of Izmir. Participants are the students of the two branches taught by the biology teacher who voluntarily participated in the study. Experimental and control groups were randomly assigned.

The distribution of the students participating in the study by gender is shown in Table 3. Considering the results obtained from the personal information form applied to the experimental group, it was seen that 87.8% (N=29) of the students had more than 1-5 years of computer use experience. Students; 81.8% (N=27) stated that they have taken computer lessons before and 48.4% (N=16) stated that they have a computer that they can use at home. Considering students' purposes of using the Internet, it was revealed that 84.8% (N=28) used the Internet for educational and communication purposes. It has been revealed that students connect to the Internet from Internet cafes with a rate of 60.6% (N=20) and 78.8% (N=26) provide 1-3 hours or more connections. Students expressed 87.8% (N=29) internet usage levels as sufficient or very sufficient.
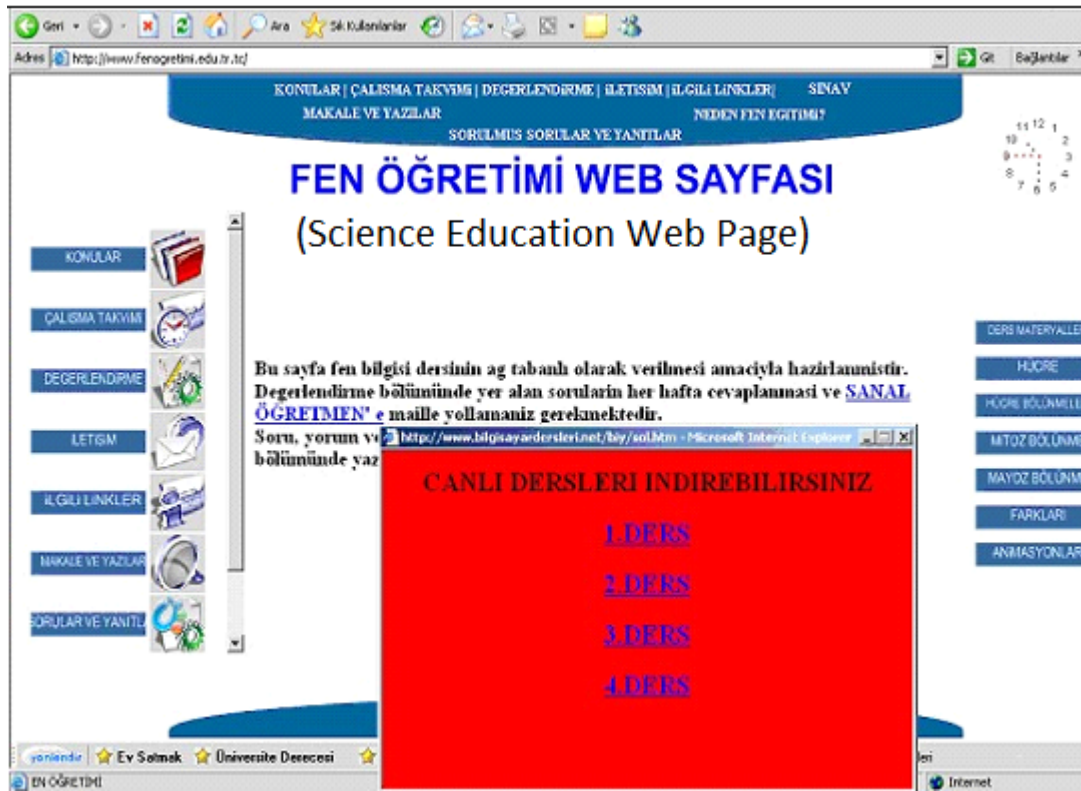
FIGURE 2. *Web page used in the application*

Table 3. *Distribution of participants in the research by gender*

Gender	Network-based Teaching Group	Traditional Teaching Group
Female	4	4
Male	28	28
Total	32	32

Experimental Processes

We can examine the experimental part of the research in 3 stages. Which are examined under the titles of pre-application procedures, procedures during application and post-application processes.

Pre-Application Processes

The "Cell Division" unit has been extensively researched before the application and content has been prepared for the web page to be used. At this stage, primarily, many sites providing science and biology education on the internet were examined and the most appropriate aspects of this study were taken as an example. Microsoft FrontPage, Dreamweaver, Macromedia Flash programs were used in the design of the web pages. In addition, the lectures of the teacher were taken through a digital video camera. Adobe Premier Program was used in the works on the images. Media Player program was used to watch the images by the students. Presentations of all the topics covered were added to the website. In the preparation of presentations, the PowerPoint program in Office was used. Instant chat plugin and forum page were used for teachers and students to communicate simultaneously. The titles and contents of the prepared web page are as follows:

Topics: This is the area where the topics are covered each week. The information in this area contains only written information.

Work Schedule: This is the area where the topics and their content will be covered each week.

Assessment: It is the field where the grades are based on the answers given by the students and the results of the answers.

Communication: It is the area where students can reach their answers when they want to mail the teacher to the forum page in Figure 3 and the questions in the evaluation section, which was created in order to communicate with each other and with the teacher.

FIGURE 3. *Forum Page where messages from all users can be seen*

Related Links: It is the field where the addresses of the different web pages related to science and biology are included. Students can access the web pages they want by clicking the relevant link.

Articles and Articles: This is the area where articles and various research articles on Science and Biology are available.

Questions and Answers: This is the area where the questions related to the topic covered each week and the answers to the questions asked last week.

Exam: This is the area where students can measure their knowledge and become an online exam. As shown in Figure 4, the number of right and wrong is informed to students instantly.

Course materials: This is the area where students can access written, audio or video course materials related to the course they are teaching. The video footage of the subject, which is covered every week, is also included in this field. Students have the opportunity to download and view these images on their own computers.

Transactions during the Application

All applications and communications from the beginning to the end of the study were made over the internet or the computer network installed in the application laboratory. After the web design was finished, e-mail and e-mail group accounts were opened and students were notified. The e-mail address and forum page announced on the website were used for communication. With instant chat software, teachers and students were provided to communicate simultaneously.

During the application, students were offered the opportunity to work in a computer lab with an Internet connection speed of 4 MBPS during the biology class hour (80 minutes) in order to access the network-based science teaching resource. An Internet room with 20 computers in the school where the application is made is available for students. In addition, students can access the site from anywhere with an Internet connection.

The website continued its publication at www.fenogretimi.edu.tr.tc. The site has been updated every week for four weeks after the launch of the application. The questions asked each week were changed, and the answer to the question asked the previous week was added to the site. The grades taken by the students depending on the answers of the questions they posted were published on the site as shown in Figure 5.

Online Exam Sample

FIGURE 4. *Online exam sample*

FIGURE 5. *View of the page published by the students' grades*

In order to ensure student-student and teacher-student interaction, which is inherent in network-based teaching, various discussion questions have been posted on the forum page. Each

student was allowed to become a member on the prepared form page. Questions that students wonder or want to discuss are also included in this field.

In order to watch the video images taken in the course environment of the subject covered every week by the students, images were uploaded to the server computer on the network installed in the computer lab. Students were provided with the opportunity to access video images from their computers and mobile phones over the internet.

Post-Application Procedures

After the application is over, the Science-Attitude Scale and Problem-Solving Inventory used in the research were sent to each student via e-mail and it was ensured to be taken back in the same way. The questionnaires were distributed to the students in the control group and collected at the end of a suitable time (40 minutes) that they could easily answer.

Population and Sampling

As the population of the research, 64 high school first year students were selected at Anadolu Technical and Industrial Vocational High School.

Data Collection Tools and Scoring

"Science Attitude Scale" and "Problem Solving Inventory" were used to collect data, evaluate the study, and evaluate whether there is a significant difference in students' problem solving skills and their attitudes towards science before and after the study.

In the study; the validity and reliability of "Science Attitude Scale" was used by Baykul (1990). "Science Attitude Scale" with Cronbach Alpha reliability coefficient .94 consists of 30 items in total. While the scale consisting of 30 sentences containing positive and negative expressions was scored, the total score was found by reversing negative expressions. A minimum of 30 and a maximum of 150 points can be obtained from the scale and high scores indicate a positive attitude. In the Attitude Scale towards Science, 15 of 30 attitude expressions were arranged as positive and 15 as negative expressions.

In the research, the "Problem Solving Inventory", which was adapted by Şahin, Şahin and Heppner (1993) in Turkish, was used. Cronbach Alpha reliability coefficient of the scale is .90, it is a 6-point Likert type scale consisting of 35 items with positive and negative expressions. While scoring the scale, negative expressions were reversed and total score was found. A minimum score of 32 and a maximum of 192 can be obtained from the scale. Problem solving inventory; 3 items are excluded from the evaluation (items 9, 22 and 29), items 1, 2, 3, 4, 11, 13, 14, 15, 17, 21, 25, 26, 30 and 34 are reversed items. The high total scores obtained from the scale shows that the individual perceives himself inadequate in terms of problem solving skills.

Application of Data Collection Tools

The questionnaires were distributed to the students who received traditional education and were collected after a suitable period (45 or 60 minutes) that they could easily answer. The questionnaire was answered by the experimental group on the computer, and the results were received through the network installed in the computer lab to the researcher.

Data Analysis

In the research, the following statistical processes were used to evaluate the data obtained from the measurement tools. SPSS package program was used in the analysis, for the purposes of the research. The t-test was used for binary comparisons in the procedures performed in order to determine the significance of the difference between the mean differences, the mean scores of the attitude and problem-solving skills of the experimental and control groups. The level of importance in the study was accepted as .05.

FINDINGS

Findings Related to the First Sub-Problem

The first sub-problem of the research was expressed in the form of "Is there a statistically significant difference in the pre-test score averages between the attitudes and problem-solving skills of students who have been applied traditional teaching (control group) and network-based teaching method (experiment group) to pre-application science?".

For this purpose, arithmetic mean and standard deviations of network based education and traditional education groups according to the attitude scale of science and preliminary measurements of problem solving inventory were calculated, and t-test was performed to understand whether the difference between the groups' arithmetic averages was significant (Table 4 and Table 5).

Table 4. *Arithmetic mean, standard deviation, t and p values according to preliminary measurements of science based attitude scores of network based education and traditional education groups*

Groups	N	Mean	Std.Dev.	t value	p value	Level of Significance
Network Based Instruction	32	101.21	25.78	.27	.786	p>.05
Traditional Teaching	32	99.40	27.38			

When Table 4 is analysed, it is seen that the average of the network-based teaching group ($\bar{x}$=101.21) is higher than the average of the traditional teaching group ($\bar{x}$=99.40). When the standard deviation results are analysed, it is seen that the standard deviation (ss=25.78) of the network-based teaching group is lower. Accordingly, it can be said that the network-based teaching group has a more homogeneous structure than the traditional teaching group. In order to understand whether the difference between the attitude pre-measurement averages of the science of the students in both groups is significant, a t-test was conducted. Findings from the preliminary measurements show that the mean scores of attitudes towards science did not differ statistically between experiment and control groups (t = .27, p> .05).

Table 5. *Arithmetic mean, standard deviation, t and p values according to problem solving inventory of network based education and traditional education groups*

Groups	N	Mean	Std.Dev.	t value	p value	Level of Significance
Network Based Instruction	32	101.53	17.77	.83	.072	p>.05
Traditional Teaching	32	93.50	17.33			

When Table 5 is analysed, it is seen that the average score of the network-based group ($\bar{x}$=101.53) from the problem-solving inventory is higher than the traditional teaching group average ($\bar{x}$=93.50). When the standard deviation results are analysed, it is seen that the standard deviation (ss=17.77) of the network-based teaching group is higher. Accordingly, it can be said that the traditional teaching group has a more homogeneous structure than the network-based teaching group. According to the findings, students' scores from the problem-solving inventory do not differ statistically significantly according to the groups (t = 1.83, p> .05). In the findings obtained from the preliminary measurements, it can be said that the problem-solving skills of the students are similar to each other.

Findings Related to the Second Sub-Problem

The second sub-problem of the research; It was expressed in the form like "Is there a statistically significant difference in the post-test point averages between the attitudes and problem-solving skills of the students who have been applied traditional teaching (control group) and network-based teaching method (experiment group) after the application?. In order to respond to this sub-problem, arithmetic mean and standard deviations were calculated according to the final measurements of the attitude scale towards science of traditional education groups and t-test was performed to understand whether the difference between the arithmetic averages of the groups was significant. The results are summarized in Table 6.

Table 6. *Arithmetic mean, standard deviation t and p values according to the final measurements of science based attitude scores of the network based and traditional education groups*

Groups	N	Mean	Std.Dev.	t value	p value	Level of Significance
Network Based Instruction	32	105.06	23.96	.25	.214	p>.05
Traditional Teaching	32	97.37	24.98			

When Table 6 is examined, it is seen that the average score of the network-based group ($\overline{x}$=105.06) is higher than the average of the traditional teaching group ($\overline{x}$=97.37). When the standard deviation results are analysed, it is seen that the standard deviation (ss=10.47) of the network-based teaching group is lower. Accordingly, it can be said that the network-based teaching group has a more homogeneous structure than the traditional teaching group. A t-test was conducted to determine the final measurement attitudes of the students according to the groups towards science. It was found that students' attitudes towards science did not show a statistically significant difference compared to the groups (t=5.01, p>.05). According to the findings, it can be said that the attitude levels of the students in the network-based teaching group and the traditional teaching group towards science are similar to each other according to the post-test results.

Arithmetic mean and standard deviations were calculated according to the latest measurements related to problem solving skills of network-based education and traditional education groups, t-test was performed to understand whether the difference between the arithmetic averages of the groups was significant and the results are summarized in Table 7.

Table 7. *Arithmetic mean, standard deviation, t and p values according to the problem-solving inventory final measurements of the network based education and traditional education groups*

Groups	N	Mean	Std.Dev.	t value	p value	Level of Significance
Network Based Instruction	32	90.68	20.88	.49	.621	p>.05
Traditional Teaching	32	93.00	16.00			

Looking at Table 7, it is seen that the average of the traditional education group ($\overline{x}$= 93.00) is higher than the average of the network-based education group ($\overline{x}$=90.68). When the standard deviation results are analysed, it is seen that the standard deviation (ss=20.88) of the network-based teaching group is higher. Accordingly, it can be said that the traditional teaching group has a more homogeneous structure than the network-based teaching group. Findings of the problem-solving skills of the students in both groups were determined using the t-test. The problem-solving skills of the students do not show a statistically significant difference according to the groups (t = .49, p>.05).

Findings Related to the Third Sub-Problem

The third sub-problem of the research; "Is there a statistically significant difference between the experimental group and the control group's mean of the difference (level of development) between their attitudes towards science (science) and their problem-solving skills?" It was expressed in the form.

Findings related to the post-test pre-test differences of the attitude points of the network-based education and traditional education groups towards science are summarized in Table 8.

Table 8. *Arithmetic mean, standard deviation, t and p values of post-test-pre-test difference between the attitude scores of science-based and traditional education groups towards science*

Groups	N	Mean	Std.Dev.	t value	p value	Level of Significance
Network Based Instruction	32	3.84	14.48	.26	.211	p>.05
Traditional Teaching	32	2.03	21.93			

When Table 8 is analysed, it is seen that the average of the traditional education group ($\overline{x}$=3.84) is higher than the average of the network-based education group ($\overline{x}$=2.03). When the standard deviation results are analysed, it is seen that the standard deviation (ss=14.48) of the network-based teaching group is lower. Accordingly, it can be said that the network-based teaching group has a more homogeneous structure than the traditional teaching group. To test whether the difference between the arithmetic means of the groups is important or not, t test was performed. According to the groups, it was found that the attitudes towards science (sciences) did not show a statistically significant difference (t=1.26, p>.05).

Based on this result, it can be concluded that the effects of both teaching methods on students' attitudes towards science do not differ statistically. However, the attitudes of the experimental group towards science (sciences) (Pre-measurement $\overline{x}$=101.21, Post-measurement $\overline{x}$=105.06) improved positively, while the attitude of the traditional teaching group (Pre-measurement $\overline{x}$=99.40, Post-measurement $\overline{x}$=97.37) decreased. Accordingly, it can be said that network-based education has positive effects on students' attitudes towards science.

Table 9. *Problem solving inventory of network based education and traditional education groups according to post-test-pre-test differences between groups, arithmetic mean, standard deviation, t and p values*

Groups	N	Mean	Std.Dev.	t value	p value	Level of Significance
Network Based Instruction	32	10.84	21.27	2.26	.027	p<.05
Traditional Teaching	32	.50	14.63			

When we look at Table 9, it is seen that the average of pre-test-post-test differences of the network-based teaching group (x = 10.84) is higher than the average of the traditional teaching group (x = 0.50). When the standard deviation results are analysed, it is seen that the standard deviation (14.63) of the traditional teaching group is lower. According to this, it can be said that the traditional teaching group has a more homogeneous structure than the network-based teaching group.

A t-test was applied to understand whether there was a statistically significant change between the groups in the mean scores of post-tests–pre-test differences (level of development) between problem solving skills scores, and the results are summarized in Table 9. It was determined that the development of students' problem-solving skills differed statistically (t = 2.26, p <.05). This difference is in favour of the network-based teaching group. In this context, it can be said that the teaching method applied is effective in developing students' problem-solving skills.

As a general result, network-based teaching significantly increases students' problem-solving skills compared to traditional teaching; It was determined that there was a positive change in the attitudes towards science in favour of the experimental group, but this difference did not cause a statistically significant change.

The reason for the lack of a significant relationship between the attitudes of the students in the experimental and control groups towards the pre-test - post-test science, the students in the experimental group have difficulties and the "Cell Division" unit, which they have difficulty in understanding, is thought to be given by a network-based teaching method. However, it is known that studying and developing attitudes requires a long process. At this point, the application period being limited to 4 weeks may not be sufficient in examining the change in students' attitudes towards science.

The findings obtained as a result of the experimental process made in the research coincide with the previous research results. The results of the research conducted by Mathew (1998), Feyzioğlu (2002) and Yenice (2003) with similar practices have positively influenced students' attitudes towards science (sciences), in the researches of Synder (2000) and Neo (2005), it is revealed that the applications that use network-based teaching method improve students' problem solving skills.

The results of the research above show that network-based science teaching positively affects students' attitudes towards science and it supports the conclusion that it significantly improves problem solving skills and is in line with the results of the research conducted.

Students solving the problems that arise by establishing individual and collaboration, accessing different resources, online exams held on the site and it is thought that students' problem-solving skills have improved with the research they have done to answer the questions given every week. Students' collaboration with web-based instruction, both individually and through forum pages, seeking solutions to their problems has been influential in the emergence of the result that network-based learning significantly improves students' problem-solving skills.

In network-based teaching, students watched the lesson according to their individual learning speeds and observed objects and events developing at the microscopic level, They were able to work wherever and whenever they wanted to find what they thought was missing, and had the opportunity to access different visual and auditory resources. With these features, it is thought that network-based education positively affects students' attitudes towards science.

DISCUSSION CONCLUSION AND SUGGESTIONS

The results obtained in the research, which examines the effect of network-based science teaching on the problem-solving skills and attitudes towards science in high school first grade, are given below. When the pre-test results are examined, no significant difference was found between the students in the experimental and control groups in terms of their attitudes towards science and problem-solving skills. The initial levels of the groups were accepted as equal.

Considering the post-test results, it was concluded that the effect of network-based science teaching on students' attitudes towards science compared to traditional teaching method is more positive but this difference is not statistically significant.

Considering the development differences of the experimental and control groups in the research, it is seen that network-based education significantly increases students' problem solving skills compared to traditional education, it was determined that there was a positive change in the attitudes towards science group in favour of the experimental group, but this difference did not cause a statistically significant change. The result that network-based education positively affects students' attitudes towards science; it is consistent with the research results of Mathew (1998), Federico (2001), Feyzioğlu (2002) and Yenice (2003), Cibik (2009), and Koç & Böyük (2012) with similar applications.

There was a significant improvement in the problem-solving skills of the experimental group students, where the network-based teaching method was applied. The results of research conducted by Synder (2000), and Neo (2005) with similar applications and the research result at hand are parallel and supportive.

It is an expected result that network-based teaching will positively affect the students' attitudes towards science (sciences) and improve their problem-solving skills according to traditional teaching method. Because in traditional group is better especially in science lessons; a) students do not participate in the learning process, b) experimental studies could not be carried out due to reasons such as lack of physical facilities and insufficient teachers, c) the students are not questioning, criticizing, or watching the lesson passively, d) It has been observed that the routine topics are bored and students are concerned with other things.

Therefore, science teaching methods aim to raise rational individuals who have problem solving skills, and know how to gain meaning to add the events that develop around them which cannot reach their real purpose. It has been observed that the students in the network-based teaching group continue their studies whenever and wherever they want according to their learning speeds, reach visual and auditory resources and find solutions to their problems either individually or in collaborative methods.

In this context, since the science curriculum generally includes abstract concepts, it should include different teaching strategies and methods in which students can participate in different activities inside and outside the classroom. With its features such as network-based science teaching, eliminating the limitation of time and space, accessing visual and auditory recordings, performing dangerous experiments without risk, monitoring microscopic events, it is a teaching method that will reduce the problems experienced in science education. In addition to this, with the use of computers and networks in science teaching, students' interests, curiosity and positive

attitude towards science and problem-solving skills can be developed. In this study, because of these reasons, the attitudes of the network-based teaching group towards science and problem-solving skills were found to be more positive than the group in which traditional education was applied.

Network-based teaching will become a teaching method that is used more in the 21st century. However, it is not enough to prepare and present the content in network-based education. Designs that will guide students to think, question, research, and collaborate must be revealed. At this point, the obligations of technical staff trained in the field of computer software and hardware and related field experts to collaborate emerge. Because, it is necessary to prepare the instructional content in the network-based teaching and to decide how this content will be delivered to the student and how it will be maintained in interaction. Otherwise, it will not go beyond simply passing the information to the student after a point in teaching over the network. Not being able to attract the attention of the student in traditional education, not being able to actively participate etc. problems will also be encountered in network-based teaching. For this, attention should be paid to instructional design, technical infrastructure and communication methods and techniques to be established with students. It is very important to give the content plain, understandable and in accordance with its purpose especially in teaching on Internet. Considering that students who are educated over the internet work most of the lesson individually, giving examples that will increase the students' interests, delivering the feedback on time, continuing interactions, providing access to different resources may increase the interest in the lesson and therefore success.

Suggestions

Based on the results obtained from this study and the results of other studies, the following suggestions have been made.

1. In the application of experiments that cannot be carried out within the scope of science courses, difficult to apply, laboratory conditions and available possibilities, asynchronous in network-based training, simultaneous communication should be used in the communication to be established.
2. Cooperation with relevant departments of universities should be organized in network-based teaching practices, and in-service training programs should be organized for the development of computer technology for teachers and school administrators, web design and content development with interactive, multimedia options.
3. Broadband networks, in particular, are essential for multi-media content and interactive network-based instruction. Internet connection problem should be solved in educational institutions in Turkey. Internet connection provided free of charge to educational institutions by the Ministry of National Education should increase bandwidth.
4. Since problem solving skill is a feature that can be improved, the importance and time should be given in order to gain problem solving skills in distance education programs.
5. Teachers' guides that will enable them to gain problem solving skills behaviours should be prepared by a commission formed by network-based teaching institutions and should be taken into the distance education environment.
6. A central education network with Turkish content should be established where students and teachers can benefit from all levels and areas.
7. Network-based science teaching students' problem-solving skills in the light of the research finding that it positively affects their attitudes towards science and science network-based teaching environments should be used in all educational levels, both in and out of the classroom.
8. Our students and teachers should be encouraged to carry out dangerous experiments especially in the field of science, to obtain data accurately rapid, to process and provide instant feedback, so that benefits from computer and internet technology provides student to student, student to teacher and student to content interaction.
9. Attitudes towards the course affect success. Therefore, studies on the development of student attitudes towards science should be considered in correspondence education, the

purpose of which is to gain scientific attitudes and values, scientific process skills and scientific knowledge in general and to understand the relationship between science, technology, society and environment.

10. The effectiveness of the research was seen in the short term. Studies investigating the long-term effectiveness of the method should be conducted.

11. The research was carried out at secondary level. Similar studies should be included in other education levels and for different courses.

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