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Nature of Science, Scientific and Geoscience Models: Examining Students and Teachers' Views

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ABSTRACT

This study investigates Portuguese science teachers' and Portuguese high school students' views regarding nature of science, scientific models and Geoscience models and explores the relations between their views. It also examines how Portuguese science teachers value and use models in science classroom. A survey was applied to 145 science teachers and 415 students of the last year of secondary school, who answered to 14 multiple choice questions. Descriptive analyses showed that teachers and students hold intermediate views regarding nature of science and scientific models. Some errors were also detected concerning Geoscience models. T-test analyses showed significant differences between teachers and students' views, as teachers gave globally more informed answers. Authors considered that more attention should be given to teachers training regarding those issues and that more research is needed in order to understand how teachers deal with nature of science teaching and how they value and use models in classes.

Keywords: Nature of Science; Scientific Models; Geoscience Education; Science Teachers' Views; High School Students' Views.

INTRODUCTION

Scientific literacy has been recognized as a crucial learning outcome, in order to prepare students to take decisions and to act as informed citizens regarding scientific, personal and societal issues (Praia, Gil-Pérez, and Vilches, 2007; Smith, Loughran, Berry, and Dimitrakopoulos, 2012). Hodson (1998) argues that scientific literacy, as well as Science Education, must imply the learning *of* science - acquiring and developing conceptual and theoretical knowledge; the learning *to do* science – engaging in and developing expertise in scientific inquiry and problem-solving and the learning *about* science - developing an understanding of the nature and methods of science, appreciation of its history and development. In fact, many educational reforms highlight both the development of scientific literacy and of informed views of Nature of Science (NOS), being the last one a fundamental component of scientific literacy (Abd-El-Khalick, 2006; McComas and Olson, 1998). Indeed, Portuguese Science Education standard documents also emphasizes the importance of

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developing NOS understanding and of developing scientific literacy as a way to understand, reflect and act in our world.

In spite of all the relevance that NOS understanding has to scientific literacy and Science Education, many studies disclose that students possess inadequate views of NOS (Bell, 2006; Bell, Blair, Crawford, and Lederman, 2003; Lederman, 1992; Praia et al., 2007). This can be due to inadequate references to NOS in science textbooks and in other curricular materials and also to the reliance on implicit approaches to NOS instruction (Bell 2006; McComas, Clough, and Almzroa, 1998). However, it is remarkable how teachers play an important role in students' educational experience (Matthews 1990; McComas et al., 1998), failing to emphasize NOS aspects to their students. Bearing this in mind, some studies reveal that teachers, although having an adequate understanding of NOS, normally do not give too much attention in the design and development of learning activities that prompt a suitable construction of their students' NOS views (Abd-El-Khalick, Bell and Lederman, 1998; Buaraphan, 2012). In fact, as McComas et al. (1998) argued "… an understanding of the nature of science is a necessary, but insufficient condition, for purposeful teaching to facilitate student understanding of the nature of science" (p.20). Reis and Galvão (2004) suggest a diversity of factors that influence teachers' translation of their views about NOS and of their conceptions regarding the teaching and learning of science into their classroom practices, such as the curriculum, the national exams, their previous experiences with scientific activities and their own educational goals.

Scientific Models (SM) are considered to have an important role not only in scientific practice but also in Science Education, being a powerful tool for engaging students in thinking about science (Halloun, 2007; Justi and Gilbert, 2002; Justi, 2009; Oh and Oh, 2011). Apart from promoting the development of adequate understandings of nature of models, as well as of NOS, in science classroom, models can facilitate the understanding of complex knowledge and phenomena, can foster the construction of adequate mental models and can engage students in inquiry activities. Thus, Portuguese Science Education standard documents also highlight the resort to models in science classes, especially in Geoscience classes. As Geoscience research heavily resorts to models and analogical thinking we consider essential the use of Geoscience models in Geoscience classes promoting science classes' activities that reflect scientists' activities.

Within this framework, we considered important to asses science teachers and K-12 students' views on NOS and SM and to analyse the relationship, if any, between their views. Moreover, we also wanted to examine how science teachers deal and use models in the classroom, as well as to evaluate students' and teachers' knowledge regarding some Geoscience models referred in the Portuguese curriculum.

THEORETICAL BACKGROUND

Nature of Science and Science Education

Nature of Science (NOS) "is a fundamental domain for guiding science educators in accurately portraying science to students" (McComas et al. 1998, p.4). In fact, NOS describes how science works, what science is, how scientists operate and how science relates with society, merging aspects of history, sociology, philosophy and psychology of science (McComas et al. 1998).

Regardless all the debates regarding NOS concepts among philosophers, historians, sociologists of science and science educators, there is a general consensus of NOS concepts that are important and should be focused in science classes for the development of students' science views and scientific literacy (Abd-El-Khalick, et al., 1998; Abd-El-Khalick, 2006; Bell, 2006; McComas and Olson, 1998). Abd-El-Khalick et al. (1998) have suggested some

characteristics of the scientific enterprise that are suitable and accessible for K-12 students, relevant for their daily lives and not contentious (Abd-El-Khalick et al., 1998; Lederman, Abd-El-Khalick, Bell and Schwartz, 2002; Liu and Lederman, 2007). These characteristics include the views that scientific knowledge is tentative (it changes as new evidences are found and as existing evidences are reinterpreted); empirically based (based on and/or derived from observations of the natural world that are filtered through our perceptions and instrumentations); subjective (theory-laden); partly the product of human inference, imagination and creativity and that is socially and culturally embedded. The distinction between observation and inference, the inexistence of a general and universal scientific method and the functions of and relationships between theories and laws are other important aspects referred by the authors.

Understanding NOS is considered to be central for achieving scientific literacy and also for the improvement in science teaching and learning process. In fact, there are many reasons to include NOS in science curriculum. For example, McComas et al. (1998) argued that it helps students in learning science content and in understanding how science operates; it increases interest in science and enhances informed decision making and it could assist teachers in understanding students' views and in implementing effective educational actions. Matthews (1989/ 1990) stated that NOS also prompt the development of critical thinking and promote a greater awareness of the achievement of science and intellectual excitement that science involves. Moreover, the development of NOS understanding is also related to the development of argumentation skills and to the construction of stronger counterarguments (Khishfe, 2012).

As McComas et al. (1998) argued teachers have the central role of providing an accurate description of the function, processes and limits of science, instead of engaging students in deep discussions that are characteristic of philosophers of science. Besides, each NOS aspect could be focused at different levels of complexity in science classes depending on students level (Lederman et al., 2002).

However, and despite all the benefits of developing NOS understandings in science classes, many studies reveal that students do not possess an adequate view of NOS (Bell, 2006; Bell et al., 2003; Lederman 1992; Praia et al., 2007; Khishfe, 2012).

Scientific Models and Science Education

Schwarz et al. (2009) defined a Scientific Model (SM) "as a representation that abstracts and simplifies a system by focusing on key features to explain and predict scientific phenomena" (p. 633). Despite all model definitions found in the literature and all the diversity of models, we must say that a model is a representation of a target, and it is considered a mediator connecting a theory and phenomenon (Giere, 2004; Oh and Oh, 2011). Models can also represent a variety of targets which are represented for some purpose (Giere, 2004; Giere, 2010; Oh and Oh, 2011). In fact, a model does not copy reality; it consists of a representation of reality that varies with our purposes (Matthews, 2007).

Models and modelling play a central role not only in scientific enterprise but also in Science Education (Halloun, 2007; Justi and Gilbert, 2002; Oh and Oh, 2011), being the understanding of models an important issue of one's understanding of science (Gobert et al., 2011). Models are powerful tools that scientists use in developing scientific knowledge. As a result, models and modelling activities in science classes may contribute to the understanding of many aspects of scientific inquiry and of different aspects of NOS, as they contribute to the understanding of the tentativeness of models; of the role that creativity plays in the construction of models and of the multiplicity of models, among others (Crawford and Cullin, 2004).

In fact, models and modelling are essential to achieve the three main Science Education aims suggested by Hodson (1998). Models and modelling activities allow students to: (i) learn *of* science - as students come to know the major models that are the products of science; (ii) learn how *to do* science - by creating and testing their own models and (iii) learn *about* science - by constructing an adequate view of the nature of models and by being able to appreciate the role of models in the accreditation and dissemination of the products of scientific enquiry (Justi and Gilbert, 2002; Justi and Gilbert, 2003).

Although all the reported positive effects of model-based approaches, it is crucial that teachers clearly understand the value and nature of models and modelling for the purpose of using models in science classrooms in an effective way (Oh and Oh, 2011). Based on a literature review, Oh and Oh (2011) identified five relevant subtopics that teachers of science must know concerning the nature of models and modelling: *meaning of a model*, *purposes of modelling*, *multiplicity of scientific models*, *change in scientific models* and *uses of models in the science classroom*. Concerning the last subtopic, these authors also emphasize the need for students to participate in student-centred modelling activities, in order to make their learning more meaningful.

However, some studies unveil that teachers reveal limited and naïve views about models in science and for teaching and that they do not usually rely on models and modelling activities in their classes (Crawford and Cullin, 2004; Justi and Gilbert, 2002; Khan, 2011; Wang et al., 2014).Therefore, in our study, we aimed to analyse both Portuguese science teachers and high school students' views regarding some NOS aspects, emphasizing the aspects related to models nature. Giving the relevance of teachers in students NOS understandings, we also wanted to compare science teachers and high school students' views regarding those aspects.

Geoscience Models and Science Education

Although SM are undoubtedly important in Science Education, we must say that they play an even greater role in Geoscience Education, as this scientific area heavily depends on a diversity of models (Oh and Oh, 2011). In fact, geoscientists resort to comparisons and SM as they deal with processes and forces that cannot be directly perceived (Jee et al., 2010). In this way, Portuguese Geoscience Curriculum highlights the use of models in Geoscience classes and it suggests a diversity of Geoscience models, such as the earth's internal structure model and the solar system model (Torres, Moura, Vasconcelos and Amador, 2013a).

The use of models, especially the simulation of geological phenomena, contributes to the development of different competencies which are fundamental in Geoscience learning and thinking, as it contributes to a better understanding of deep time, as well as to the development of spatial vision (Bolacha, Moita de Deus and Fonseca, 2012). Additionally, the analysis of the historical evolution of scientific models is crucial for students to understand science construction and evolution; constraints, contexts and issues that limit, influence or promote scientific knowledge development and the importance of different data in models design. Moreover, models can be really useful for teachers in classroom to demonstrate how things work and to explain sophisticated knowledge (Oh and Oh, 2011). However, the use of models in classroom should overtake the traditional way that only emphasis the learning *of* science (Torres, Moutinho, Almeida and Vasconcelos, 2013b).

Considering that teachers are those who determine a considerable part of students' educational experience, it is important that they have a clear and valid notion of models and their nature in order to use models effectively in science classes (Oh and Oh, 2011; Torres et al., 2013a).

The main purpose of this study was to examine Portuguese science teachers and Portuguese high school students' views on nature of science and scientific models and to explore the relationship, if any, between their views.

Additionally, we intended to analyse how Portuguese science teachers value and use models in science classroom. Moreover, due to the relevance that Geoscience models have in Geoscience research and education, we also aimed to evaluate and compare Portuguese science teachers and Portuguese high school students' knowledge regarding some Geoscience models recommended in Portuguese curriculum.

Consequently, our main research questions were:

(i) What are the Portuguese Science Teachers and Portuguese High School Students' views on Nature of Science and Scientific Models? Are their views related?

(ii) How do Portuguese Science Teachers value and use models in science classroom?

(iii) How well do Portuguese Science Teachers' and Portuguese High School Students' know Geoscience Models? Is their knowledge related?

METHODOLOGY

This research is included in a broader study that mainly aims to improve teachers' views regarding Nature of Science (NOS) and Scientific Models (SM) and consequently students' views and learning.

In this first stage of the research, which mainly intends to evaluate Portuguese science teachers and Portuguese high school students' views of NOS and SM, a survey research was performed. With this purpose, a questionnaire was constructed and administered both to high school students of the last year of high school and to middle and high school science teachers (teachers that teach students with ages ranging from 10 to 17) from different schools of Portugal. A descriptive and statistical analysis was developed after data collection.

The paper questionnaire was applied to high school students in classes either by their teachers or by one member of the research team. This instrument was also administrated to teachers, on paper or by digital support. When using the digital one, we also asked teachers to collaborate with us and to request their colleagues to participate in the study.

a) Sample

Table 1. *Students characterization (n=415).*

Gender		**Age**		**Failed in school**	**Main future courses desired**	
Female	**Male**					
f (%)	f (%)	Mean	SD	f (%)	Course	%
239 (57.6)	176 (42.4)	17.27	0.55	55 (13.3)	Medicine	31.2
					Psychology	17.6
					Do not know	15.6
					Primary Teaching	11.8

Legend: f- frequency; % - percentage.

In this study, participants comprised two groups. Four hundred and fifteen high school students, with ages ranging from 16 to 19 (Table 1), and one hundred and forty five science teachers, with ages ranging from 23 to 63 (Table 2), from different regions of Portugal answered the questionnaire.

Table 2. *Teachers characterization (n=145).*

Gender		Age		Qualifications		
Female	**Male**					
f (%)	f (%)	Mean	SD		f	%
125 (87.4)	18 (12.6)	43.71	9.1	BSc	94	64.8
				MSc	38	26.2
				PhD	1	0.7
				BSc + other qualification	10	6.9
				MSc + other qualification	2	1.4

Legend: f- frequency; % - percentage.

b) Instrument

The questionnaire focused mainly on science teachers and high school students' views on NOS, SM and Geoscience models and was designed by two authors of the research team after a deep study and analysis of relevant literature and research. It only focused in some aspects concerning NOS understanding, as we wanted to achieve a general overview regarding both science teachers and high school students' views. We also wanted to essentially analyse their views regarding NOS, emphasizing their views related to scientific models (epistemological views and content knowledge about Geoscience models).

The questionnaire had some initial questions in order to gather personal socio-demographic data of the respondents and the main questionnaire comprised 11 closed questions and 3 semi-open questions.

The first part of the questionnaire comprised 7 closed questions that were elaborated based on recent literature regarding NOS and SM. The questions refer to 3 different topics regarding NOS and to 4 topics about SM (Table 3).

Table 3. *Topics under analysis regarding NOS and SM issues.*

Issue	Topic under analysis	Authors of reference
NOS	Tentativeness of scientific knowledge	Lederman et al. (2002); Liu & Lederman (2007).
	Creativity and imagination in science	Lederman et al. (2002); Liu & Lederman (2007).
	Scientific theories and laws	McComas (1998); Lederman et al. (2002); Liu & Lederman (2007).
SM	Theories, phenomena and models	Oh & Oh (2011).
	Scientific models nature	Abd-El-Khalick et al. (1998); Oh & Oh (2011).
	Definition of scientific model	Danusso et al. (2010).
	Scientific models in science classes	Justi & Gilbert (2002).

The general format of each of these questions comes from the Views on Science-Technology-Society (VOSTS) questionnaire structure, developed by Aikenhead and Ryan (1992) (VOSTS questionnaire is available on: http://www.pearweb.org/atis/tools/15).

Regarding each topic presented, teachers and students were asked to choose only one of seven options that best match their opinion. The seven options provided included: (i) four statements that reveal different points of view concerning each topic and that were derived from major results obtained in other previous studies and (ii) three neutral statements that represent other possible responses: 'I have difficulties in understanding the above sentences'; 'I do not have enough knowledge to make a choice' and 'None of the options reflects my point of view'.

We tried to diminish some ambiguity problems, using choices that derived from results of other studies. Also, the three neutral options may avoid the selection of a random answer that could distort students and teachers' opinions and consequently the results and may also contribute to a better and a deeper understanding of the results.

The following 3 semi-open questions, which comprised the second part of the questionnaire, were mainly related to the use of models in science classes. High school students and science teachers were asked about the way models and simulations are used in science classrooms and teachers were requested to justify their decisions, by writing their own reasons.

After a review of the literature, the first two parts of the questionnaire were content validated by two Science Education experts. It suffered some adjustments in order to make each option simpler and more concise. To better validate the questionnaire, the first two parts of the questionnaire were initially administered to a preliminary sample (Torres et al. 2013b). However, no difficulties were detected during the fulfilment of the questionnaire. Moreover, concerning the first seven questions almost all respondents chose one of the main four options provided. Only an average of 7.9% selected one of the 3 other neutral options. This means that the main options provided were understood and that they generally fitted the views of the majority of respondents that answered the questionnaire.

The last four closed questions intended to evaluate high school students and science teachers' knowledge regarding four Geoscience SM recommended in national curriculum. In these last four questions, teachers and students were asked to choose one option from the five provided. The five options provided included: (i) 1 correct answer; (ii) 3 wrong answers and (iii) 1 neutral (I do not know) answer. This third part of the questionnaire was content validated with the support of both, literature revision and two Science Education experts.

Having in mind that the students who participated in the study were already attending the last year of the secondary school and the aim of comparing teachers and students views, the questions of the questionnaires administered were the same (except for questions related to the use of models in science classes, as we can see in tables 7 and 8).

c) Data Analysis

Nature of Science and Nature of Models

To analyse science teachers and high school students' answers regarding NOS and SM, a preliminary descriptive statistic was made using SPSS 21 version. For each question, science teachers and high school students were asked to choose one option of 7 possible answers that best match their opinion. These 7 possible answers were classified into different categories: "uninformed", "informed", "naïve" and "neutral", as presented in table 4 and 5. Informed answers correspond to answers which were closer to contemporary views and uninformed answers to answers that do not match and that deviate the most from those views. Naïve answers were those that do not completely match those views. For each question, there are one informed, one uninformed, 2 naïve and 3 neutral possibilities.

After this descriptive analysis it was performed a t-test to compare the results obtained by science teachers with the ones obtained by high school students. For this purpose, answers were scored from -1 to 2, according to the correspondent category. To "uninformed" answers it was attributed the worst score (-1) and to "informed" answers it was attributed the best score (2). "Naïve" answers were scored with 1 point and the "neutral" responses were scored with 0 points. After this score process, a t-test was performed.

Scientific Models in Science Classes

Concerning the use and valorization of models in science classes, a content analysis had to be previously made to science teachers justifications that support their choice regarding the

use of models in science classrooms. This content analysis which involved the definition of different categories and codes was performed by two researches separately. Afterward, categories and codes attributed to each answer were compared and discussed in order to guarantee a homogeneous and reliable codification of data. After that, a descriptive statistical analysis was also undertaken concerning science teachers and high school students' answers, by presenting the percentage of the selected answers and of the main justifications provided.

Geoscience Models

To evaluate science teachers and high school students' knowledge regarding Geoscience SM, 4 different SM that students learn through their school training were chosen and a descriptive study was undertaken. Science teachers and high school students' answers were classified into "wrong", "correct" and "neutral" categories. Correct answers were valued with 1 point, wrong answers with -1 point and neutral answers (I do not know) with 0 points. Afterward, a t-test was performed in order to compare the results obtained by science teachers and by high school students regarding Geoscience models.

FINDINGS

Nature of Science and Nature of Models

The answers given to the 7 closed questions regarding nature of science and models nature are presented in the tables 4 and 5.

As shown in table 4, science teachers and the majority of high school students do not considered scientific knowledge absolute. However, the bulk of both science teachers and high school students held a naïve view concerning its tentative aspect. On the subject of creativity and imagination, the majority of respondents considered that they are needed in the development of scientific knowledge. Still, a considerable percentage of them considered that creativity and imagination are only needed in some stages of the research. Concerning theories and laws definition, the majority of science teachers and high school students held naïve or even uninformed views about it.

In general terms, it is possible to verify that both science teachers and high school students held intermediate views regarding NOS.

Regarding the relation between theories, phenomena and models, 79,3% of science teachers recognized that a model is a representation of phenomena and serves as a 'bridge' connecting a theory and a phenomenon. On the other hand, a high percentage of high school students (45,6%) held an uninformed view about this issue, mixing up models with theories (Table 5).

The bulk of respondents considered that scientific models result from inference. However, still 13,6% of high school students considered that scientific models are a copy of reality.

Table 4. *Category and rate of responses regarding NOS aspects.*

Question and answer options	Category of answer	%	
		STs	HSSs
Q1 – *Regarding scientific knowledge, you consider that …*			
Scientific knowledge is absolute and correct, being a proven truth.	Uninformed	0	3.9
Scientific knowledge, although reliable, is tentative and never certain.	Informed	31	39.8
Scientific knowledge change solely with new information and advanced technology.	Naïve	55.9	50.8
Scientific knowledge is tentative due to insufficient evidence for proving their validity.	Naïve	5.5	3.1
I have difficulties in understanding the above sentences.	Neutral	0	0
I do not have enough knowledge to make a choice.		0	0.5
None of the options reflects my point of view.		7.6	1.9
Q2 *– Relating to creativity and imagination, you think that…*			
They are not necessary in the construction of scientific knowledge.	Uninformed	1.4	5.8
Only make sense in planning and design stage.	Naïve	6.2	15.2
They are needed in the development of scientific knowledge.	Informed	67.6	50.4
They are needed during all the research except in the data collection stage.	Naïve	24.8	22.9
I have difficulties in understanding the above sentences.	Neutral	0	1.0
I do not have enough knowledge to make a choice.		0	1.0
None of the options reflects my point of view.		0	3.9
Q3 – *Regarding theories and laws, you consider that…*			
Theories and laws are different kinds of knowledge and one cannot become the other.	Informed	7.6	6.3
Theories evolve to laws with the evidence accumulation.	Naïve	37.9	39.2
Laws reflect a proven knowledge and so they are more certain than theories.	Naïve	9.0	28.1
Laws are the explanations of phenomena and theories constitute descriptions of patterns related to observational phenomena.	Uninformed	35.9	22.0
I have difficulties in understanding the above sentences.	No answer	1.4	1.0
I do not have enough knowledge to make a choice.		2.1	1.9
None of the options reflects my point of view.		6.2	1.5

Legend: %- percentage; STs– Science Teachers; HSSs- High School Students.

Science teachers as well as high school students did not possess a consistent definition of SM, as only 29,3% of science teachers and 22,4% of high school students answered in an informed way to question number 6. Although the majority of science teachers and high school students recognized that the use of models in science classes contributes to a better learning *of* science, *about* science and *to do* science, 23,2% of high school students considered that the use of models only contributes to the understanding of complex natural phenomena.

Globally, it is possible to verify that both science teachers and high school students possess intermediate views regarding SM. However, it also seems that science teachers hold better views on this issue than students.

When comparing students and teachers informed answers regarding NOS and SM, it is possible to verify that teachers globally gave more informed answers, except for question 1. We may also suppose that questions with better results for teachers are also for students and

that questions with worst results for teachers are also for students, excluding question number 4.

Table 5. *Category and rate of responses regarding Scientific Models.*

Question and answer options	Category of answer	%	
		STs	HSSs
Q4 – *Concerning the relation between theories, phenomena and models, you believe that…*			
A model is a representation of phenomena or processes and serves as a 'bridge' connecting a theory and a phenomenon.	Informed	79.3	40.0
A model is a fundamental theory to understand a phenomenon and to formulate future theories.	Uninformed	11.7	45.6
A phenomenon can be represented only by a unique model.	Naïve	0.7	1.7
A model represents all the aspects of a phenomenon.	Naïve	1.4	3.4
I have difficulties in understanding the above sentences.	Neutral	1.4	3.4
I do not have enough knowledge to make a choice.		3.4	3.2
None of the options reflects my point of view.		2.1	2.7
Q5 – *Relating to models, you think that…*			
Scientific models are a copy of reality.	Uninformed	5.6	13.6
Scientific models are immutable.	Naïve	1.4	2.7
Scientific models result from inference.	Informed	67.1	53.5
Models created by scientists are all proven.	Naïve	3.5	10.4
I have difficulties in understanding the above sentences.	Neutral	1.4	2.7
I do not have enough knowledge to make a choice.		0	4.6
None of the options reflects my point of view.		21.0	12.6
Q6 – *Do you consider a scientific model as…*			
A reference to which a phenomenon has to be compared to help understanding it scientifically.	Uninformed	12.1	21.7
An abstract representation which reproduces the behaviour of a phenomenon using suitable parameters.	Informed	29.3	22.4
The set of rules and schemes which identify a given phenomenon and allow understanding it.	Naïve	37.9	37.8
An abstract tool to analyse reality designed from the observation of that reality.	Naïve	14.3	10.7
I have difficulties in understanding the above sentences.	Neutral	0.7	2.7
I do not have enough knowledge to make a choice.		2.9	2.7
None of the options reflects my point of view.		2.9	2.0
Q7 – *The use of models in the classroom…*			
Only contributes to the understanding of complex natural phenomena.	Naïve	7.6	23.2
Contributes to a better learning *of* science, *about* science and *to do* science.	Informed	88.2	67.9
Requires more traditional teaching methodologies.	Naïve	2.8	3.4
Does not contribute to the understanding of the Nature of Science.	Uninformed	0	0.5
I have difficulties in understanding the above sentences.	Neutral	0	0.7
I do not have enough knowledge to make a choice.		0	1.7
None of the options reflects my point of view.		1.4	2.7

Legend: %- percentage; STs– Science Teachers; HSSs- High School Students.

However, when comparing the answers given by teachers with the answers given by students to these 7 questions, it was verified that teachers had better results and obtained a higher mean (Table 6). When applying a t-test, it was verified that there is a statistically significant difference between the two means obtained both by teachers and students (Table 6).

Table 6: *Means obtained and T-test analysis (Q1-Q7).*

Group	Mean	Std. Deviation	t-statistic	
			t	p-value
HSSs (n=415)	6.98	2.698	-7.865	0.000**
STs (n=145)	8.76	2.215		

Legend: HSSs – High School Students; STs – Science Teachers; p- p value (x** - p < 0,01).

Scientific Models in science classes

Regarding the use of models in science classes, the majority of science teachers and high school students reveal that both models and analogue models (considered in this paper as simulations), are used from time to time in science classes (Table 7 and 8).

Table 7. *STs answers concerning the use of models in science classes.*

Question	Answer Options	%	Mains Justifications Presented	%
How often do you use scientific models in Science Classes?	Never	3.5	It is not suitable for students' level.	100
	Sometimes	96.5	It helps in the understanding of phenomena and processes.	52.6
			Its use is content dependent.	13.7
			Its use allows an approach to reality.	7.4
How often do you use analogue models (simulations) in Science Classes?	Never	6.3	It is not suitable for students' level.	60.0
			Due to students' age.	20.0
			Lack of material.	20.0
	Sometimes	93.8	It leads to a better understanding of the evolution of natural phenomena.	37.2
			Allow us to observe phenomena that are impossible to observe naturally due to spatial and temporal constraints.	7.0
			Its use is content dependent.	7.0
In science classes, how do you mostly use models?	You present the models that you have.	29.6	Conditioned by time.	47.6
			Conditioned by students' age.	33.0
	You suggest students to construct their own models.	4.2	Students learn more.	50.0
			Students test the model while presenting it.	25.0
			It helps in phenomena understanding.	25.0
	Both options.	66.2	Limited by time.	19.0
			It implies an autonomous process of knowledge construction.	19.0
			To facilitate the understanding of certain phenomena.	15.5

Legend: %- percentage; STs–Science Teachers.

As shown in table 7, science teachers use models and simulations as they mainly help in the understanding of phenomena and processes and they lead to a better understanding of the evolution of natural phenomena, respectively. Teachers that never use models in science classes are mainly (80%) teachers of youngest students (students' age ranging from 10 to 12) and the bulk of teachers (77,8%) that never use simulations are also teachers of students of this age group.

It is possible to verify that science teachers and high school students present different answers concerning the way that models are used in science classes. In fact, the majority of high school students referred that teachers present their own models; while science teachers indicated that they present their own models and that they also suggest students to construct models (Table 7 and 8).

Table 8: *HSSs answers concerning the use of models in science classes.*

Question	Answer Options	%
How often scientific models were used in Science Classes?	Never	5.6
	Sometimes	94.4
How often analogue models (simulations) were used in Science Classes?	Never	18.9
	Sometimes	81.1
In science classes, how models were used mostly?	Teachers present their models to students.	58.7
	Teachers suggest students to construct their own models.	6.4
	Both options.	34.9

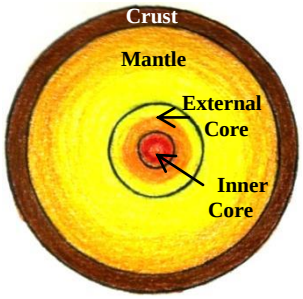
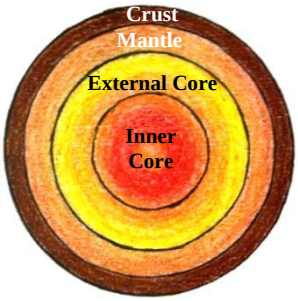
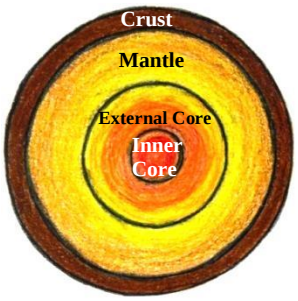
Legend: %- percentage; HSSs- High School Students.

Geoscience Models

The answers related to Geoscience models are presented in tables 9 to table 12.

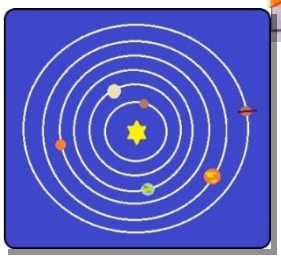
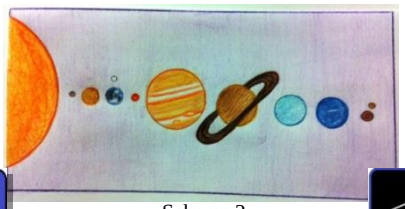
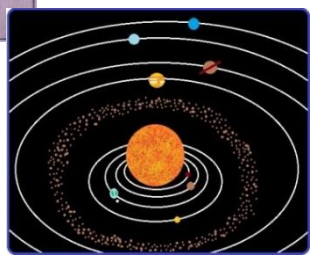
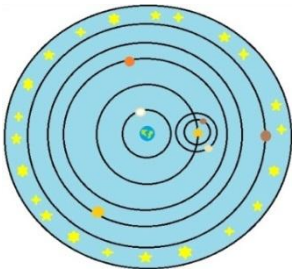
In relation to Earth's internal structure model, specifically to layers depth, the majority of science teachers (64%) answered correctly, while the majority of high school students (60,2%) answered incorrectly to this question (Table 9).

Table 9: *STs and HSSs answers regarding Earth's structure model – Layers depth.*

Evaluation Issue	Earth's internal structure model (Layers depth)			
Question	What is the scheme that represents the best the earth's interior?			
	 **Scheme 1.**	 **Scheme 2.**	 **Scheme 3.**	
			Category of answer	**%**
				STs	**HSSs**
Answers	Scheme 1		Wrong	7.9	44.0
	Scheme 2		Wrong	2.9	11.4
	Scheme 3		Correct	64.0	35.7
	No one is correct.		Wrong	16.5	4.8
	I do not know.		Neutral	8.6	4.1

Concerning Solar System models, it is possible to verify that the majority of both science teachers and high school students answered correctly to this question. However, science teachers presented a higher rate of correct answers, when comparing with high school students correct answers (Table 10).

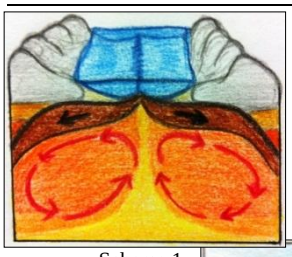
Table 10: *STs and HSSs answers regarding Solar System Model.*

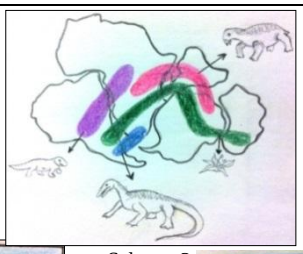
Evaluation Issue	Solar System Model			
Question	Sort the schemes in chronological order, according to the historical evolution of the different solar system models.			
	 Scheme 1.	 Scheme 2.	 Scheme 3.	 Scheme 4.
			Category of answer	**%**
				STs	**HSSs**
Answers	1 → 2 → 3 → 4		Wrong	0	1.2
	4 → 1 → 3 → 2		Wrong	23.7	17.6
	1 → 4 → 2 → 3		Wrong	4.3	16.4
	4 → 1 → 2 → 3		Correct	66.9	59.2
	I do not know.		Neutral	5.0	5.6

Regarding tectonic plates model it is also possible to verify that the bulk of science teachers and high school students answered correctly to this question. Furthermore, science teachers also presented a higher rate of correct answers (83,6%), when comparing with high school students correct answers (68%) - Table 11.

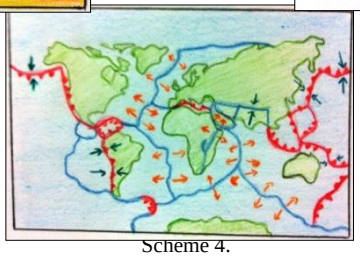
Table 11: *STs and HSSs answers regarding Tectonic Plates Model.*

Evaluation Issue	Model of Tectonic Plates
Question	Identify the arguments in favor of Continental Drift Model and the arguments in favor of Tectonic Plates Model.


Scheme 1.


Scheme 2.


eme 3.


Scheme 4.

		Category of answer	**%**	
			STs	**HSSs**
Answers	Schemes 1 and 4 represent the arguments in favor of the model of tectonic plates and schemes 2, 3 and 5 represent the arguments in favor of continental drift model.	Correct	83.6	68.0
	Schemes 1 and 4 represent the arguments in favor of continental drift model and schemes 2, 3 and 5 represent the arguments in favor of the model of tectonic plates.	Wrong	2.9	8.6
	All schemes represent the arguments in favor of continental drift model.	Wrong	0	7.8
	All schemes represent the arguments in favor of the model of tectonic plates.	Wrong	4.3	7.1
	I do not know.	Neutral	9.3	8.6

On the subject of Mountain Chain Formation models, the majority of science teachers and high school students failed to recognize that convection does not have a direct relation with mountain formation. The bulk of science teachers and high school students considered that scheme 2, which was indeed a model presented in the 19th century for representing this process, was the scheme that does not represent a model of mountain chain formation (Table 12).

Table 12: *STs and HSSs answers regarding Mountain Chain Formation Models.*

Evaluation Issue	Mountain Chain Formation Models
Question	Identify the scheme that does not represent a model of mountain chain formation.


Scheme 1.


Scheme 2.


Scheme 3.


Scheme 4.

		Category of answer	**%**	
			STs	**HSSs**
Answers	Scheme 1.	Wrong	9.4	2.0
	Scheme 2.	Wrong	69.8	77.8
	Scheme 3.	Correct	7.2	8.0
	Scheme 4.	Wrong	7.9	7.8
	I do not know.	Neutral	5.8	4.4

When comparing science teachers and high school students' answers, it seems that science teachers have a better knowledge and consequently more correct answers concerning Geoscience models. It was verified that science teachers obtained better results and that there is a statistically significant difference between the two means obtained by science teachers and high school students, when applying a t-test (Table 13).

Table 13: *Means obtained and T-test analysis (Q11-Q14).*

Group	**Mean**	**Std. Deviation**	**t-statistic**	
			t	**p-value**
HSSs (n=415)	-0.35	1.692	-7.233	0.000**
STs (n=145)	0.70	1.430		

Legend: HSSs –High School Students; STs – Science Teachers; p- p value (x** - p < 0,01).

DISCUSSION

NOS, SM and Geoscience models are fundamental issues in science classes, as well as in Geoscience classes. According to its relevance, this study investigated science teachers and high school students' views about those aspects and a possible relation between their views.

Regarding nature of science and nature of models aspects, science teachers had better results than high school students which may be related to the lack of relevance and attention that teachers provide to this aspects in classes, as argued by Abd-El-Khalick et al. (1998) and McComas et al. (1998). However, it is also important to notice that although science teachers reveal a better understanding about those aspects, the majority of science teachers still present naïve views on the subject of the tentativeness of scientific knowledge and of the relation between theories and laws. These results are similar to those obtained by Liu and Lederman (2007). Moreover, science teachers did not possess a consistent definition of scientific models as it is suggested in the literature regarding teachers' views on models (Justi and Gilbert 2002/2003; Justi 2009). In order to better teach NOS aspects and to better use models in

science classrooms, the researchers consider that it is of utmost importance to improve science teachers' views regarding those aspects.

In fact, although the majority of science teachers recognized that the use of models in science classes contributes to a better learning *of* science, *about* science and *to do* science in question number 7, only 1 teacher (teacher number 32) mention that reason to justify the use of models in subsequent questions. He justifies the use of models referring: "For the same reason that I have mentioned in question number 7 (It contributes to a better learning *of* science, *about* science and *to do* science)" and he justifies the use of simulations stating: "the use of simulations in science classes contributes to a better learning *of* science, *about* science and *to do* science, since the adaptations and limitations of simulations are clear for students". Indeed, the majority of science teachers revealed in their justifications that they use models mainly to facilitate the understanding of phenomena and processes and simulations to promote a better understanding of the evolution of natural phenomena, which reflects their emphasis on the value of models in the learning *of* science over their value in the learning *to do* science and *about* science. These results are aligned with Crawford and Cullin (2004) findings, as no intentions to teach *about models* were revealed. In the same way, a substantial percentage of high school students (23,2%) considered that the use of models only contributes to the understanding of complex natural phenomena (question number 7). Bearing this in mind, it is important that science teachers develop their understanding regarding models in order to take full advantage of using them in science classrooms.

Although the majority of high school students have agreed with the majority of science teachers, revealing that models and simulations are used from time to time in science classes, they disagreed with science teachers when referring to the way models are used in classes. In fact, students' answers lead us to suppose that science teachers do not give students as much autonomy as they presume, as the majority of high school students refer that teachers mainly show them the models, while the majority of science teachers mention that they not only present the models, but also suggest students to construct their own models. Science teachers recognized that students' construction of models stimulates a better learning and an autonomous process of knowledge construction and it also facilitates the understanding of certain phenomena. However, they also assumed that they are conditioned by time and students' age. As it is intended to mirror scientists' activities in science classrooms, it is imperative that teachers provide students activities where they have an active role. Practical activities like, for example, modelling promotes their development of scientific content as well as epistemological knowledge and inquiry competencies.

Concerning Geoscience models, science teachers had more correct answers than high school students, being the difference between science teachers' answers and high school students' answers statically significant. However, the majority of both participants failed in recognizing historical mountain chain formation models, which may indicate a certain lack of knowledge regarding historical issues. A greater reliance on historical models may contribute to a deeper understanding of science dynamics and also to the understanding of different NOS aspects.

CONCLUSIONS and EDUCATIONAL IMPLICATIONS

NOS and SM are considered key elements in Science Education, not only in national but also in international curricula. Nevertheless, some studies reveal that students do not generally develop an adequate view regarding these issues. This may be related to many factors such as educational resources; teachers' aims; and teachers' views concerning these issues.

In view of this, the aim of this study was to analyze and to compare Portuguese science teachers' and Portuguese students' views of NOS and SM. Results show that although

both participants hold intermediate views regarding NOS and SM, science teachers showed a better conceptual knowledge. However, questions where science teachers failed the most are also the questions were high school students had worst results. Both participants failed mainly in questions related to scientific theories and laws, to SM definition and to historical mountain chain formation models.

Regarding the use of SM in science classes, there are two very interesting findings. First of all, SM are used in science classes mostly as an auxiliary resource to the understanding of phenomena or scientific processes. Secondly, it seems that students do not have such an active role as it was supposed when modelling.

These results have some implications for the teaching and learning of NOS and for the use of SM in science classes. In fact, there is a need to improve Portuguese science teachers' view regarding NOS so as to become more consistent with contemporary NOS views. Moreover, it is also important that Portuguese science teachers become more aware of the benefits and importance of teaching NOS in science classes. Portuguese science teachers also need to develop their understandings about SM and about their full potential in order to use them effectively. .Due to modelling activities importance in Geoscience research, this issue has a more relevant meaning in geoscience teachers' training. As such, authors considered that it will be important to improve science teachers views concerning NOS and SM either in their initial training or in their continuous training. Additionally, more research is also needed in order to understand how teachers deal with NOS and SM in classes and to understand which factors restrain and mediate their practices.

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The Awareness Levels of Science and Technology Teacher Candidates towards Ecological Footprint

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ABSTRACT

The aim of this study was to investigate and evaluate the ecological footprint awareness levels of science and technology teacher candidates. This research was performed in 361 science and technology teacher candidates, who were in Science Education Department of Gazi Education Faculty of Gazi University in the spring semester of 2013-2014. The research was carried out using a cross-sectional survey model. The variables of this research were gender and grade levels. The data were collected using the Ecological Footprint Awareness Scale. Descriptive statistic techniques, independent samples t-test, and one-way ANOVA were used for data analysis. The results obtained from this study showed that science and technology teacher candidates have the largest footprint in food subscale, and the smallest footprint in energy subscale. The ecological footprint awareness levels of female science and technology teacher candidates were found significantly higher than those of male science and technology teacher candidates. The ecological footprint awareness of science and technology teacher candidates was observed significantly higher than that of freshmen science and technology teacher candidates.

Keywords: Ecological Footprint; Environmental Education; Science and Technology Education; Sustainable Life.

INTRODUCTION

In the universe's perfectly running system, each and every piece forming the universe are connected to each other in an excellent balance. The most important element in humans' lives, one of the elements forming the universe, is the balance element. The strongest step of this balance is the natural balance formed spontaneously between human and the environment (Yıldız, 2014). Since the systems forming the natural balance as a whole are connected to each other with the long connection links, a damage which may occur in one of the links on the chain disturbs this balance by affecting the whole chain, which causes environmental problems. Humans' efforts to regulate the nature by disturbing the natural balance have caused the environment to get into a deterioration process by causing breaks in the links on the chain (Doğan, 1997).

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Environmental problems appearing in different forms during the production and the consumption process disturb the nature's balance, which have become a threat to both environment, and thereby the existence of all species (Gökmen, 2011). These problems faced by the humanity and environment are related to many factors and the processes, such as population increase, insensible use of the natural sources, destruction of the wild life habitat, extinction of many plants and animals, natural disasters, urbanization, and the wealth difference within a country and between countries.

Although the environment can renovate itself in spite of the problems caused by people, its self-renovating limit has also been exceeded especially with the realization of the industrial revolution (Aydoğdu and Gezer, 2006). With the industrialization process, local productions in agricultural societies have been replaced with factories and growing industrialization has increased the rural-urban migration. Developing industrialization, rapidly growing population, urbanization, and people's wish to have better life conditions have caused the insensible overuse of natural resources and consumption. Consequently, the earth has become unable to restore the natural resources, i.e. it has become unable to renovate itself (Yıldız, Sipahioğlu and Yılmaz, 2008).

Human beings concerned for the future because of the problems they have caused have started to look for a solution to the environmental problems. Within this context, firstly the sustainable development concept has been suggested as a solution for the environmental problems. With the concept of "sustainability", leaving a livable environment to the next generations is meant. The other important concept accompanying the concept of "sustainability" is "ecological footprint".

Ecological footprint is a sustainability indicator measuring how much the products are is consumed at the end of human activities and at which point the consumption has exceeded the national and global limits The Ecological Footprint is a resource accounting tool that measures how much bioproductive land and sea is available on Earth, and how much of this area is appropriated for human use. The Ecological Footprint, human demand, and biocapacity, ecosystem supply, are both measured in units of global hectares, a hectare normalized to the average productivity of all bioproductive hectares on Earth. (Kitzes and Wackernagel 2009; Lenzen and Murray 2001).

Actually ecological footprint means more than an indicator with regards to sustainability owing to the benefits of being an educational approach for sustainability and getting over the physiological perspectives of especially some current global environment problems In this context, we think that the ecological footprint is more than an indicator for sustainability. It has the merits of being an educational approach to sustainability, especially concerning overcoming some of the physiological perspectives of current global environmental problems. (Gottlieb, Vigoda-Gadot and Haim, 2013). With this point of view, it can be said that, the basic emphasis on ecological footprint is on the sustainability concept, which stipulates the increase in the bio-productive areas that have the capacity to renovate themselves and to maintain their renovation abilities, including the idea of leaving a preserved environment to next generations.

Within this context, for the sustainability of life, it is imperative for individuals to adapt their life conditions and economic activities with regards to the bearing capacity of the Earth (Young, 2009).

By learning our ecological footprint, we can see the size of the damage that we give to the environment and we can identify the measures that need to be taken against them. Therefore, the importance of involving the concept of ecological footprint in environment education curricula becomes clear. We can raise individuals who are sensitive to the environment and have high awareness levels with the integration of the ecological footprint applications to the education setting (O'Gorman and Davis, 2013). Teachers who are the most

important elements of education in raising individuals who have environmental sensitivity and are aware of the environment problems have an enormous responsibility.

It is natural that teachers, who are sensitive about and interested in environmental issues, and with positive attitudes and behaviors regarding environment would be expected have a positive impact on student regarding these concepts. Within this context, it is necessary for teachers to complete their education equipped with required knowledge and skills. Therefore, pre-service teachers should be introduced to the concept of ecological footprint before they begin practicing. That's why ecological footprint concept absolutely should be included in the current teacher training programs. Determining the teacher candidates' current status in ecological footprint awareness issue will be beneficial in the reconstruction of education programs.

An analysis of the contents of the subjects shows that that especially science and technology teachers have more duties and responsibilities. Therefore, science and technology teachers should be equipped with necessary knowledge and skills regarding the issue before they graduate and start practicing. Therefore, in this study, science and technology teachers' ecological footprint awareness levels were aimed to be evaluated.

To this end, the question "What are science and technology teacher candidates' awareness levels about ecological footprint subject?" was investigated through the following research questions:

1. Which field contributes most to the ecological footprint awareness levels of science and technology teacher candidates?
2. Do the ecological footprint awareness levels of science and technology teacher candidates show any significant differences according to their genders?
3. Do the ecological footprint awareness levels of science and technology teacher candidates show any significant differences according to their grade levels?

METHODOLOGY

This part includes the model of the research, research population and sample, and the data collection tool subtopics

a) Model of the research

The present research is a quantitative study, and a descriptive research model was used. Since the survey method is one the most commonly used methods, descriptive studies are generally known as survey studies (Tanrıöğen et. al., 2012). Survey studies are the ones in which researchers provide detailed information about the current situation (Fraenkel and Wallen; 2006). In this research, the cross-sectional survey model, in the descriptive research model, was used in the determination process of the ecological footprint awareness levels of science and technology teacher candidates.

b) Research Population and Sample

Science and Technology Teacher Candidates studying at the Science Education Department of Gazi Education Faculty of Gazi University in the spring semester in 2013-2014 were the research population.

To determine the sample of the research, the stratified purposive sampling method was applied. Individuals in the population were divided into 4 groups according to their grade levels. To determine the population features and to be able to compare between the units, stratified purposive sampling method was chosen. The number of participants in each grade level is given in Table 1.

Table 1. *The Number of Participants in Each Grade Level*

Grade level	N	%
1	62	17.2
2	63	17.5
3	126	34.9
4	110	30.5
Total	361	100

Table 1 shows that 17.2% of the participants were in the 1st grade (N=62), 17. 5% in the 2nd grade (N=63), 34. 9% in the 3rd grade (N=126), and 30.5% in the 4th grade (N=110). In total, 361 teacher candidates participated in the present research (N_T=361).

c) Data Collection Tool

The Ecological Footprint Awareness Scale, developed by Coşkun (2013) to determine the primary school teacher candidates' awareness levels about ecological footprint subject, was used for data collection in the present research.

The first part of the Ecological Footprint Awareness Scale includes 6 items regarding individuals' demographic features, namely gender, grade, longest living unit, economical income, and parents' educational status. In the second part of the Ecological Footprint Awareness Scale, there are 46 items to determine the individuals' ecological footprint awareness levels.

During the preparation of the Ecological Footprint Awareness Scale, firstly related literature was reviewed, and the 83-item scale that was drafted was presented to 1 field expert, 1 education expert, 1 language expert, and 1 evaluation and assessment expert for their critical review. The scale was reduced to 71 items after the first round of review, which was reviewed again by 2 field and 1 language expert. The final version of the scale included 46 items with 5 sub-dimensions.

The Ecological Footprint Awareness Scale includes 5 sub-dimensions, namely food, transportation and accommodation, energy, wastes, and water consumption. There are 8 items in the food sub-dimension, 9 items in the transportation and accommodation sub-dimension, 15 items in the energy sub-dimension, 9 items in the wastes sub-dimension, and 5 items in the water consumption sub-dimension. The reliability coefficient for each sub-dimension was found as 0.65 for food, 0.71 for transportation and accommodation, 0.89 for energy, 0.80 for wastes, and 0.73 for water consumption.

Five-point Likert scale was used for all items. Decreasing points were given as 5 points to "Definitely agree", 4 points to "Agree" statements, and so on. The items left blank by participants were considered as 0 point.

To determine the ecological footprint awareness levels of teacher candidates and which sub-dimension contributes most to the ecological footprints, descriptive statistics was used. Independent samples t-test was used to determine the effect of the gender on the ecological footprint. Finally, to examine the effect of the grade variable to the ecological footprint, one-way ANOVA analysis was performed. SPSS 18 (Statistical Package for Social Sciences Program, Version 18.0) was used for statistical analyses.

d) Data Analysis

We used various descriptive and inferential analyses in the present study. Descriptive statistics were used to understand the psychometric factors of GM foods and the teaching of this topic. We used structural equation modelling (SEM) as an inferential analysis to test the

relationships between CBs and teaching efficacy beliefs. We controlled the assumptions of SEM such as normality, random missing data and model specification. To find the predictors of beliefs about teachers' roles in teaching SSI, we used Multinomial Logistic Regression (MLR). In addition, we tried to understand the potential use of a teaching method in SSI education with a scatter gram, which was plotted using the mean scores of the responses to questionnaire items in the first part (efficacy beliefs) against the mean scores of the responses to the items in the second part (effectiveness beliefs). To measure the relations between CBs and beliefs about teaching methods, we used Pearson Moments Correlations and correlated the CBs with the effectiveness beliefs about teaching methods in SSI education.

FINDINGS

In the first question, to find out the participants' distribution among the sub-dimensions of the scale and to identify which sub-dimension contributed most to the ecological footprints, descriptive statistics was used and the results are presented in Table 2.

Table 2. *Descriptive Statistic Results Belonging to Sub-dimensions*

Sub-dimension	N	Min	Max	X	SS
Food	361	1.75	4.75	3.20	0.47
Transportation and accommodation		1.22	4.78	3.26	0.57
Energy		1.73	5.00	4.08	0.57
Wastes		1.78	5.00	3.72	0.60
Water Consumption		1.80	5.00	3.87	0.71
Ecological Footprint		2.24	4.76	3.68	0.45

Table 2 shows the average ecological footprint awareness level of the participants as X=3.68, and the highest vale was observed in the energy sub-dimension (X=4.08) with the lowest value in the food sub-dimension (X=3.20). The other sub-dimension in which the ecological footprint awareness level was the second most was the water consumption sub-dimension (X=3.87). Wastes (X=3.72) and transportation and accommodation (X=3.26) sub-dimensions followed. Since the ecological footprint in any sub-dimension reduces as the awareness level increases, the high level of awareness in a sub-dimension means that this sub-dimension contributes less to the ecological footprint. Based on this, it was found that the least contributing sub-dimension to the ecological footprint was energy sub-dimension. Water consumption, wastes, and transportation and accommodation followed it. Again the highest ecological footprint level was determined in the food sub-dimension.

Second research question inquires if the ecological footprint awareness levels of the participants show any significant differences according to the gender.

Descriptive statistics results of the participants regarding the gender variable, and independent samples t-test results of ecological footprint awareness levels in all sub-dimensions are given in Table 3.

Table 3. *Independent Samples T-test Results of Ecological Footprint Awareness Levels in All Sub-dimensions According to the Gender*

Sub-dimensions	Gender	N	%	X	SS	sd	r^2	t	p
Food	Female	309	85.6	3.24	0.46	359	0.027	3.20	.001
	Male	52	14.4	3.01	0.47				
Transportation and Accommodation	Female	309	85.6	3.28	0.55	359	-	1.53	.126
	Male	52	14.4	3.15	0.67				
Energy	Female	309	85.6	4.12	0.55	359	0.015	2.35	.019
	Male	52	14.4	3.92	0.62				
Wastes	Female	309	85.6	3.76	0.57	359	0.030	3.33	.001
	Male	52	14.4	3.47	0.68				
Water Consumption	Female	309	85.6	3.91	0.69	359	0.019	2.66	.008
	Male	52	14.4	3.63	0.77				
Total	Female	309	85.6	3.71	0.43	359	0.028	3.24	.001
	Male	52	14.4	3.49	0.51				

Table 3 shows that the ecological footprint awareness levels of the female participants in the food sub-dimension (X=3.24, s=0.46) is significantly higher than those of the male participants (X=3.01, s=0.47) ($t_{(359)}$=3.20, p<.05 and r^2=0.027). It was observed that 2.7% of the variance in the awareness level according to the effect size is explained with the gender variable. To Cohen (1988), this value is described as small effect.

No significant difference was observed between the ecological footprint awareness levels of female (X=3.28, s=0.55) and male participants (X=3.15, s=0.67) in the transportation and accommodation sub-dimension ($t_{(359)}$=1.53, p>.05).

It was observed that the ecological footprint awareness levels of female participants in the energy sub-dimension (X=4.12, s=0.55) were significantly higher than those of the male participants (X=3.92, s=0.62) ($t_{(359)}$=2.35, p<.05 and r^2=0.015). In terms of the effect size, 1.5% of the variance in the awareness level is explained by gender variable. To Cohen (1988), this value is described within the small effect range.

It was observed that the ecological footprint awareness levels of female participants (X=3.76, s=0.57) in the wastes sub-dimension were significantly higher than those of the male participants (X=3.47, s=0.68) ($t_{(359)}$=3.33, p<.05 and r^2=0.030). According to the calculated the effect size, 3.0% of the variance in the awareness level is explained by the gender variable. To Cohen (1988), this value is identified as small effect.

It was observed that the ecological footprint awareness levels of female participants (X=3.91, s=0.69) in the water consumption sub-dimension were significantly higher than those of the male participants (X=3.63, s=0.77) ($t_{(359)}$=2.66, p<.05 and r^2=0.019). In terms of the effect size, 1.9% of the variance in the awareness level is explained by the gender variable. To Cohen (1988), this value is identified as small effect.

According to the general data analysis results of the Ecological Footprint Scale, it was observed that the ecological footprint awareness levels of female participants (X=3.71, s=0.43) were significantly higher than those of the male participants (X=3.49, s=0.51) ($t_{(359)}$=3.24, p<.05 and r^2=0.028). In terms of the effect size, 2.8% of the variance in the awareness level is explained by gender variable. To Cohen (1988), this value is in the small effect categorization.

Third research question inquires if the ecological footprint awareness levels of the participants show any significant differences according to the grade level.

Descriptive statistic results of participants in terms of the grade level variable are given in Table 4.

Table 4. *Descriptive Statistic Analysis Results of Ecological Footprint Awareness Levels in All Sub-dimensions According to the Grade Levels*

Sub-dimensions	Grade Level	N	%	X	SS
Food	1	62	17.2	3.19	0.41
	2	63	17.5	3.24	0.51
	3	126	34.9	3.16	0.42
	4	110	30.5	3.25	0.53
	Total	361	100	3.20	0.47
Transportation and Accommodation	1	62	17.2	3.26	0.50
	2	63	17.5	3.29	0.59
	3	126	34.9	3.25	0.59
	4	110	30.5	3.25	0.57
	Total	361	100	3.26	0.57
Energy	1	62	17.2	3.92	0.55
	2	63	17.5	4.23	0.50
	3	126	34.9	4.07	0.57
	4	110	30.5	4.12	0.59
	Total	361	100	4.09	0.57
Wastes	1	62	17.2	3.66	0.61
	2	63	17.5	3.80	0.60
	3	126	34.9	3.66	0.57
	4	110	30.5	3.77	0.61
	Total	361	100	3.72	0.59
Water Consumption	1	62	17.2	3.77	0.76
	2	63	17.5	3.93	0.65
	3	126	34.9	3.91	0.75
	4	110	30.5	3.85	0.67
	Total	361	100	3.87	0.71
Total	1	62	17.2	3.60	0.40
	2	63	17.5	3.76	0.44
	3	126	34.9	3.65	0.46
	4	110	30.5	3.70	0.47
	Total	361	100	3.68	0.45

In Table 4, it is seen that 4ht grade participants with higher ecological footprint awareness levels in the food sub-dimension (X=3.25; s=0.53) had higher point averages than the other students. In the transportation and accommodation, energy, and water consumption sub-dimensions, the 2nd grade participants with higher ecological footprint awareness levels had higher point averages than the other students. To determine if the differences in these point averages are statistically significant in terms of grade levels and sub-dimensions, one-way ANOVA analysis was performed and the results are given in Table 5.

Table 5. *ANOVA Results of Ecological Footprint Awareness Levels in Different Grade Levels*

Sub-dimensions	Resource	SS	df	MS	F	p
Food	Inter groups	0.541	3	0.180	0.816	0.486
	In groups	78.892	357	0.221		
	Total	79.432	360			
Transportation and Accommodation	Inter groups	0.89	3	0.30	0.091	0.965
	In groups	116.626	357	0.327		
	Total	116.715	360			
Energy	Inter groups	3.263	3	1.088	3.436	0.01
	In groups	113.007	357	0.317		
	Total	116.270	360			
Wastes	Inter groups	1.454	3	0.485	1.372	0.251
	In groups	126.122	357	0.353		
	Total	127.575	360			
Water Consumption	Inter groups	1.036	3	0.345	0.683	0.563
	In groups	180.481	357	0.506		
	Total	181.516	360			
Total	Inter groups	0.972	3	0.324	1.589	0.192
	In groups	72.844	357	0.204		
	Total	73.816	360			

Table 5 shows that there is no statistically significant differences between the ecological footprint awareness levels in food, transportation and accommodation, wastes, water consumption sub-dimensions and the general ecological footprint awareness levels in terms of grade levels. Only in the energy sub-dimension, it was observed that there is a significant difference in terms of grade levels ($F_{(3,357)}$=3.436; p<.05). To determine in which groups there is a significant difference, Scheffe test was performed. According to the Scheffe

test result, between the ecological footprint awareness levels of the 1st and 2nd grade participants in energy sub-dimension, a significant difference in favor of the 2nd grade participants ($X_{2.grade}$=4.23, $X_{1.grade}$=3.92) was found. For this research, the effect size was found as (eta square) .028. According to Cohen (1988), this value is in the small effect size category and also 2.8% of the variance in the awareness level of the science and technology teacher candidates in energy sub-dimension is caused by the grade level variable.

CONCLUSION and DISCUSSION

Analyses showed that the highest awareness level of the participants was in the energy sub-dimension, and it was followed by water consumption, wastes, and transportation and accommodation, and the least awareness level was with the food sub-dimension (Table 2). The reason for the highest awareness level of the participants was with the energy sub-dimension may be that individuals are conscious about energy consumption and that they have limited economic conditions. The reason for having the second highest ecological awareness level in the water consumption sub-dimension can be explained with the factors that individuals attending to the research have comprehended the importance and necessity of using water resources carefully, and thus they have behaved cautiously about water consumption. As the reason of ecological awareness level in wastes sub-dimension, the effect of the public service advertisements prepared to raise public awareness and the activities about recycling conducted in many agencies and institutions can be shown. The fact that the lower awareness level of the teacher candidates in food and transportation and accommodation sub-dimensions than the other sub-dimensions may have resulted from the fact that the participants were students; therefore, they may be prone to consume convenience food, including frozen foods and foods originated from animals, and they may have limited options in terms of transportation means. Moreover, it can be said that the factors like most of the teacher candidates' accommodating in dormitories and some of them sharing the same house have contributed to reduce the ecological footprint. These results are in line with the results expressing the fact that teacher candidates have the smallest ecological footprint in energy sub-dimension and the result found in the previous reports performed to determine the awareness level of the teacher candidates, the most contributing sub-dimension to the ecological footprint is the food sub-dimension (Coşkun, 2013; Keleş, 2007; Keleş et. al., 2008). Also, the result that the most contributing field to the ecological footprint is the food sub-dimension shows similarity with some reports in the literature (Simpson, Petroeschesky and Lowe, 2013).

In terms of all sub-dimensions, except for the transportation and accommodation sub-dimension, there was a statistically significant difference between genders favor of females (Table 3). According to this result, it has been determined that females are more aware with regards to food, energy, wastes, water consumption, and the awareness of ecological footprint in general than males. Compared to males, females are usually more active in social life, especially in house or family environment, during the process of providing food for the house, and they are more conscious in terms of energy use and saving, waste disposal at home, and water use. These factors may be listed among the reasons for females' higher ecological footprint awareness levels. These results are in parallel with the fact that the ecological footprint awareness levels of the individuals show significant differences according to the gender as reported by Keleş's (2011) and Ek et. al. (2009), namely female students are more sensitive to the environmental problems compared to males. Moreover the research results showing that there is no statistically significant difference in transportation and accommodation sub-dimensions according to the gender is in a line with the results of some previous reports in the literature (Akıllı et. al., 2008; Keleş et. al., 2008; Coşkun, 2013).

In terms of the relationship between grade levels and the awareness level, the results showed that there is a statistically significant difference between grade levels and the energy sub-dimension in favor of the 2nd graders (Table 4 and Table 5), and there is no significant difference in the other sub-dimensions and in total scores. The fact that students in the 1st grade generally accommodate in dormitories in their first years and then later they stay at homes, and they shoulder some various responsibilities as a result of some chores they do, such as consumption of the electricity and gas, paying the bills can be shown as a reason for their higher awareness in energy sub-dimension. Coşkun (2013) reports that that there is no significant difference between the awareness level of the primary school teacher candidates studying in the 2nd grade and the awareness level of the primary school teacher candidates studying in the 3rd grade in the study is in line with this results of the present study.

As a result, it is determined that the education received at the university does not increase the ecological footprint awareness levels. Especially an improvement should have been observed in the ecological footprint awareness levels of the candidates after the subjects are taught about the environment in the 3rd grade. Based on this outcome, it can be concluded that the environmental education given at the university is insufficient.

SUGGESTIONS

In the light of the results and the findings obtained within this research, the following points are suggested:

The environmental education given at the university does not contribute to the ecological footprint awareness of the individuals in a positive way. Therefore the required education activities should be arranged appropriately in order for the teacher candidates to start the profession with the sufficient knowledge and skills about the sustainability and ecological footprint.

Similar studies should be performed in in-service teachers and their ecological footprint awareness levels should be determined. In the light of the studies to be performed, they should be provided with the opportunities to raise their awareness about the sustainability and the ecological footprint through in-service trainings and other means.

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Biology Curriculums from the Tanzimat Reform To Today*

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ABSTRACT

This study aims to analyze the contents of the courses related to biology education in primary and secondary education institutions and to introduce the related developments and transformations by comparing the period of change and curriculums of those courses from Ottoman Empire from the Tanzimat reform to today. Our study is based on document analysis. As a result of the current study, it is seen that biology curriculum has been given as not an individual course but within an integrated understanding which includes the subjects like nature, agriculture, medicine and geology and information which should be known by a student in daily life during the modernization period of Ottoman Empire as a result of current study. Developments in biology were reflected even partially to curriculum but lack of supporting materials of the course and the fact that courses were always given theoretically and not supported by laboratory and equipment stand out as most important deficiencies. Program for primary schools were handled mainly until 1950s and biology instruction programs were developed in the following years and scientific developments were tried to be followed within these programs in the republic period. A constructivist approach has been adopted and instruction programs have been developed within a cyclical and integrated approach after 2000s.

Keywords: Ottoman Empire; Education; Biology; Curriculum.

INTRODUCTION

Important changes have been experienced in science, art, literature, philosophy and social sphere in Europe since 17th Century. Experimental studies and new inventions were made in other disciplines like physics, mathematics, chemistry and biology. When the importance of the said disciplines in the development and improvement of countries was comprehended, education system didn't remain insensitive to those developments. How to teach the courses for sciences and social sciences in the new education system gained importance, logic was used in instruction programs.

Elementary level Quran School (Sıbyan Mektebi) and madrasahs were the most important institutions where civilians might take education since the foundation of them in Ottoman Empire trying to change education system by modeling itself on western society.

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Even though the ones established individually for medical training were always present in the madrasahs intended to instruct Islamic law, Mathematics and Sciences other than Medicine became the subject of instruction in the environments out of madrasahs but instruction of these sciences remained more constricted. Development of these sciences is generally up to personal interest and effort out of madrasah (Zengin, 2008, p.213).

Any course name associated with the instruction on animals, plants or creatures within classical madrasah training in Ottoman Empire hasn't been found (Ergun, 1996). Since these institutions couldn't meet the requirements of that era; modernization efforts were initiated first in education of military in order to prevent regression. Contemporary sciences were instructed first in militaristic schools, Hendesehane (Engineering School), Muhendishane-i Berri-i Humayun (Imperial School of Military Engineering) and Muhendishane-i Bahri-i Humayun (Imperial School of Naval Engineering). But it is very difficult to say that the sense of experiment in these sciences entered into educational institutions in Ottoman Empire. It is understood that laboratories have not been established in the engineering schools which were the primary education institutions of the first era. Some equipments intended to make measurements in artillery and navigation are available in these schools (Tekeli and İlkin 1999, p. 51-52).

New educational institutions rendering training at the levels of primary, secondary and high schools other than madrasahs and elementary level Quran schools (Sıbyan Mektebi) where civilians may take education were founded in the Tanzimat reform era (Koçer, 1987). Curriculums, course books and school programs were handled again in parallel with the foundation of the institutions like Rusdiyye (Ottoman junior high school), Idadi (high school), Sultani (high school), Daru'l-funun (Ottoman University). Positive sciences providing Europe to develop were included in the curriculums as separate courses; course books were written to be taught in the mentioned courses and new legal regulations were made for the matter concerned.

Ordinance of General Education (Maarif-i Umumiye Nizamnamesi) which is one of the most important ordinances in the modernization process of Ottoman education was accepted on September 1, 1869 in the period of the minister of education, Saffet Pasha. This ordinance constituted a system to lead Ottoman education and is the first complicated legal text intended to regulate the general education in the capital and provinces Many subjects like rating educational institutions, curriculums, contents of courses, powers of the ones authorized within institutions and financial aspects of education were handled in the ordinance. Furthermore it is possible to reach similar information in the yearbooks for education and other publications published in the following years. It is possible to determine the courses and contents related to biology in primary, secondary and high educations.

This study aims to analyze the contents of the courses related to Biology education in the primary and secondary educational institutions in Ottoman Empire and to introduce the transformations by comparing the period of change and curriculums from Ottoman Empire since the Tanzimat Reform Era to Today and to fill in the blank in the literature for the matter involved.

METHODOLOGY

This study was conducted by using document analysis from qualitative research models. History and historical process of the subject are critically important for a researcher in commenting the findings. In this context researcher may collect two kinds of data: 1- Archive Data, 2- Historical Data. Archive data includes routine records of a community and organization or culture. Records are used to enrich and compare the findings of research. Historical data allows obtaining significant inferences associated with the infrastructure of the research subject in other words history. It requires a researcher to review newspapers,

journals, books and similar documents. Data sources used in collecting historical data are records, reports, official documents, books, journals and similar documents, autobiographies and documentaries, questionnaires, songs, poetries and similar folkloric documents (Bas ve Akturan, 2013). Yearbooks for education (Maârif Sâlnâmeleri), curriculums and course books etc. published by the ministry of education were used in our study. Yearbooks for education were known to be published in 6 issues under the name of Sâlnâme-i Nezaret-i Maârif-i Umûmiyye between A.H. 1316 and 1321 / A.D.1898 and 1903 and 5th issue published in A.H. 1320/1902 hasn't been encountered in the libraries until now. Information regarding primarily history of educational institutions, ministers of education, teachers, schools and libraries and other subjects. In addition to them, tables regarding the permillage rate of the students studying in all schools in the province in the population of that province in that era are available in the yearbooks for education as well as military schools, general examination scales, interest distribution scales of Mulkiye Mekteb-i (Imperial School of Political Sciences) and Mekteb-i Sultani (Imperial High School) (Hızlı, 2008).

Stages of document review may be collected under following titles like reaching documents, checking its authenticity, understanding documents, analyzing and using data (Yıldırım ve Simsek, 2013). The ones pertaining to Ottoman Empire from the documents used in our study were reached from the Periodical Information System of National Library of Turkey located in Ankara and Rare Works Collection at the Hall of Seyfettin Ozege of Ankara University. Authenticity of documents was checked and then transcription of documents was made and then the obtained data was analyzed and considered. Curriculums of the republican period were reached from the official web site of Ministry of National Education. Same stages were followed for these documents.

FINDINGS

Courses of "Ma'lûmât-ı Tabiiye" (Natural Sciences), "Hıfz-us-sıhhat" (Protection of Health), "Ma'lûmât-ı Nafia" (Useful Information), "Elifba ve Sifahi Ma'lûmât" (Life Sciences) in Rusdiyye schools (Ottoman Junior High Schools), "Hikmet-i Tabiiyye" (A Treatise on Physics) or "Tarih-i Tabiiyye" (A science dealing with the evolution of animals, plants and the world), "Malumat-ı Fenniye ve Hıfz-us-sıhhat" (Protection of the Health), "Ilm-i Mevalid" (Science on Animals, Botanic and Plants) in Mekteb-i Sultani (Imperial High School) and Idadis (Imperial High Schools) giving education at the levels of high schools, courses like "Ilm-i Nebatat" (Botanical Science), Ilm-i Hayvanat (Animal Science) and "Tarih-i Ulûm-i Tabiiye" (History of Natural Sciences) in the branch of Ulûm-i Tabiiye (natural sciences) of Darulfunun (Ottoman University) are associated with the subjects within the current curriculums of Biology in the educational institutions within the modernization process of Ottoman Empire

1. Courses related to Biology in Rusdiyye schools

What the exact status of Rusdiyye schools in Ottoman educational system is can't be found today. Despite this, Rusdiyye schools were intended to include the education following elementary level Quran School (sıbyan mektebi) and to be a preparatory school for during its foundation. It may be considered as a school providing education over primary school level and under Idadi (Imperial High Schools) level. Process triggering the foundation of rusdiyye schools begun with the firman published by Sultan Abdulmecid for the establishment of a new European-style education system thought to be carried out in 1845. Education system thought to be established in three stages is made up of elementary level Quran School (sıbyan), rusdiyye schools and Darulfunûn (Ottoman University). Kemâl Efendi, director of Mekâtib-i Umûmiyye (Public Schools) planned to open the rusdiyye schools intended to give

education following the elementary level Quran school (sıbyan), since the necessary reforms weren't made in the infants' school (Ozturk, 1993).

Even though Mekteb-i Maârif-i Adliyye (School for Learning) and Mekteb-i Ulûm-i Edebiyye (School of Literary Sciences) founded in 1839 are Professional Schools in terms of their contents, they are the first rusdiyye schools founded in Ottoman Empire. Rusdiyye schools were founded in many provinces particularly in Istanbul. Subjects of biology curriculum are observed in the courses of Hıfz-us-sıhhat" (Protection of the Health), Ma'lûmât-ı Tabiiye" (Natural Sciences), Ma'lûmât-ı Nafia" (Useful Information), "Elifba ve Sifahi Ma'lûmât" (Life Sciences) in the course programs of rusdiyye schools.

1.1. Hıfz-us-sıhhat (Protection of the Health)

Course of "Hıfz-us-sıhhat" (Protection of the Health) including the subjects concluded by Biology curriculum is seen in the courses of sciences to be instructed in idadi schools and Rusdiyye schools are giving jointly education in the year 7 of the Course Schedule given by Mahmud Cevad (Mahmud Cevad, 2001, p. 368). These subjects are seen in the 5th grade in the course schedules of same schools in the yearbooks for education. (Salnâme-i Nezâret-i Maârif-i Umûmiyye [SNMU], A.H. 1316/A.D 1898-1899, p. 282-285). The name of this course is not available in the schedules of rusdiyye schools for boys.

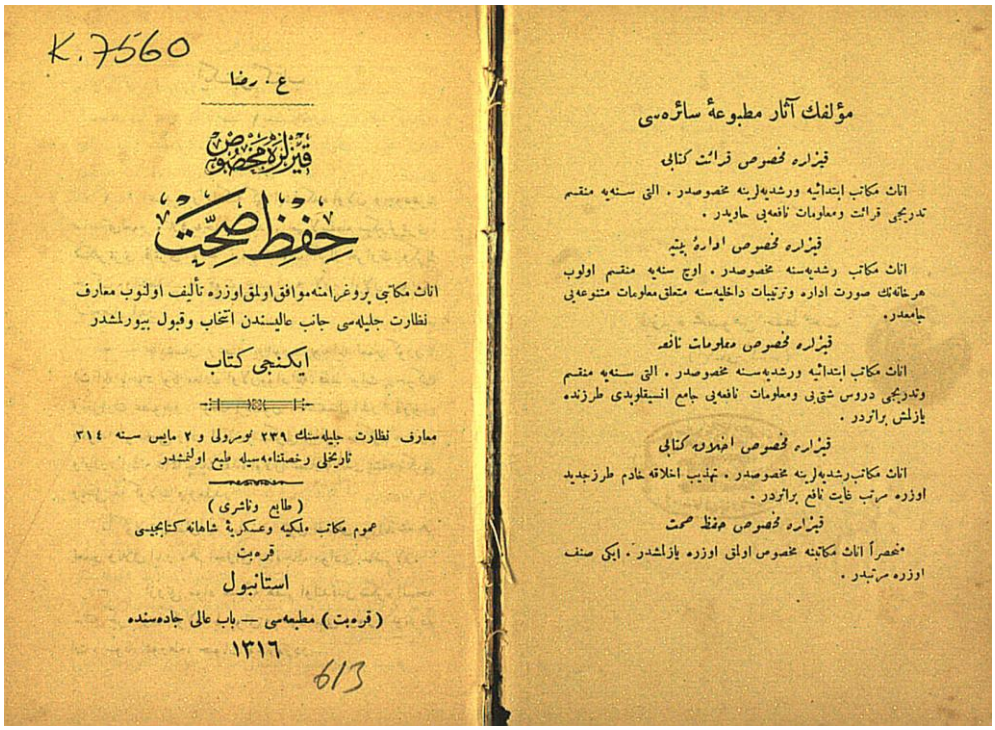
Contents of the course are almost as same as the contents given by Mahmud Cevad in the yearbook. Curriculum of Hıfz-us-sıhhat is as follows:

Table 1. *Course content of Hıfz-us sıhha (Protection of the Health)*

Third Year	Fourth Year	Fifth Year (Rusdiyye Schools for Girls)
Introduction-Microbes (microorganisms):Microbes; Their forms and movements, reproduction, secretions, living and reproduction places of microbes in and out of body, ways of entering into body. Water: Potable Waters; Their structure, chemical properties and vital characteristics, water sources; rains, sources, rivers, wells, water treatment, ways of treatment (filtering and boiling). Beverages containing water, ice. Air: Air and respiration, air composition, Exchange of it by respiration, compressed air, asphyxiation caused by oxygen deficiency, air amount required for life, existence of various gases in the air, air cleaning, air pressure, overpressure and underpressure, respiration through a hole opened on throat, dusts in the air, association of earth and air, marshes.	Foods Foods of Animal Origin: Meats and types, hazardous and healthful meats, toxic meats, fresh meats, consomme. Milk: Components, degradations in components, sterilization, butter. Fish meats: Poisonous mussels and oysters, fish conservation and canned foods . Phytonutrients: Bread, potato, mushrooms, vegetables, sugar. Chocolate, salt, mustard, vinegar. Beverages: Alcoholic beverages: Wine, bear, raki ve their harmful substances, alcoholic things. Coffee and tea. Clothes: Effect of Clothing substances, dye and weaving Infectious diseases: Description of infectious disease and microbes, protection from infectious diseases. Locations, body cleaning, movement and exercise, regeneration, ways of removing bad smells. Eye health, lighting, and children's health.	1-Parts of skeleton, functions of muscles and organs 2-Ingestion organ, ingestion, foods 3-Blood, circulatory system, blood circulation 4-Respiratory organs 5-Neural system, nerves, movements and feelings 6-Sense organs (touch, tasting, smelling, hearing, sight) **Sixth Year** 7-Foods: Foods of Animal Origin and phytonutrients, milks and components, milk to be given to children. 8-Water, potable and non-potable waters, water cleaning & treatment 9-Tea, Coffee and chocolate. 10-Drunkeness, types of addictives and pleasure-inducing substances: Tobacco and Persian tobacco, narghile tobacco, snuff and hashish. 11-Air, necessity to treat air, air circulation. 12-Protection of the health of body, movement, comfortable sleep, sanitation, soap and hamam and bathroom. 13-Clothes: Clothes for children, men and women. 14-Location: effect of bedrooms, beds, water-closet, environment and vicinity. 15-Protection from infectious diseases: Ways and modes of transmission, vaccine. 16- First treatments to be made for some accidents. 17-Special health rules

This course was agreed to be instructed in seven-year idadi School in Istanbul in accordance with this curriculum (Mahmud Cevad, 2001, p. 415-416; SNMU, H. 1316/M. 1898-1899, p. 282-285).

Same course was thought one hour in the years five and six within the scope of the 24-hour program per week for the six-year rusdiyye schools for girls containing primary and rusdiyye classes in the yearbook of education for A.H.1317/A.D.1899-1900 (SNMU, A.H.1317/A.D.1899-1900, p.433) and contents of course are stated in Table 1.



Picture 1. *Hıfz-us-sıhhat (second book) for girls, 1316, Karabet Printing House, Istanbul.*

In 1881, a new curriculum was suggested and "Usûl-i Hıfz-us-sıhhat" (Ways of protecting the health) was projected to be taught in Mekâtib-i Âliye (Higher Education) upon the determination that the level of the education provided in the ibtidâî and rusdiyye schools was much lower than Christian Schools. In 1982 Course of Ma'lûmât-ı Fenniye (Sciences Teaching) is agreed to be taught 2 hours per week in the grade 4 in the course schedule issued by the commission established with the imperial decree for military and civilian rusdiyye schools (Kaya Doğanay, 2011, p.253).

Course of Hıfz-us-sıhhat (protection of the health) instructed one hour per week in the grades 6 and 7 within the scope of 30-hour course program in the year 1891-92 for the seven-year Industry School for Girls providing rusdiyye training together with preparatory class (iptidaiye class) has same curriculum with the ones in the rusdiyye schools for girls (Mahmut Cevad, 2001, p. 274). No course for the matter involved isn't available in ibtidai (elementary) and country-village schools. Course of Hıfz-us-sıhhat is available in the year five in Imperial Tribal School (Mahmut Cevad, 2001, p. 333-337).

Course program in the yearbook for education for 1903/1904 (A.H.1321) was amended and course of Hıfzı-us-sıhhat was removed. But it is seen that the mentioned course has been instructed in some archive documents (Kaya Doğanay, 2011, p. 264).

In 1913, rusdiyye schools were fused into ibtidâî (elemantary) schools upon the issuance of Tedrisat-ı İbtidâiye Kanûn-ı Muvakkat (temporary law on primary education school). Course of "Ma'lûmât-ı Tabiiyye and Tatbikat-ı Hıfz-us-sıhhat" (Natural Sciences and

Health Practices) is not available in the courses to be instructed in ibtidâî (elementary) schools (Dustur, 1896, p. 807-808).

Today, curriculum of Hıfz-us-sıhhat is encountered in the programs for the courses of Sciences & Technology and Biology. It is discussed in the subject of "Let's Know the Microscopic Creatures" in Unit 6 in 5th Grade and in the subject of microbes in the unit of the world of creatures in the course of Biology in 9th Grade, in the unit of "Let's solve the riddle of our body" in first unit in 4th Grade and in the subject of air, water and respiration in the unit of "human physiology" in 11th Grade in the course of Biology and in the subject of foods in the same unit in 5th grade. Subjects for the year 5 in the rusdiyye schools are discussed today in the unit of "Let's solve the riddle of our body" in first unit in 4th Grade, in the unit of "The Systems in Our Body" in 6th and 7th Grade and in the unit of "human physiology" in 11th Grade in the course of Biology (Ministry of National Education [MEB], 2005).

Today, Course of Hıfz-us-sıhhat has a view of a single course which is an interwoven course intensively in the curriculum of Sciences and Technology and the Curriculums of Hygiene and Biology. The fact that the course subjects of Hıfz-us-sıhhat take place spirally every year in the subjects of Sciences and Technology and Biology and Hygiene is a reflection of the constructivist training understanding. But such approach is not observed to have been reflected in the curriculum.

1.2. Ma'lûmât-ı Nâfıa (Useful Information)

Course of "Ma'lûmât-ı Nafia" and "Hıfz-us-sıhhat" is seen to be taught one hour per week in first year within the course schedule to be followed in the rusdiyye and idadi schools in the yearbook A.H.1316 /A.D.1898-1899 (SNMU, A.H. 1316 /A.D. 1898-1899, p.191). The name of the course called as Ma'lumat-ı Nafia in which the course subjects of Biology are discussed is founded as "Durûs-ı esya and Ma'lûmât-ı nafia" taught 2 hours per week in first three years and one hour per week in the years 4, 5 and 6 in the rusdiyye schools for girls after the combination of Rusdiyye Schools and İptidai Schools. Course of Hıfz-us-sıhhat is taught one hour per week in fifth and sixth grades in same program (Mahmud Cevad, 2001, p.247).

Course of Ma'lûmât-ı Nâfıa was taught one hour per week in first four year in the schedule showing the quantity of the courses per week within the scope of the ulûm and funûn (science and scholarship) to be taught in rusdiyye and idadi schools giving education together. Course of Hıfz-us-sıhhat with the mentioned curriculum above was started to be instructed in the year 5 (SNMU, A.H. 1316/ A.D. 1898-1899, p.278-282).

As it is evident from its name, information on public works is given in this course. The course includes the information which should be known by a student in daily life. A part of the subjects given here are discussed today within the scope of the courses of Science and Technology. It is discussed in the unit of "Let's solve the riddle of our body" in 4th and 5th grades and in the unit of "the systems in our body" and in the unit of "human physiology" in 11th grade.

Names of main parts of human body like head, hand, arm and food, names of certain animals in our country, names of the plants which serve to nourishment and may be observed by students (common trees and flowers etc. in the yards and gardens) and subjects like colors, day and night, treatment of five senses are available respectively in the section of Sifahî ma'lûmât (verbal information) and in the section of the suggestions on the protection of health in the course of "Elifbâ ve Sifahî Ma'lûmât" (Life Sciences) instructed in the rusdiyye schools for girls. (SNMU, A.H.1317/A.D. /1899-1900, p. 435).

Classification of creatures is outlined in this course.

Since this course was instructed in the ibtidâî (elementary) part of the rusdiyye schools for girls, it is not taught in the rusdiyye schools for boys. Author of the book titled "Hıfz-us-sıhhat" (Health Care) as well as the books and booklets accepted to be instructed in the idadi

schools in the yearbook of education of 1900/1901 (A.H. 1318) is Ahmed Rasim (SNMU, A.H. 1318/A.D. 1900/1901, P. 496-498).” Similar subjects are seen to have been discussed within the curriculum of the course of “Life Science” (Mahmud Cevad, 2001, p. 412-415)

Table 2. *Course content of Ma’lûmât-ı Nâfia*

First Year	Second Year	Third Year	Fourth Yar
Earth and stars: Earth’s movement, shape, evidence of roundness, gravitational force, comparison of earth and sun in size and distance between them, number of movements, seasons, four directions.	Ground: Stones, digging, hammer, Stone pit, Malta stone, marble, granite etc.	Weaving: Copper, lamp, candlestick, candle, gas, petrol, heating , cereal, bread, chocolate, tea, coffee (Wine, beer, jujube), salt, sugar, things intended to dress foods.	Earth from agricultural information, agriculture.
Water: Properties, characteristics, vapor, condensation of vapor, formation of cloud, rain, distillation, solidification of water, ice, snow, hail, well, artesian wells, water mill.	Trees: Types, knowing tree species, timber, pine, oak, chestnut, elm, beech, ash tree, cherry, walnut, boxwood, lathe, saw etc.	Paper, story of a book, equipments for students, descriptions, human body,	Animals
Fire: Properties, non-occurrence of fire in airless environment, hottest level of candle flame, Evidence for air to be ignited and to cause the fire, combustible matters, natural and artificial fire, volcano, benefits of fire in industry, ship, railway (train), thermometer.	Mines and pits: Iron, rust, cast iron, forged iron, Perforated plate intended to make wire from melted substance (Rolling mile), steel, copper, bronze, brass, forged steel, lead, natural lead oxide, basic lead carbonate (ceruse), manufacture of buckshot, tin, solder, canister, being tinned, zinc, galvanization, golden, comparison of golden and iron, silver, gilding, silver plate.	Training of emotions, sight, hearing, smelling, tasting, touching.	Plants
Location: Plan, cabin, cave, base, mast, covering, beam, ceiling, ladder, roof, roofing, terrace, location of housing, coffee tree, tea tree, chocolate, paper.			Metals
Human body: Skeleton, organs Five senses: Sight, force-touching force serving to feel the softness and stiffness of an object, smelling force, tasting force, hearing force, seven colors			

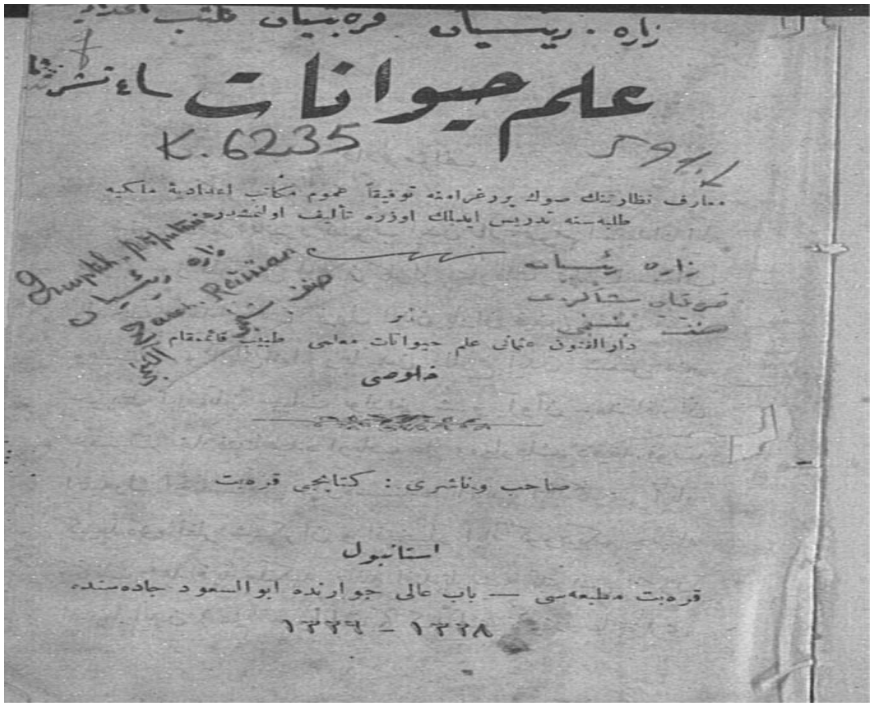
2. Courses related to Biology in the Idadi Schools

The name of the idadi schools intended to fuse Muslim and Christian communities with each other and to raise them in a common culture (MUN, Article 33) was used previously for the preparatory schools intended to complete the imperfect knowledge of the students desiring to study in Military Schools and Military Medical Schools and they were opened in army centers in 1845 and one of them was founded in Bosnia (Ergun, 2000). According to MUN, idadi schools would be opened in the allocation units with a population higher than one thousand residences. But the said provision couldn’t be fulfilled completely due to financial difficulty. First civil idadi school was founded in Istanbul in 1873 in the place of the first high school called as Dârulmaârif. They were opened also in the provinces after two years and it was founded in Nauplion subordinated to Janina (Demirel, 2010). Many idadi schools were seen to be opened in the following years

Course of "ilm-i mevalid" (Life sciences) was agreed to be instructed in the idadi schools (Article 38), Mekteb-i Sultani (Imperial High School) (Article 46) and Darulmuallimin schools (teacher training schools) (Article 55) as stated in General Regulations for Education called as Maârif-i Umumiye Nizamnamesi.

According to the program determined in 1892 courses of Ma'lûmât-ı Fenniye (Science Knowledge) and Mevalid and Hıfz-us-sıhhat (Sciences and Health Protection) were agreed to be instructed respectively 3 hours per week in fifth grade and 3 hours per week in 7th grade (Vilayat-i Sahanede Bulunan Leyli ve Nehari Mekatib-i İdâdiyeye Mahsus Olarak Bu Kere Maarif Nezaretince Ta'dilen Kaleme Alınan Ders Programları, Dersaâdet 1310, p. 2-12). Course of mevalid (sciences) would be instructed two hours per week in 6th and 7th grades in the idadi schools combined with 7-year rusdiyye schools in the yearbook dated A.H. 1316/A.D. 1898-1899. Course of Ma'lûmât-ı Nafıa ve Hıfz-us-sıhhat would be instructed one hour per week in the first five years.

Course of mevalid was taught four hours per week in the final year in the programs for idadi schools, agreed on 1903–1904 (A.H.1321/A.D.1903-1904) (SNMU, A.H. 1321/A.D.1903-1904, P. 25-26).



Picture 2. *Cover of the book "Ilm-i hayvanat" taught in the idadi schools (Hulûsi, 1326-1328. Ilm-i Hayvanat, Karabet Printing Office, Istanbul).*

2.1. Ma'lûmat-ı Fenniye and Hıfz-us-sıhhat (Sciences and Medical Knowledge)

Contents of the said course instructed from the first grade in seven-year idadi schools:

Farming: Farmers and farming tools: Anchor, shaft, fork (used in gardening), plough, plow (according to new methods).

Seed planting: seed planting tool in accordance with new method. Harvest: harvest tool, hook, scythe, new style harvest, new style seed planting.

Farm: Livestock, horse, cattle, donkey. Dairy: Sheep, goat and shepherd. Poultry house: chicken, turkey, goose, duck and pigeon. Milk house: milk, butter, cheese. Pastures: Natural and artificial pastures, mowing, fodder. Bees: hive, comb, honey, beeswax. Travel: way, highways, railways, ships, four main directions, compass, magnet. birdhouses, birds' service to humanbeing, caterpillar, insects, pests, butterfly, silk worm. Communication tools: Mail telegram, phone, electricity, pigeon. Lighting equipments: Oils, candles, wax, tallow,

spermaceti, petrol, petrol lamp, air gas, gas lamps, electric light. Heating: Cool, hot and cool towns, snow, ice, moisture, thermometer, oven, stove, chimney, wood, coal, pit coal, match, fire, pump.

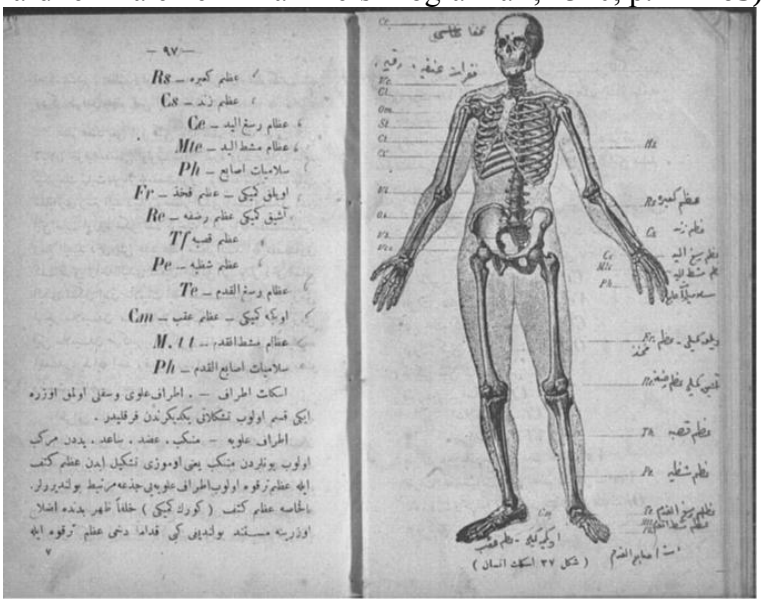
Human being: Main limbs of human body, skeletal system, stomach, lungs, heart, five sensorial organs, sweat, sweating.

Animals: Classification of animals. Vertebrates, mammalians, birds, reptiles, fishes, invertebrates, articulates, origins of animals.

Plants: Parts of plants, root, stem and leafs, flower, seed, vaccine, respiration and nutrition of plants, fertilizer.

Layers of the world: Basic information on the formation of the world, center of movement, volcanoes and earthquakes. Metal objects: Elements, mixtures, hydrogen, oxygen, nitrogen, coal, silver, golden, platinum, iron (steel), copper, lead, tin, aluminum, nickel, sulfur. Waters, mixture of waters, potable waters, sea waters, wells, atmosphere, mixture, measurement. Three states of a matter, solid, liquid, gas. Weights of objects, density, measurement. Barometer, balloons, burning, respiration of animals, bad smells, opposite of bas smells, preservation of foods. Alloys: Bronze, brass, printing letters manufactured from alloys. Temperature: Expansion of objects caused by heat, conductive and non-conductive objects, heat, water vapor, vapor machines. Waterways: flow of waters on earth, watercourse, stream, river, lake, sea, high tide and low tide, cold water bath, travel, evaporation of waters by sunlight. Weathers, water vapor, cloud, rain, snow, hail, thunder and lighting, lighting protection, rainbow, winds.

Foodstuffs: Foods and beverages, wheat, flour, mill, strainer, bread and bread making, meat, butcher, honey, vegetables, fruits, sugar, coffee, appetite, indigestion, physician. Clothing: Need of man for clothing, woven, flax, cotton, silk, textile fabric, leather, dyeing, needle and tailoring, dressmaking, cleaning of clothes, soap. Residences: Need of man for accommodation, parts of distance, construction materials, timber, stone, stone pits, iron, brick, tile, slate, plaster, lime, sand, flax and cannabis hulls, zinc. Construction craft: Carpentry, woodworking, architecture, ironworking. School: Materials required in school, paper and paper craftsmanship, pen, pencil, lead pencil, manufacture of ink, book, printing, volume. Hıfz-us-sıhhat (Health protection), various foods, locations, sanitation, hamam, clothes. (Vilayat-i Sahanede Bulunan Leyli ve Nehari Mekatib-i İdâdiyeye Mahsus Olarak Bu Kere Maarif Nezaretince Ta‘dilen Kaleme Alınan Ders Programları, 1310, p. 14-105).



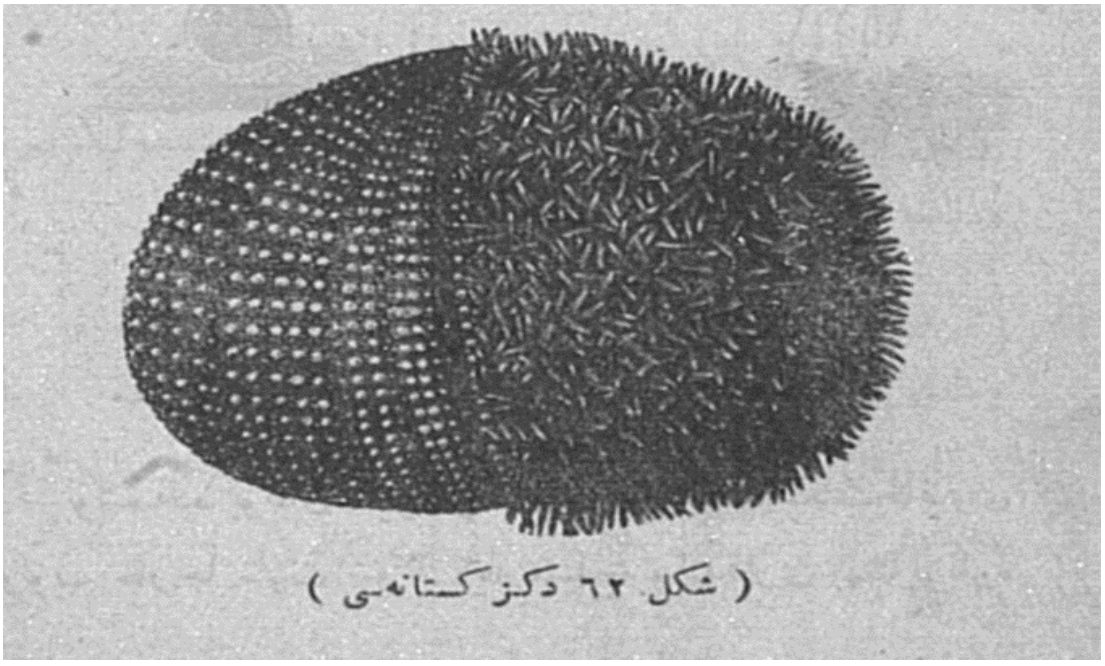
Picture 3. *Contained by the book “Ilm-i hayvanat” (Animal Science) taught in the idadi schools. (Hulûsi, 1326-1328. Ilm-i Hayvanat, Karabet Printing House, Istanbul).*

Novelties were cited in the program and scientific developments were followed even partially. Similar subjects are discussed today in the unit of “Let’s solve the riddle of our body” in 4th and 5th grades and in the unit of “human physiology” in 11th grade (Ministry of National Education, 2005).

2.2. İlm-i Mevalid (Science of Nature)

In the courses of sciences taught in all the rusdiyye and idadi schools, courses of Mechanical physics and Chemistry, and mevalid were taught respectively 3 hours in 6th and 7th grades and four hours in seventh grade (two hours animal science an one hour for each one of botanic and species) and course of Hıfz-us-sıhhat was taught one hour per week in 3rd, 4th and 7th grades and one hour per week in Dersaadet school (Mahmut Cevad, 2001, p. 368-369).

In the courses of sciences taught in all the rusdiyye and idadi schools, course of mevalid was taught four hours in seventh grade (two hours animal science an one hour for each one of botanic and species) and course of Hıfz-us-sıhhat was taught only one hour per week in 3rd, 4th and 7th grades and one hour per week in Dersaadet school (Mahmut Cevad, 2001, p. 368-369) and related curriculum is as follows (SNMU, 1316/ M. 1898-1899, p. 202-204 and 276-278): Information concerned with the said curriculum is available in the course book written by the instructor of zoological sciences (İlm-i hayvanat) in Darulfunûn-i Osmanî (institution of higher education) (Hulûsi, A.H. 1328-1329).



Picture 4. *Picture of a “sea urchin” in the book “Ilm-i hayvanat” (zoological sciences) taught in the idadi schools (Hulûsi, 1326-1328. Ilm-i Hayvanat, Karabet Printing House, Istanbul).*

Table 3. *Contents of Ilm-i Mevalid (Science of Nature)*

İlm-i hayvanat (Zoological Science): (two hours per week)	İlm-i nebatat (Botanical Science): (one hour per week)	Tabakatul arz (Geology): (one hour per week)
Description of tarih-i tabîînin (science discussing animals, plants and the evolution of the world), classification, significant organs, range of animals, description of nature, vital ingredients, skeletal parts, main limbs, cell life. Nourishment duty, digestion, digestion organs, nutrients, digestion and absorption of nutrients, chewing and swallowing, saliva, functions of stomach, Gall, functions of pancreas, absorption. Blood, blood circulation, blood circulation organs, information of circulation, Liver and systemic circulation, portal vein, glands related to blood circulation, spleen, thyroid and timus, lymph and lymphatic circulation. Respiration: Respiratory organs, gill, trachea, bronchia, cutaneous respiration, respiration theory, shortness of breath, heat of animals. secretory organs, secretion and sweating, glands, urinary secretion, kidneys, glands and cutaneous secretion, veins, mucous membranes and secretion of the thin membranes covering the significant organs like encephalon, lungs, heart and intestines, their duties against each other, movement, sensory and movement organs. Sensory system, neural system organs, big sympathetic, regressive actions, actions of plants, mind and managing nature. Sensorial Organs, personal sensibilities, dream, dementia, laryngeal, swallowing. Description of animals: First branch: vertebrates, general properties, classification: mammalians, birds, reptiles, frogs, fishes (sediye, tuyur, zahife, dıfdaiye, esmak). Second branch: invertebrate animals, insects, caterpillar, spiders, crustaceans, earthworms, birds like nightingale, ouzel, grackle Third branch: mollusks, Fourth branch: radiolaria or plants	Classification of plants, general characteristics of plants, parts of plant, chemical contents of leafs, main structures, nutritive organs, root and structures of roots, scape, extrusions, growing of leaf, needle leaved plants(ehdab), lamelled plants (harasif), plants in form of briar patch (esvak and leeches), respiration and sweating, growing of plants, vaccination(telkıh), plant nutrition and foods obtained from plants. Reproductive organs: Types, types of flowers, transformation in plants, flowering, flower leaves, nectar (pollen), egg(buyeyizat), movement, sleep. Fruit: Basic parts, formation and contents, classification, seed(entas), development from seed to fruit, content, classification of fruits in accordance with their fruits in three branches. Zatul filkateyn (magnoliopsida), vahidul filkateyn (monocotyledons), acalycine plants, classification of animals and plants	Structure and layers of the world, information on the geological structure of the world, heat center, heat source, formation of mountains, volcanoes and earthquakes, lava stone and sediment stone, layer forming earth's crust, organic rocks, porphry, basalt, slate, quartz, sand, grind stonei. Hard rocks, marble, stones, chalk, gypsum, flammable rocks, diamond, coal, petrol, combination of plant field. Health ruled to be obeyed in physical and mental works, health rules for schools, foods, beverages, housing sanitation, cleaning, baths, shortness of breath and preliminary precautions to be considered for hyperemia towards a certain point of body, smallpox vaccine, preliminary precautions required to be taken in case of contagious disease outbreak

Subjects of the course of Ilm-i hayvanat correspond to the ones in the curriculum of today's biology course to a large extent (Ministry of National Education, 2005). But there is not any subject title on the cell discovered by Robert Hooke in year 1665. It is observed that artificial classification is taken as a basis for the classification of creatures and that classification steps weren't formed on the basis of phylogenetic classification in the classification of animals. This shows that scientific developments and changes arising out weren't reflected very quickly in the curriculum programs.

Similar information is available in the course book titled as "Ilm-i nebatat" written by Dr. Esad Serafeddin in A.H.1329 to be instructed in the idadi schools (Doktor Esad Serafeddin, 1329).

Course of sciences and technology in the curriculum of the course of Ilm-i nebatat for sixth grade has similarities with the curriculum of Biology for 9th and 12th grade. It is seen

that phylogenetic classification is not taken as a basis for classification (Ministry of National Education, 2005).

Course of "fenn-i hıfz-us sıhhayı umumiye" (scientific general health care) was taught in the last grade of the idadi branch of Mekteb-i sultani which is one of the other important secondary education institution.

3. Higher Education

Courses of sciences and mathematics were given as conferences in the Darulfunun founded first in 1863. It was decreed in 1863 that hikmet-i tabiiyye (treatise on physics) is taught by Superintendent of the Imperial Mines in Darulfunun, Dervis Pasha and that existing equipments are transferred thereto, and then Dervis Pasha started to give training on 13rd January 1863. Course of chemistry was taught by Aziz Bey who had completed his edcuation in tıbbiye-i askeriye (Military School of Medicine) and is well-known with his work called as "Kimya-i tıbbi" (medical chemistry). Salih Efendi who had studied also in military school of medicine and is an expert in the courses of ilm-i mevalid started to give education on 16th February 1863 in Darulfunun (Mahmud Cevad, 2001, p. 209). But no branch was discriminated and a program was issued, where all students would receive the same courses in Darulfunun founded for the second time following the failure of the first intervention for the said formation in 1870. Courses of ilm-i hayvanat (zoological sceince), ilm-i nebatat (botanical science), heyet and hikmet-i tabiiyye (astronomy and physics) and ilmi tabakatul arz (geology) were stated to be instructed in the Ordinance of General Education (Maârif-i Umumiye Nizamnamesi). The said courses that we may call as Botanic, zoology and geology were planned to be taught individually. But because of the trouble in finding an instructor and a book, the said courses were taught under the name of ilm-i mevalid without making any discrimination for branch (Ishakoğlu, 1998, p. 322). Even though the courses of sciences were taught intensively in the first two grades in the third intervention in 1873, that intervention wasn't long-lived. Courses of sciences and education were agreed to be taught in the branch of ulum-i riyaziye (mathematical sciences) and tabiiye (biology) with three-year educational period in Darulfunun-ı Sahane (Imperial University) founded on September 1, 1990. Darulfunun was divided in five branches under the supervision of Emrullah Efendi in 1912, nebatat-ı umûmı (general botanics) and ilm-i arz (geology) and ilm-i maden (mining) were included by the courses of ulum-ı tabiye (Biological Sciences) (Ishakoğlu, 1995, p. 230-232). Courses of "ilm-i hayvanat" (zoological science), "ilm-i nebatat" (botanical science), and "ilm-i nebatat ve tabakatul arz" (Botanical Science and Geology) were taught 2 hours per week in the course program 1903-1904 in the department of sciences in the branch of sciences. (Ishakoğlu, 1995, p. 255).

Osman Ergin (1977) stated that courses in the branch of ulum-i riyaziye (mathematical sciences) and tabiiye (biology) are theoretical, they are followed through books and notes and there is no laboratory to allow any operation or experiment. He declared also that books aren't printed on colored papers appropriately (Ergin, 1977, p. 1223-1224).

In 1897 examinations of nazar-ı mebadi-i ilm-i hikmet-i tabiiyye (biology) , kimya-yı madeni (mining chemistry), and tarih-i tabiiden ilm-i hayvanat (zoology) and then hikmet-i tabiiyye (Biology), kimya-yı madeni (mining chemistry) uzvi ve sınai (Organic and Industrial), hayvanat (zoology), nebatat (botanic) and madeniyyat (mineralogy) were agreed to be done respectively in the second grade and the fourth grade for the students to be recruited in Mekteb-i Mulkiye (School of Political Science) (Mahmut Cevad, 2001, p. 164). Courses of hikmet-i tabiiyye (biology), kimya-yı madeni (mining chemistry) uzvi ve sınai (Organic and Industrial), ilm-i hayvanat (zoology) intended for farming and ilm-i nebatat intended for (agriculture) take place in the course program of the said year. (Mahmut Cevad, 2001, p. 170).

Course of ilm-i mevalid was agreed to be instructed in the Darulmuallimin schools founded in Istanbul in the Ordinance of General Education (Maârif-i Umumiye Nizamnamesi) (Article 55) in order to meet the need for teachers in the rusdiyye schools on March 16,1848. Course program of the branch of Mekatib-i Ali (college) of Darulmuallimin in 1880 includes ilm-i hayvanat (zoology), nebatat (botanic), hikmet-i tabiiyye (biology) and chemistry (Mahmud Cevad, 2001, p. 179).

Mekteb-i Maârif-i Adliyye (School for Learning) had been increased to three year and focused on governmental officer training since the years 1862-63 and then replaced by Mekteb-i Aklam and Mahrec-i Aklam respectively (Akyuz, 2011, p. 171). Courses of hikmet-i tabî'yye (biology) and chemistry are seen to have been taught in the third grade of the course program of Mahrec-i Aklâm (school for education of state officials) in 1875. But there is not any course related to the curriculum of biology and there is not also any course related to sciences in the course programs of Darulmuallimat (teacher's training school) (Mahmut Cevad, 2001, p. 142-143).

4. Biology Training in the Republic Period

Biology training was continued based on the translation of the books of foreign researchers until the era of the republic era (Tekeli and İlkin, 1999). Contemporary sciences education implemented since the foundation of republic was modified from times to times and affected by external developments (Yılmaz and Morgil, 1992). Turkish and foreign experts were taught in order to enrich the contents of programs as a result of the fundamental changes between 1923 and 1946. Program studies performed until 1950s were generally intended for primary education and studies to develop program in Turkey are performed by preparing the lists of courses and subjects (Ayas, Çepni & Akdeniz, 1993).

Developments in sciences and then biology are observed to have gained acceleration upon the scientific and technological developments affecting all stages of training. It became necessary to integrate new biology, physics, chemistry programs and to develop related instruction materials and this causes modern instruction techniques, methods and curriculums, sciences and scientific study methods to be included in the system. Developments in biology training and curriculum after the foundation of republic may be listed as follows:

*Many studies intended to develop the trainings on sciences and biology were completed successfully in parallel with the scientific development in 1950s (Gezer vd., 2003). TUBİTAK initiated its first studies on "Modern Biology Instruction Program" in 1959. Students were intended to participate more actively in the courses by the use of this program prepared within a short time. Thus classical biology instruction program until that time was improved and modernized. But implementation of program was ceased upon the withdrawal of its support from TUBİTAK on the projects of sciences (Yılmaz ve Soran, 1999).

*Foundation of Ankara science high school in 1964 is an important result of the effects of the activities developing the science instruction in the world in our country.

*Toing and foing on Project supports and coordinated works were experienced between Ministry of National Education and TUBITAK from 1950s to 1980s and the related collaboration has lost its function completely since 1980s. MEB couldn't receive enough support from universities and TUBITAK and this causes biology program not to be modernized enough in the years when new technological and scientific developments were experienced.

*Both the lack of well-trained teachers and the lack of course equipment and tools in biology training cause Ministry of National Education to make a revision in the contents of modern biology training on which modernization studies were performed in 1980s (Turgut, 1990).

*Ministry of National Education re-regulated the instruction of Biology course within a single book in 1985. Related program is as follows (MEB, 1985):

High School-Grade 1: Introduction to biology, what is science, diversity of creatures, populations, animal groups and communities, life unions, life in an animal cell, multi-cell organisms and tissues.

High School-Grade 2: Managing molecules and genetic code, reproduction and development, inheritance, handling systems, respiratory systems, digestive systems, urinary system, musculoskeletal system, endocrine systems, and neural system.

High School-Grade 3: Chemical energy and life, luminous energy and life, oxygen and life, managing molecules, generic code, reproduction, development, population genetics, transportation, respiration, musculoskeletal system, endocrine and neural system.

Biology course program wasn't renewed and only biology subjects for the course of advanced sciences were made detailed and appropriate for the hours of courses in the periods where passing grade and credit system are implemented (Yılmaz and Soran, 1999).

Units of biology course and distribution of the subjects taking place in the instruction program of the courses of Sciences and Technology are as follows (MEB, 2013):

Table 4. *Distribution of the Units and Subjects in the course programs of Sciences and Technology (MEB, 2013)*

Grade 4	**Grade 5**	**Grade 6**	**Grade 7**	**Grade 8**
UNITS	**UNITS**	**UNITS**	**UNITS**	**UNITS**
Unit 1:Let's solve the riddle of our body Creatures and Life	Unit 1: Let's solve the riddle of our body Creatures and Life	Unit 1: Systems in our body / Creatures and Life	Unit 1 :Systems in our body / Creatures and Life	Unit 1: Reproduction, Growing and Development of Human being / Creatures and Life
Recommended Subject Headings • Support and Movement • Breathing •Blood Circulation in Body •Let's exercise • Microscopic creatures and Our environment	Recommended Subject Headings • Nutrients and their properties • Digestion of nutrients •Urinary system in our body	Recommended Subject Headings •Cell •Support and movement system. •Respiratory System •Circulatory System	Recommended Subject Headings • Digestive System • Urinary System • Supervisory and regulatory systems • Sensorial Organs •Donation and transplantation of organs	Recommended Subject Headings • DNA and Genetic Code • Mitosis - Meiosis • Reproduction, Growing and Development of Human being • Adolescence and Health
Unit 6. Let's solve the riddle of our body / Creatures and Life	Unit 5: Let's know and travel around the world of creatures / Creatures and Life	Unit 5: Reproduction, Growing and Development of Animals / Creatures and Life	Unit 5: Human being and Environment	Unit 5: Relation between creatures and energy/ Creatures and Life
Recommended Subject Headings • Let's know the assets in our environment • The Environment where we live in •Living Spaces •Environment Pollution •Environment Protection	Recommended Subject Headings • Let's know the creatures • Relation between human being and environment	Recommended Subject •Plants and Reproduction, growth and development of plants	Recommended Subject Headings • Ecosystems • Biodiversity	Recommended Subject Headings • Energy Flux in food chain • Matter cycles • Sustainable Development • Biotechnology

Modifications were performed in the course program of biology upon the extension of high school period to four years. Grades and course programs were reshaped. Units and subjects are distributed as follows:

Table 5. *Instruction Program of Biology Course in 2013*

Grade 9	**Grade 10**	**Grade 11**	**Grade 12**
UNITS	**UNITS**	**UNITS**	**UNITS**
Life Science-Biology	**Reproduction**	**Energy Transformations in Creatures**	**From gene to protein**
.Nature of Scientific Information and Biology .Common Properties of Creatures . Basic Components in the structure of the creatures	.Mitosis and Asexual Reproduction .Meiosis and Sexual Reproduction .Growth and Development	. Liveliness and Energy . Photosynthesis . Chemosynthesis . Respiration	. Discovery and Significance of Nucleic Acids .Genetic code and protein synthesis
World of Creatures	General Principles of Heredity	Human Physiology	Plant Biology
. Basic Unit of Liveliness .Diversity and classification of creatures . World of Creatures and Their Properties	.Heredity and Biodiversity .Modern Genetic Applications	. Tissues .Nerves, hormones and homeostasis . Support and Movement System Blood Circulation Lymphatic Circulation . Respiratory System . Urinary System	.Structure of Plants .Growth Movement .Agent Transport in Plants . Sexual reproduction in plants
Actual Environmental Problems	Our World	Behavior	Community and Population Ecology
. Actual environmental problems and human being .Preservation of natural sources and biodiversity	.Ecosystem Ecology .Biomes	.Behavior	. Community Ecology .Population Ecology .Beginning of Live and Evolution

CONCLUSION and DISCUSSION

Courses of “Ma’lûmât-ı Tabiiye” (Natural Sciences), “Hıfz-us-sıhhat” (Protection of Health), “Ma’lûmât-ı Nafia” (Useful Information), “Elifba ve Sifahi Ma’lûmât” (Life Sciences) in Rusdiyye schools (Ottoman Junior High Schools), “Hikmet-i Tabiiyye” (A Treatise on Physics) or “Tarih-i Tabiiyye” (A science dealing with the evolution of animals, plants and the world), “Malumat-ı Fenniye ve Hıfz-us-sıhhat” (Protection of the Health), “Ilm-i Mevalid” (Science on Animals, Botanic and Plants) in Mekteb-i Sultani (Imperial High School) and Idadis (Imperial High Schools) giving education at the levels of high schools, courses like “Ilm-i Nebatat” (Botanical Science), Ilm-i Hayvanat (Animal Science) and “Tarih-i Ulûm-i Tabiiye” (History of Natural Sciences) in the branch of Ulûm-i Tabiiye (natural sciences) of Darulfunun (Ottoman University) are associated with the subjects within the current curriculums of Biology in the educational institutions within the modernization process of Ottoman Empire

Contemporary sciences were instructed first in militaristic schools, Hendesehane (Engineering School), Muhendishane-i Berri-i Humayun (Imperial School of Military Engineering) and Muhendishane-i Bahri-i Humayun (Imperial School of Naval Engineering). Subjects in the curriculums of biology are encountered in the courses of “Hıfz-us-sıhhat” (Sanitation), “Ma’lûmât-ı Tabiiye” (Natural Sciences), “Ma’lûmât-ı Nafia” (Useful Information), “Elifba ve Sifahi Ma’lûmât” (Life Sciences) in the course programs followed in the Rusdiyye schools which were founded following the said schools where theoretical information was taught. Information on physiological anatomy and health protection in the

rusdiyye schools for girls where microbes, waters, air and foods were discussed in the course of "Hıfz-us-sıhhat". Subjects like earth, stars, water, fire, residence, human body, trees, mines, agriculture, animals and human body, nutrition, health protection were taught as useful information respectively in the courses of "Ma'lûmât-ı Nafia" and "Elifba ve Sifahi Ma'lûmât". Subjects constituting the curriculum of biology cited in these courses are seen to be intended to offer the practical information used in daily life and not to go beyond the theoretical information.

Subjects of biology started to be stated as a discipline in the idadi schools and the name of course was called as ilm-i mevalid (science of nature). Assets, creatures and non-creatures, description and contents of zoology, difference between animals and plants, structure and texture of animals, classification of animals, organs of animals, digestive organs of animals, digestive organs of human beings, details and function of digestive organs in animal types, types of circulation system, respiratory system and its types, respiratory system, skeleton, muscles, nerves, five sensorial organs, significant and useful types of animals were stated briefly in the course of "Ilm-i Mevalid". Furthermore the structure, the texture, duties of the plants, scopes and duties, buds, hook and its function, flowers and respiratory organs, fruits, vegetables, nutrition of plants, absorption, respiration, proper nutrition and saliva, brief classification of plants, germination and reproduction, important and useful plants are stated to be described generally in the course of "Ilm-i Mevalid". Subjects like farming, seed planting, livestock, bees, birds etc. were discussed and classification of animals, segmentation of plants, layers of the world and mines, weather events and goods were tried to be taught in the course of Ma'lûmat-ı Fenniye ve Hıfz-us-sıhhat.

Actually it is observed that a confusion was experienced and subjects of biology were stated again and again under different names, in different subjects in the course of the determination of new programs in the modern schools founded in the period of Ottoman Empire. Change in the course programs and names of the courses for the years may be observed with the instabilities on which subject would be in which grade, in which course. This situation was tried to be removed but the problem about the curriculum of the courses was inherited to new republic upon the collapse of Ottoman Empire. Proclamation of the republic, innovations made and alphabet reform drew all attention towards primary school and especially literacy. Preparation of instruction programs were neglected for a long time.

Biology education in the republic eras based on the translation of foreign books until 1950s caused later and then studies on modern biology caused the course books of biology to be collected in a single book. Studies were continued to be performed through various projects between the Ministry of National Education and TUBİTAK until 1980s and were collected by MEB within a single book in 1985. Finally MEB reshape its curriculum of biology in 2005 and 2013. Many subject titles were found hereby to be common in the curriculum of biology from Tanzimat era to today.

Curriculum of the courses related to biology after Tanzimat reform in Ottoman Empire are seen to be close the curriculum of today. Today, curriculum of Hıfz-us-sıhhat is encountered in the programs for the courses of Sciences & Technology and Biology. The fact that the course subjects of Hıfz-us-sıhhat take place spirally every year in the subjects of Sciences and Technology and, Biology and Hygiene is a reflection of the constructivist training understanding. But it is seen that such approach has been reflected in the curriculum. As a result of current study, it is seen that biology curriculum in Ottoman Empire has been given as not an individual course but within an integrated understanding which includes the subjects like nature, agriculture, medicine and geology and information which should be known by a student in daily life during the modernization period of Ottoman Empire. Developments in biology were reflected even partially to curriculum but lack of supporting materials of the course, the fact that the courses were always given theoretically and not

supported by laboratory and equipment stand out as most important deficiencies. Subject of cell is one of the basic subjects of biology and almost half of the subjects in the curriculum of Biology is associated with cell. Developments going on until 1665 and continuing with the discovery of cell and especially the subject of cell were not seen to be cited enough and thus it gives the impression of a delay in following scientific developments.

One of the most important indicators of the delay in following the scientific developments is the fact that artificial classification is taken as a basis in the classification of creatures. For instance steps of classification are not seen to be made on the basis of phylogenetic classification in the classification of animals.

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Kavram Karikatürleri Destekli Probleme Dayalı Öğrenme Yönteminin Öğrencilerin Kavramsal Anlama Düzeyleri ile Problem Çözme Becerisi Algıları Üzerine Etkisi[1]

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ÖZET

Araştırmanın amacı fen bilimleri öğretiminde probleme dayalı öğrenme içerisinde kavram karikatürü kullanımının öğrencilerin kavramsal anlama düzeyleri ile problem çözme becerisi algıları düzeylerine etkisini belirlemektir. Bu amaç doğrultusunda denkleştirilmemiş-eşitlenmemiş ön test-son test kontrol gruplu yarı deneysel desen kullanılmıştır. Araştırmanın çalışma grubunu İzmir'in merkez ilçelerinde yer alan 9 okuldan seçilen toplam 27 sınıfta öğrenim gören 553 altıncı sınıf öğrencisi oluşturmaktadır. Deney gruplarından birinde dersler kavram karikatürü destekli probleme dayalı öğrenme yöntemiyle (Deney 1), diğerinde sadece probleme dayalı öğrenme yöntemiyle (Deney 2) ve kontrol grubunda ise dersler sadece Fen ve Teknoloji Öğretim Program içeriği ve etkinlikleriyle işlenmiştir. Deneysel uygulama 16 ders saati sürmüştür. Verilerin toplanmasında problem çözme beceri algı ölçeği ve kavramsal anlama testi kullanılmıştır. Kavramsal anlama düzeyi açısından probleme dayalı öğrenme ile kavram karikatürlerinin birlikte kullanıldığı deney grubu ile (Deney 1) kontrol grubu arasında anlamlı bir farklılık görülmüştür. Bunun yanı sıra sadece probleme dayalı öğrenmenin uygulandığı deney grubu ile (Deney 2) kontrol grubu arasında deney grubu lehine anlamlı bir farklılığın olmadığı belirlenmiştir. Ayrıca problem çözme becerisi açısından probleme dayalı öğrenme ile kavram karikatürlerinin birlikte kullanıldığı deney grubu ile (Deney 1) kontrol grubu arasında ve sadece probleme dayalı öğrenmenin uygulandığı deney grubu (Deney 2) ile kontrol grubu arasında deney grupları lehine anlamlı bir farklılık olduğu sonucuna ulaşılmıştır. Deney gruplarının kendi arasında karşılaştırılması sonucunda ise son test problem çözme becerileri açısından anlamlı bir farklılık olmadığı, son test kavramsal anlama test puanları açısından probleme dayalı öğrenme ile kavram karikatürlerinin birlikte kullanıldığı deney grubu (Deney 1) lehine anlamlı bir farklılığın olduğu belirlenmiştir.

Anahtar Kelimeler: Kavram Karikatürü; Probleme Dayalı Öğrenme; Kavramsal Anlama; Problem Çözme Becerisi Algıları

[1]Bu makale TÜBİTAK tarafından desteklenen 1001/110K574 Nolu Sosyal Bilimler araştırma projesinin bir bölümünden hazırlanmıştır.

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GİRİŞ

Gelişen teknolojiyle birlikte fen bilimlerinin etkilerini ve izlerini hayatın her aşamasında görmek mümkündür. Toplumların geleceği açısından fen eğitimi anahtar bir rol oynamaktadır (İşman, Baytekin, Balkan, Horzum ve Kıyıcı, 2002). Bu nedenle bilim ve teknolojide ilerlemek, teknolojinin getirdiği yenilikleri gerektiği gibi kullanabilmek için bilgi üreten, sorgulayan, eleştiren, karşılaştığı problemleri çözebilen, fen okuryazarı olan nitelikli bireylerin yetiştirilmesine ülkeler ihtiyaç duymaktadırlar. Söz konusu nitelikli bireylerin yetiştirilmesinde eğitim ve öğretim sürecinin önemli bir bileşen olduğu düşünülmektedir. Köseoğlu & Kavak (2001)'a göre karşılaştığı olayları araştıran, fikirleri inceleyen, üretken bireyler yetiştirebilmek için fen öğretiminin gerekliliği ve önemi bilinmektedir. Bu nedenle özellikle bilim ve teknolojideki gelişmeler göz önüne alınarak fen eğitiminin etkililiği ve önemi üzerinde birçok araştırma yapılmakta ve öğrenme sürecinin öğrencilerin duyuşsal, bilişsel ve psikomotor becerisinin gelişim düzeyleri üzerindeki etkilerini belirlemeye yönelik çalışmalar gerçekleştirilmektedir. Ayrıca ülkeler eğitim-öğretim süreçlerini değerlendirerek ve diğer ülkelerle var olan durumlarını karşılaştırarak eğitim-öğretim süreçlerindeki eksikliklerini ve hatalarını belirlemekte, böylece elde edilen verilere dayanarak eğitim-öğretim sürecinde gerekli düzenlemeler yapmaktadırlar.

TIMSS 1999 ve PISA 2003 çalışmasından sonra ülkemizde öğretim programlarının geliştirilmesine yönelik gerçekleştirilen araştırmalar artmıştır. PISA 2006 sonuçlar ise öğretim programlarında değişimin gerekliliğini ortaya koymaktadır. Bu nedenle ülkemizde Fen Bilgisi Öğretim Programı, öğrencilerin günlük yaşamda karşılaştığı olaylardan yola çıkarak sorgulama, araştırma, eleştirme gibi becerisini kullanmalarıyla bilgiye ulaşmaların ve var olan bilgileriyle sınıf ortamında öğrendikleri bilgileri ilişkilendirmelerini amaçlayan yapılandırmacı yaklaşımı temele alan Fen ve Teknoloji Öğretim Programı olarak değiştirilmiştir.

Öğrencilerin var olan bilgi yapıları ile edindikleri yeni bilgiler arasında kavramsal ilişkilerin yapılandırıldığı bu aktif süreç, aynı zamanda anlamlı ve kalıcı öğrenmenin gerçekleşmesine yardımcı olmaktadır (Hsu, 2004). Söz konusu öğrenme ortamlarında öğrencilerin araştırma, sorgulama, eleştirel ve yaratıcı düşünme gibi üst düzey becerisini kullanarak sosyal ortamlarda bilgiye kendilerinin ulaşması etkili öğrenmenin gerçekleşmesinde önemli bir rol oynamaktadır. Bu nedenle öğrencilerin söz konusu becerisi kullanmalarını ve böylece bu becerisini geliştirmelerini sağlayacak, onların öğrenme sürecinde aktif olmalarına olanak tanıyacak öğrenme ortamlarının oluşturulması büyük önem taşımaktadır. Bu sürecin sonunda uygulanan PISA 2012 fen performansındaki yıllık artış incelendiğinde 2006 - 2012 yılları arasında, Türkiye'nin istatistiksel olarak anlamlı bir artış gösterdiği gözlenmekle birlikte, fen bilimlerindeki başarısının katılımcı diğer ülkelerle kıyaslandığında üst seviyelerde yer almadığı görülmektedir (Milli Eğitim Bakanlığı, 2013a).

Zorunlu eğitimin 12 yıla çıkaran kanunla eğitim sisteminde başlayan yeni dönemin doğal sonucu olarak 2013 Fen Bilimleri Öğretim Programı geliştirilmiştir. Söz konusu 2013 Öğretim Programı öğrenenlerin, araştıran-sorgulayan, etkili kararlar verebilen, problem çözebilen, kendine güvenen, işbirliğine açık, etkili iletişim kurabilen, sürdürülebilir kalkınma bilinciyle yaşam boyu öğrenen fen okuryazarı bireyler; fen bilimlerine ilişkin bilgi, beceri, olumlu tutum, algı ve değere; fen bilimlerinin teknoloji toplum-çevre ile olan ilişkisine yönelik anlayışa ve psikomotor becerilere sahip bireyler olmalarını hedeflemektedir (Milli Eğitim Bakanlığı, 2013b). Bu bağlamda ülkemizde 2005 Fen ve Teknoloji Öğretim Programının yapılandırmacı yaklaşımın, 2013 Fen Bilimleri Öğretim Programının araştırma sorgulamaya dayalı öğrenme yaklaşımın temelinde düzenlenmesiyle öğrenen merkezli öğrenme ortamlarının oluşturulmasına olanak sağlayan yöntem ve teknikler gündeme gelmiştir.

Günümüzde işbirlikli öğrenme, proje tabanlı öğrenme, kavram karikatürleri, kavram haritaları, zihin haritaları gibi çeşitli yöntem ve teknikler araştırma sorgulamaya dayalı öğrenme yaklaşımı olarak kullanılmakta ve söz konusu yöntem ve tekniklerin farklı özelliklerine yönelik araştırmalar gerçekleştirilmektedir (Pekmez & Balım, 2003; Bozdoğan, Taşdemir & Demirbaş, 2006; Balım, İnel & Evrekli, 2008; Evrekli, Balım & İnel, 2009; Çıbık, 2009). Öğrenenlerin araştırmasına ve sorgulamasına olanak tanıyacak yöntemlerden biri de probleme dayalı öğrenme yöntemidir. Probleme dayalı öğrenme, öğrencilerin işbirlikli ortamlarda var olan bilgileri ve araştırmaları sonucunda edindikleri bilgileri kullanarak günlük hayattan bir probleme ilişkin çözüm yolları geliştirdikleri bir öğrenme yöntemidir.

Probleme Dayalı Öğrenme

Genel olarak probleme dayalı öğrenmenin amacı, öğrencilerin problem çözme becerisini geliştirmek, onlara etkili işbirliğini öğretmek ve başarılı yaşam boyu öğrenen bireyler olmaları için gerekli becerisi kazandırmaktır (Beringer, 2007).

Probleme dayalı öğrenme (PDÖ), öğrencilerin gerçek yaşam problemlerinden yola çıkarak öğrenme alanlarıyla ilgili temel kavramları edinirken aynı zamanda eleştirel düşünme ve problem çözme gibi üst düzey düşünme becerisini kullanmalarını, geliştirmelerini ve iyi iletişim becerilerine sahip olmayı sağlayan ortamlar oluşturan bir öğrenme yöntemidir (Alper, 2008; Iglesias, 2002; Kindler Grant, Kulla, Poole & Godolphin, 2009). Probleme dayalı öğrenme yönteminde senaryolarda yer alan problemler üzerinde öğrenciler 5-12 kişilik küçük gruplarda çalışmaktadırlar (Berkel & Schmidt, 2000). Probleme dayalı öğrenme ortamlarında problemle ilgili bilgilerin elde edilmesiyle ve öğrencilerin problem çözme becerisini kullanmalarıyla senaryolarda yer alan problemlerin analizi gerçekleştirilmektedir. Bu süreçte öğrenciler hem yeni bilgileri öğrenmekte hem de bu bilgileri problemin çözümünde kullanmaktadırlar (Arts, Gijselaers & Segers, 2002; Berkel & Schmidt, 2000). Oturumlar şeklinde yürütülen bu süreç öğrenenleri öğrenme ihtiyacı duymaya teşvik etmek için dikkatlice tasarlanmalıdır. Böylece öğrenciler problemi çözmek için yeni bilgileri edinme ihtiyacı duymaktadırlar (Shepherd & Cosgriff, 1998).

Evrekli, İnel & Çite (2006) fen derslerinde tartışma ortamlarının oluşturulmasının, öğrencileri keşfetmeye teşvik etmek ve öğrencilerin bilgilerini sosyal ortamlar içerisinde tartışarak yapılandırmasını sağlamak için gerekli olduğunu belirtmektedir. Bu amaç doğrultusunda kullanılabilecek görsel araçlardan biri de kavram karikatürleridir. Bu bağlamda fen derslerinde kavram karikatürü kullanımının, öğrencilerin dikkatlerini derse yoğunlaştırarak eğlenceli, görsel ve görüşlerini tartışabilecekleri öğrenme ve bilgiyi yapılandırma ortamları yaratabileceği düşünülmektedir (Balım, İnel & Evrekli, 2008). Kavram karikatürleri fen alanında yapılandırmacı yaklaşıma ilişkin öğrenmeye dayalı olarak yenilikçi bir öğrenme ve öğretme stratejisi olarak geliştirilmiştir (De Lange, 2009).

Kavram Karikatürleri

Karikatürler genel anlamda sembolleri ve resimleri kullanarak aktarmak istedikleri mesajları aktaran ve insan duygularını etkileyen önemli bir görsel dili temsil eden sanat formudur. Özellikle fen öğretiminde karikatürlerin öneminin son yıllarda farkına varılmıştır (Dalacosta, Kamariotaki-Papparrigopoulou, Palyvos & Spyrellis, 2009). Karikatürler eğitimsel amaçlarla birçok farklı yolla kullanılmaktadır. Roesky & Kennepohl (2008)'a göre öğrenmeyi ve katılımı arttırmada etkili olarak kullanılan bir diğer önemli karikatür türü kavram karikatürleridir. Kavram karikatürleri genel olarak çoğu karikatürde olduğu gibi mizah ya da taşlama amacıyla kullanılmamaktadır (Keogh & Naylor, 1999; Şengül & Üner, 2010). Kavram karikatürleri komik özellikler taşımamaktadır ve bununla birlikte öğrencileri düşünmeye teşvik etmek ve tartışmayı arttırmak için düzenlenmiştir (Webb, Williams & Meiring, 2008). Martinez (2004)'e göre kavram karikatürleri öğrencilere eğlenceli ve görsel

ortamlarda kavram ve bilgilere ulaşmasını sağlayan ve çeşitli durumlarda karşılaştığımız olaylara ilişkin bilimsel bakış açılarını içeren araçlardır.

Balım, İnel & Evrekli (2008)'ye göre kavram karikatürleri öğrencilerin öğrenme ortamlarına katılımlarını sağlayan ve sınıf içinde bir tartışmaya katılımı sağlamak için kullanılabilen çizimler ve görsel araçlardır. Öğrencilerin kavram karikatüründe yer alan tartışmayı çözmek için gereksinimleri olduğunun farkına vardığında bilimsel sorgulamanın bir yönü olarak tartışmanın süreçle bütünleştirilmesi için öğrenciler tartışmaları sonucunda sonraki sorgulamalara katılmak için davet edilmektedirler (Keogh, Naylor & Downing, 2003; Naylor, Keogh & Downing, 2007).

Korkmaz (2004) kavram karikatürlerinin tartışmanın yanı sıra küçük sınıflarda kavramsal öğrenmeyi kolaylaştırmak, öğrencilerin ön kavramlarını ortaya çıkarmak ve ne öğrendiklerini belirlemek için kullanılabileceğini belirtmektedir. Kavram karikatürleriyle birlikte yanılgıların çizgi karakterlerle kişiselleştirilmesi, öğrencilerin öğretim öncesindeki sahip oldukları düşünce biçimlerinin ortaya çıkarılması ve var olan yanılgıların giderilebilmesini mümkün kılmaktadır (Saka, Akdeniz, Bayrak & Asilsoy, 2006). Bu nedenle kavram karikatürleri öğretmenlerin fen eğitiminde kavramsal değişim oluşturmaları amacıyla kullanılabilecek bir eğitimsel araçtır (De Lange, 2009). Bu nedenle öğrencilerin hem günlük yaşama ilişkin problemleri çözmelerini hem de derse aktif katılımlarını sağlamak için kavram karikatürleri kullanılabilmektedir (Balım, İnel & Evrekli, 2008).

İlgili alan yazın incelendiğinde probleme dayalı öğrenme ya da kavram karikatürü kullanımının farklı değişkenlere etkisini inceleyen çalışmalara rastlanmakla birlikte probleme dayalı öğrenme içerisinde kavram karikatürü kullanımının öğrencilerin kavramsal anlama düzeylerine etkisini inceleyen çalışmaya rastlanamamış, problem çözme becerisi algıları üzerine etkisini inceleyen sınırlı sayıda çalışmaya rastlanmış olması nedeniyle söz konusu araştırma yapılmıştır.

Araştırmanın amacı fen bilimleri öğretiminde probleme dayalı öğrenme içerisinde kavram karikatürü kullanımının öğrencilerin kavramsal anlama düzeyleri ile problem çözme becerisi algıları düzeylerine etkisini belirlemektir.

YÖNTEM

a) Çalışmanın Yöntemi

Çalışmada probleme dayalı öğrenme içerisinde kavram karikatürleri kullanımının etkililiğinin belirlenmesi amacıyla, denkleştirilmemiş-eşitlenmemiş ön test-son test kontrol gruplu yarı deneysel desen kullanılmıştır (Bulduk, 2003; Christensen, 2004; Marczyk, DeMatteo & Festinger, 2005; Cohen, Manion & Morrison, 2005; Balcı, 2005; Karasar, 2006). Muijs (2004) ve Wiersma (2000)' e göre deneysel ve yarı deneysel araştırmalar arasındaki temel farklılık, bireylerin gruplara atanmasında görülmektedir. Bir deneysel araştırmanın iç geçerliliğinin sağlanmasındaki en iyi yol bireylerin rastgele seçimi olmasına karşın, gerçek yaşam ortamlarında bunu gerçekleştirmek çoğu zaman mümkün değildir. Bu yüzden rastgele seçimin uygulandığı desenlerde, araştırmacılar yarı deneysel desenden yararlanmalıdır (Marczyk, DeMatteo & Festinger, 2005). Temel olarak yarı deneysel çalışmalar, bir laboratuar ortamından ziyade gerçek hayat içerisinde gerçekleşen çalışmalar olarak yorumlanabilir (Vanderstoep & Johnston, 2009). Bu nedenle genellikle eğitimsel araştırmalarda araştırmacıların gerçek deneysel uygulamalar gerçekleştirmeleri oldukça güçtür (Cohen, Manion & Morrison, 2005).

b) Araştırmanın Problem Cümlesi ve Alt Problemleri

Araştırmanın problem cümlesi "Fen bilimleri öğretiminde probleme dayalı öğrenme içerisinde kavram karikatürü kullanımının öğrencilerin kavramsal anlama düzeyleri ile problem çözme becerisi algıları düzeylerine etkisi nedir?" olarak belirlenmiştir.

Araştırmanın alt problemleri şu şekildedir:

1. Probleme dayalı öğrenme içerisinde kavram karikatürlerinin kullanıldığı deney grubu (Deney 1), sadece problem dayalı öğrenmenin kullanıldığı deney grubu (Deney 2) ve sadece fen bilimleri öğretim programına dayalı etkinliklerin kullanıldığı kontrol grubunda yer alan öğrencilerin son test kavramsal anlama düzeyleri arasında anlamlı bir farklılık var mıdır?
2. Probleme dayalı öğrenme içerisinde kavram karikatürlerinin kullanıldığı deney grubu (Deney 1), sadece problem dayalı öğrenmenin kullanıldığı deney grubu (Deney 2) ve sadece fen bilimleri öğretim programına dayalı etkinliklerin kullanıldığı kontrol grubunda yer alan öğrencilerin son test problem çözme becerisi algıları arasında anlamlı bir farklılık var mıdır?

c) Çalışma Grubu

Araştırma kapsamında gerçekleştirilen çalışma yarı deneysel özellikte olduğundan dolayı evren örneklem seçimine gidilmemiş bunun yerine çalışma grubu alınmıştır. Araştırmanın çalışma grubunu İzmir'in merkez ilçelerinde yer alan 9 okuldan seçilen toplam 27 sınıfta öğrenim gören altıncı sınıf öğrencileri oluşturmaktadır. Araştırmaya katılan öğrencilerin (n=553); %47,6'sı (n=263) erkek, %52,4'ü (n=290) kız öğrencilerden oluşmaktadır. Katılımcıların %32'si (n=177) probleme dayalı öğrenme içerisinde kavram karikatürleri ile %33,8'i (n=187) sadece probleme dayalı öğrenme yöntemiyle ve %34,2'si (n=189) sadece fen bilimleri öğretim programı ile öğrenim görmüşlerdir.

d) Araştırmanın Bağımlı ve Bağımsız Değişkenleri

Bağımlı ve bağımsız değişkenlerin özellikleri dikkate alınarak bu araştırmanın bağımsız değişkenleri öğretim yöntemleri olan kavram karikatürleri destekli probleme dayalı öğrenme yöntemi ve sadece probleme dayalı öğrenme yöntemi olarak belirlenmiştir. Araştırmanın bağımlı değişkenleri ise öğrencilerin kavramsal anlama düzeyleri ve problem çözme becerisidir.

e) Deneysel İşlem Yolu

Araştırma kapsamında 9 okulda, her birinde 2 deney ve 1 kontrol grubu olmak üzere toplam 27 sınıf belirlenmiştir. Deney gruplarından birinde dersler kavram karikatürü destekli probleme dayalı öğrenme yöntemiyle (Deney 1), diğerinde sadece probleme dayalı öğrenme yöntemiyle (Deney 2) ve kontrol grubunda ise dersler sadece Fen ve Teknoloji Öğretim Program içeriği ve etkinlikleriyle işlenmiştir. Deney gruplarından birinde fen bilimleri öğretiminin gerçekleştirilmesinde kazanımlara uygun şekilde hazırlanan senaryoların ve senaryolardaki olaylara ilişkin kavram karikatürlerinin yer aldığı probleme dayalı öğrenme modülleri kullanılmıştır. Örnek senaryo EK-1'de sunulmuştur. Diğer deney grubunda ise dersler aynı probleme dayalı öğrenme modülleri kavram karikatürleri olmadan işlenmiştir. Kontrol grubunda ise sadece Fen ve Teknoloji Öğretim Programında yer alan etkinlik ve uygulamalarla öğretim gerçekleştirilmiştir. Çalışma Fen Bilimleri dersi altıncı sınıf Madde ve Isı ünitesinde işlenmiştir. Deney gruplarındaki etkinlikler öğretim programında yer alan kazanımlara uygun olarak düzenlenmiştir. Söz konusu gruplar için hazırlanan dört modül ünitenin programda belirtilen 16 ders saati kapsamına uygun olarak hazırlanmış olup her bir modül için bir haftalık (4 ders saat) süre ayrılmıştır. Araştırmanın gerçekleştirildiği her bir

okulda belirlenen iki deney ve bir kontrol grubundaki uygulamalar dersin öğretmeni tarafından yürütülmüştür. Uygulamayı gerçekleştiren öğretmenlere deneysel uygulama öncesinde çalıştay düzenlenmiştir. Bu çalıştayda toplam 16 saat kuramsal bilgi ve uygulamalara yer verilmiştir. İki gün süren çalıştayın birinci gününde yapılandırmacı kuram, probleme dayalı öğrenme, kavram karikatürleriyle ilgili kuramsal bilgiler verilmiş; ikinci gününde Öğretim Programının tanıtımı yapılmış ve çalışma kapsamında uygulamaya dahil edilen 6. Sınıf "Madde ve Isı" ünitesine ilişkin kazanımlar ve etkinlikler incelenmiş, çalışma kapsamında hazırlanan Kavram Karikatürü Destekli Probleme Dayalı Öğrenmeye (Deney 1) ve sadece Probleme Dayalı Öğrenmeye (Deney 2) yönelik ders planları, modüller ve etkinlikler sunulmuştur.

Deney gruplarındaki uygulamalarda yer alan modüller üzerinde öğrencilerin gerekli araştırmalar yapabilmeleri için bir hafta önceden dağıtılmıştır. Modüller üzerinde gerekli araştırmalar yaparak sınıfa gelen öğrencilerden öncelikle modüllerin içeriğinde yer alan senaryolara ilişkin olarak sorunu belirlemeleri beklenmiştir. Sonrasında kavram karikatürü destekli probleme dayalı öğrenme modülleriyle öğrenim gören öğrenciler kavram karikatürlerindeki görüşleri de göz önüne alarak akranlarıyla farklı çözüm yolları üzerinde düşünürlerken, sadece probleme dayalı öğrenme yönteminin uygulandığı deney grubunda ise öğrenciler probleme ilişkin akranlarıyla görüşlerini kavram karikatürü olmadan paylaşmışlardır. Sonrasında öğrencilerden, sorunun çözümüne yönelik gerçekleştirmiş oldukları araştırmalar ve sınıf içinde grup arkadaşları ile yaptıkları etkinliklerle senaryoda yer alan soruna ilişkin çözüm yolları üretmeleri beklenmiştir.

Deney gruplarında yer alan öğrenciler ayrıca her hafta modül sonunda kendilerini ve grup çalışmasını gerçekleştirdikleri akranlarını değerlendirmişlerdir.

Kontrol grubundaki uygulamalar ise öğretim programına uygun olarak "Maddenin tanecikli yapısı ve ısı" konusu 4, "Isının yayılma yolları" konusu 8 ders saati, "Isı yalıtımı" konusu 4 ders saati olmak üzere toplam 16 ders saati süresince yürütülmüştür. Dersler yürütülürken Öğretim Programındaki kazanımlara uygun olarak düzenlenen ders kitabı içeriği ve etkinlikleri temel alınmıştır. Deneysel uygulama öncesinde ve sonrasında kontrol ve deney gruplarındaki öğrencilere. "Problem Çözme Becerisi Algı Ölçeği" ve "Kavramsal Anlama Testi" ön test ve son test olarak uygulanmıştır.

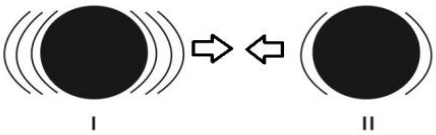
f) Veri toplama araçlarının hazırlanması ve geliştirilmesi

Kavramsal Anlama Testi: Çalışma kapsamında uygulamanın gerçekleştirildiği okullardaki deney ve kontrol gruplarında yer alan öğrencilerin kavramsal anlamalarındaki değişimin belirlenmesi ve değerlendirilmesi amacıyla 6. sınıf "Madde ve Isı" ünitesine ilişkin kavramsal anlama testi geliştirilmiştir. Testin geliştirilme aşamasında öncelikle ünite kapsamında yer alan kazanımlar belirlenmiş ve ünite kapsamında yer alan konulara ilişkin kavram analizi gerçekleştirilmiştir. Testin ilk hali araştırmacılar tarafından oluşturulan 14 maddeden oluşmuştur. Ancak çalışma sürecinde söz konusu madde sayısının ve içeriğinin yetersiz olduğu düşünülerek testin içeriğinde ve kapsamında yeniden düzenlemeler gerçekleştirilmiştir. Bu düzenleme sonucunda testteki madde sayısı 21'e yükseltilmiş ve kavram analizi tablosu yeniden gözden geçirilmiştir. Kavramsal anlama testi iki aşamalı çoktan seçmeli teşhis testi şeklinde düzenlenmiştir. Bu testin ilk kısmında öğrencilerin soruya ilişkin doğru olduğunu düşündükleri yanıtı işaretlemeleri, ikinci kısımda ise söz konusu seçeneği işaretleme nedenini açık bir şekilde ifade etmeleri beklenmiştir.

Testin geçerlilik ve güvenilirlik sürecinde öncelikle soruların öğrenciler tarafından açık bir şekilde anlaşılıp anlaşılmadığının belirlenmesi için deneysel uygulamanın gerçekleştirildiği okullardan farklı bir okulda yer alan öğrencilerin testi yanıtlamaları (n=35) ve sorun olan yerleri belirtmeleri istenmiştir. Testin kapsam ve görünüş geçerliliğinin belirlenmesi amacıyla alanında uzman üç öğretim üyesi ile bir fen bilimleri öğretmeninin

görüşlerine başvurulmuştur. Uzmanlardan testte yer alan maddeleri bilimsel bilgi içeriğine uygunluk, ilgili kavram ve kazanıma uygunluk, dil-yazım-anlatım kurallarına uygunluk bakımından incelemeleri istenmiştir. Uzmanların incelemeleri doğrultusunda testte gereken düzenlemeler yapılmış ve testten yine uzman görüşleri doğrultusunda dört madde çıkarılmıştır. Kavramsal anlama testinin son hali 17 sorudan oluşmaktadır. Uzmanların görüşlerindeki tutarlılığın belirlenmesi amacıyla Miles & Huberman (1994) tarafından önerilen uyuşum yüzdesi hesaplaması kullanılmıştır. Hesaplamalara göre uzmanların uyuşum değerleri "soru kalıbının bilimsel bilgi içeriğine uygunluğu", "soru kalıbının ilgili kavram ve kazanımlara uygunluğu" ve "soru kalıbının dil-yazım-anlatım kurallarına uygunluğu" kısımlarının her biri için .90 olarak bulunmuştur. Kavramsal anlama testine ilişkin örnek sorulara aşağıda yer verilmiştir:

1.Aşağıdaki şekilde verilen iki farklı hızda hareket eden aynı maddeye ilişkin I ve II numaralı taneciklerin çarpıştıktan sonraki hareketleri ile ilgili olarak;



(daha hızlı) I II (daha yavaş**)**

I taneciği; ( ) hızlanır ( ) yavaşlar ( ) değişmez ( ) bilmiyorum

Nedeni…….....

.....

II taneciği; ( ) hızlanır ( ) yavaşlar ( ) değişmez ( ) bilmiyorum

edeni…….....

.....

2. Ali ile Ahmet oda sıcaklığında gerçekleştirdikleri deneylerinde yün kumaşa sarılı buz ile açıkta bırakılan buzun erime süreleri üzerine kendi aralarında tartışıyorlar. Sizce hangi buz kalıpları daha önce eriyecektir?

buz

yüne sarılı buz

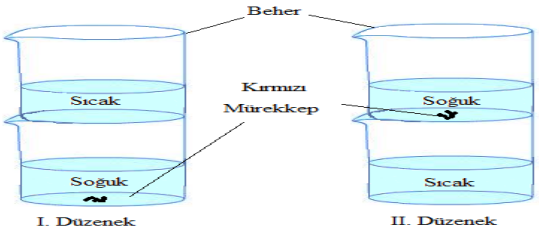
( ) Açıkta bırakılan buz kalıpları ( ) Yüne sarılı buz kalıpları

( ) Bilmiyorum

Nedeni……

……

3. Ali aşağıdaki deney düzeneklerini hazırlayarak sıcak su yardımıyla soğuk suyun ısınmasını sağlamaya çalışmaktadır. Bunu gözlemlemek için ise soğuk suyun içerisine bir damla kırmızı mürekkep damlatır.



Buna göre hangi şekilde kırmızı mürekkep soğuk suyun içerisinde daha hızlı yayılır?

I. düzenekte ( ) II. düzenekte ( ) Bilmiyorum ( )

Nedeni……

……

Kavramsal anlama testinin puanlanmasında Abraham, Williamsan ve Westbrook (1994) tarafından önerilen beşli puanlama sistemi kullanılmıştır. Bu puanlama sistemi şu şekildedir:

4- Tam anlama: bilimsel olarak kabul edilen kavramların tüm kısımlarını içeren cevaplar
3- Kısmen anlama: Bilimsel olarak kabul edilen kavramların bir kısmını içeren cevaplar
2- Kısmen anlama ve kavram yanılgısı: kavramsal anlama ile birlikte bir kavram yanılgısı içeren cevaplar / sadece örnek verilmesi-kavrama ilişkin sınırlı açıklamalar
1- Kavram yanılgısı: bilimsel olarak yanlış olan cevaplar
0- Anlamama: boş cevap, soruyu tekrar etme, ilgisiz ya da açık olmayan cevap, açıklama yok

Kavramsal anlama testine ilişkin değerlendirmeler araştırmada görev alan uzmanlar tarafından gerçekleştirilmiştir. Çalışma grubundan 9 okulun her biri için verilerin değerlendirilmesinde bir uzman görevlendirilmiştir. Bu uzmanların (n=9) değerlendirme süreçlerinin tutarlılığını belirlemek için 30 adet kavramsal anlama testi uyuşum analizleri için kullanılmıştır. Uzmanlar birbirinden habersiz ve bağımsız olarak bu testleri değerlendirmiştir. Bu verilere göre uzmanların test uyuşumları sürekli değişkenler için kullanılan küme içi korelasyon analizi ile hesaplanmıştır. Test için uzmanların küme içi korelasyon uyuşum değeri .86; pearson korelasyon değeri ise .96 olarak belirlenmiştir.

Problem Çözme Becerisi Algı Ölçeği: Araştırma kapsamında bağımsız değişkenin öğrencilerin problem çözme beceri algılarındaki etkisinin gözlemlenebilmesi için İnel Ekici & Balım (2013) tarafından geliştirilen problem çözme becerisi algı ölçeği kullanılmıştır. Araştırmacılar tarafından ölçeğin geliştirme çalışmaları 9 ilköğretim okulunda öğrenim görmekte olan 6., 7. ve 8. sınıf öğrencileri üzerinde gerçekleştirilmiştir. Uygulamaya 850 öğrenci katılmıştır. Açımlayıcı faktör analizi sonucunda ölçeğin iki faktör altında toplandığına karar verilmiştir. Elde edilen sonuçlar doğrultusunda belirlenen iki faktörlü yapının doğrulayıcı faktör analizi ile doğrulandığı sonucuna ulaşmışlardır. Ölçeğin geliştirilen son şeklinde yer alan 22 maddenin madde toplam korelasyonları .44 ile .63 arasında değiştiği, ölçeğin Cronbach alpha güvenirliği ise .88 olarak belirlenmiştir.

Çalışma uygulamalarının yapıldığı okullardan elde edilen verilere göre problem çözme becerisi algı ölçeğinin tamamına ilişkin Cronbach alpha güvenirliği tekrar hesaplanmış ve ön test-son test ölçümlerinin her ikisi için de .89 olarak hesaplanmıştır.

g) Araştırmada Kullanılan İstatistiksel Yöntemler

Araştırma kapsamında ele alınan alt problemlerin çözümü doğrultusunda nicel verilere ilişkin analizlerde, gruplardaki veri sayısı ve normal dağılıma uygunluk göstergeleri incelenerek parametrik istatistiksel tekniklerden MANCOVA (çok değişkenli kovaryans analizi) kullanılmıştır. Yapılan analize göre ön test ölçümleri kontrol altına alınarak son test ölçümleri değerlendirilmiştir.

BULGULAR

Çalışmanın bu bölümünde "Fen bilimleri öğretiminde probleme dayalı öğrenme içerisinde kavram karikatürü kullanımının öğrencilerin kavramsal anlamalarına ve problem çözme beceri algılarına etkisi nedir?" temel problem cümlesinin çözümüne ilişkin bulgulara ve bulgulara yönelik yorumlara yer verilmiştir. Araştırmadan elde edilen nicel bulguların analizinde verilerin yeterli sayıda olması (n=553) ve incelenen dağılım ile histogram grafiklerinde verilerin normal dağılıma benzer özellik göstermesi nedeniyle parametrik istatistiksel teknikler tercih edilmiştir. Araştırmadan elde edilen nicel bulgulara ilişkin betimsel verilere Tablo 1'de yer verilmiştir.

Tablo 1. *Araştırmadan Elde Edilen Nicel Bulgulara İlişkin Betimsel Veriler*

Bağımlı Değiş.	Deney 1 grubu* (*n* = 177)				Deney 2 grubu* (*n* = 187)				Kontrol grubu (n=189)			
	Öntest		Sontest		Öntest		Sontest		Öntest		Sontest	
	Ort.	SS.	Ort.	SS.	Ort.	SS.	Ort.	SS.	Ort.	SS.	Ort.	SS.
PÇ*	93,16	12,74	96,63	11,39	92,82	12,13	95,17	12,17	91,89	10,91	92,84	10,80
KA*	17,12	9,23	36,64	18,53	16,41	11,16	31,39	17,47	14,27	9,64	29,52	17,71

* Deney 1=Probleme Dayalı Öğrenme ile Kavram Karikatürleri Uygulamaları, Deney 2=Probleme Dayalı Öğrenme Uygulamaları, PÇ= Problem Çözme Becerisi, KA=Kavramsal Anlama

Bulgulara göre deney grupları ve kontrol grubunun incelenen tüm bağımlı değişkenlere göre ortalama puanlarında bir artış olduğu görülmektedir. Grupların ön test puanları incelendiğinde ise bazı değişkenler açısından ortalama puanlar arasındaki farkın yüksek olduğu belirlenmiştir. ANOVA sonuçlarına göre grupların ön test kavramsal anlama testi puanları ($F_{(2,552)}$= 4.02, p= .019) arasında anlamlı bir farklılık bulunurken; problem çözme becerisi ($F_{(2,552)}$= .557, p= .573) arasında anlamlı bir farklılık bulunmamıştır. Bu nedenle katılımcılardan elde edilen bulguların analizlerinde MANCOVA kullanılmasına karar verilmiştir. Ayrıca kullanılan öğretim yönteminin bağımlı değişkenler üzerindeki etkisinin örneklemden bağımsız değerlendirilmesi için etki değeri (kısmi eta kare) hesaplamasına yer verilmiştir. İlk analiz sonuçlarına göre Box's M testi ve Levene testi sonuçlarına göre verilerin denk kovaryans matrislerine ve hata varyanslarına sahip olduğu görülmüştür (p>.01). Bu nedenle analize devam edilerek bağımsız değişkenlerin bağımlı değişkenler üzerindeki etkisi MANCOVA kullanılarak sınanmıştır. Sonuçlar Tablo 2'de yer almaktadır.

Tablo 2. *Araştırmadan Elde Edilen Nicel Verilere İlişkin MANCOVA Sonuçları*

		Kareler Toplamı	**df**	**Ortalama kare**	**F**	**p**	**Kısmı eta kare**
Düzeltilmiş Model	Sontest PÇ	48771,865	6	8182,64	178,294	.000	.662
	Sontest KA	100184,444	6	16697,407	112,614	.000	.553
Öntest PÇ	Sontest PÇ	7943,08	1	7943,08	174,22	.000	.242
	Sontest KA	2606,625	1	2606,625	17,58	.000	.031
Öntest KA	Sontest PÇ	142,31	1	142,31	3,12	.078	.006
	Sontest KA	47709,72	1	47709,72	321,77	.000	.371
Grup	Sontest PÇ	590,99	2	295,49	**6,48**	**.002***	**.023**
	Sontest KA	1349,96	2	674,99	**4,55**	**.011***	**.016**
Hata	Sontest PÇ	24892,81	546	45,59			
	Sontest KA	80956,08	546	148,27			

* p<.05 düzeyinde anlamlı

MANCOVA'dan elde edilen grup değişkenine ilişkin sonuçlar incelendiğinde grupların son test problem çözme becerisi algıları ve kavramsal anlamaları arasında anlamlı bir farklılık olduğu belirlenmemiştir. Grupların son test düzeltilmiş MANCOVA puanlarına Tablo 3'te yer verilmiştir.

Tablo 3. *MANCOVA Sonuçlarına Göre Gruplarda Yer Alan Katılımcıların Düzeltilmiş Son Test Puan Ortalamaları*

	Son test PÇ	**Son test KA**
Deney 1 (PDÖ+KK)	95,85	34,72
Deney 2 (PDÖ)	95,32	30,98
Kontrol	93,41	31,72

Araştırma kapsamında öğrencilerin sahip olduğu kavram yanılgıları dört kategoride toplanmıştır:

Kavram Yanılgıları 1 (KY-1): "Katı maddelerin tanecikleri hareket etmez." ve "Maddeyi oluşturan tanecikler arasında hava bulunur."

Kavram Yanılgıları 2 (KY-2): "Soğukluk bir maddeden bir başka bir maddeye transfer edilebilir.", "Yalıtkanlar ısıyı çabuk ilettiğinden onları sıcak olarak hissedemeyiz.", "Saf su iyi ısı iletkenidir.", "Metaller soğuğu çeker, emer ve tutarlar.", "Molekülü büyük olan madde daha hızlı ısı iletir."

Kavram Yanılgıları 3 (KY-3): "Kazak ya da yün ısı verir.", "Alüminyum folyo ısıyı iletmez ve ısıyı sabit tutar."

Kavram Yanılgıları 4 (KY-4): "Açık renkler ısıyı tamamen soğurur, koyu renkler ısıyı tamamen iletir."

Yukarıda belirtilen kategoriler doğrultusunda öğrencilerin ön test ve son testlerde sahip olduğu kavram yanılgısı oranları Tablo 4'de sunulmuştur.

Tablo 4. *Öğrencilerin ön test ve son testte sahip oldukları kavram yanılgılarının oranları*

	KY-1		KY-2		KY-3		KY-4	
	Ön Test	**Son Test**	**Ön Test**	**Son Test**	**Ön Test**	**Son Test**	**Ön Test**	**Son Test**
Deney 2	%8,93	%19,64	%4,76	%35,71	%1,19	%17,86	%1,19	%21,43
Deney 1	%8,33	%16,67	%20,83	%42,36	%11,11	%26,39	%4,17	%20,83
Kontrol	%12,5	%21,59	%15,15	%31,82	%3,03	%19,7	%3,03	%15,91

Kontrol ve deney gruplarının ön test ve son testlerinde sahip oldukları kavram yanılgıları incelendiğinde tamamında artış olduğu görülmektedir. Bunun temel nedeni öğrencileri ön testlerde konuyu bilmemelerinden dolayı sorulara çoğunlukla cevap vermemiş olmalarıdır. Böylece kavram yanılgısı da tespit edilememiştir. Deney 2 grubunda en fazla kavram yanılgısı artışı KY-2'de iken, Deney 1 grubunda en fazla artış KY-4'de ve kontrol grubunda en fazla artış KY-3'de görülmüştür.

Araştırmada ele alınan alt problemlerin çözümlenmesine ilişkin bulgular ve yorumlar şu şekildedir:

a) Birinci Alt Probleme İlişkin Bulgular

Araştırmada ele alınan "Probleme dayalı öğrenme içerisinde kavram karikatürlerinin kullanıldığı deney grubu (Deney 1), sadece probleme dayalı öğrenmenin kullanıldığı deney grubu (Deney 2) ve sadece Fen ve Teknoloji Öğretim Programına dayalı etkinliklerin kullanıldığı kontrol grubunda yer alan öğrencilerin son test kavramsal anlama düzeyleri arasında anlamlı bir farklılık var mıdır?" alt probleminin çözümü doğrultusunda katılımcılardan elde edilen veriler MANCOVA kullanılarak analiz edilmiştir. Analiz sonuçlarına göre katılımcıların son test kavramsal anlama testinden almış oldukları puan ortalamalarının anlamlı düzeyde birbirinden farklılaştığı belirlenmiştir ($F_{(2,546)}$ = 4.55, p = .011, η_p^2 = .016). Gruplar arasındaki karşılaştırmalı istatistiksel sonuçlar incelendiğinde probleme dayalı öğrenme ile kavram karikatürlerinin birlikte kullanıldığı deney grubu ile (deney 1) kontrol grubu arasında (*MD*= 2.99, *SE*= 1.30, *p*= .022) anlamlı bir farklılık görülürken; sadece probleme dayalı öğrenmenin uygulandığı deney grubu ile (deney 2) kontrol grubu arasında (*MD*= .742, *SE*= 1.26, *p*= .558) deney grupları lehine anlamlı bir farklılığın olmadığı anlaşılmaktadır. Deney gruplarının kendi arasında karşılaştırılması sonucunda ise son test kavramsal anlama test puanları açısından probleme dayalı öğrenme ile kavram karikatürlerinin birlikte kullanıldığı deney grubu (deney 1) lehine anlamlı bir farklılığın olduğu belirlenmiştir (*MD*= 3.74, *SE*= 1.30, *p*= 0.004). Elde edilen sonuçlara göre

probleme dayalı öğrenme ile birlikte kavram karikatürü kullanımına yönelik uygulamaların öğrencilerin kavramsal anlama düzeyleri üzerine anlamlı bir farklılığa neden olduğu söylenebilir. Ayrıca söz konusu bulgulardan çıkarılabilecek bir diğer sonuç ise kavram karikatürlerinin probleme dayalı öğrenme içerisinde kullanımının öğrencilerin kavramsal anlama düzeylerinin gelişimine doğrudan olumlu bir katkısının olduğu yönündedir. Büyüköztürk (2008), η2 (eta kare) değerinin 0,00-100 arasında değiştiğini, 0,01'in küçük etki büyüklüğü, 0,06'nın orta etki büyüklüğü, 0,14'ün büyük etki değeri olarak yorumlandığını belirtmektedir. Son test kavramsal anlama düzeylerine ait varyansın %1,6'sının gruba yani uygulanan yönteme bağlı olduğu söylenebilir. Hesaplanan etki büyüklükleri dar bir etkiyi yansıtmaktadır.

b) İkinci Alt Probleme İlişkin Bulgular

Araştırmada ele alınan "Probleme dayalı öğrenme içerisinde kavram karikatürlerinin kullanıldığı deney grubu, sadece probleme dayalı öğrenmenin kullanıldığı deney grubu ve sadece Fen ve Teknoloji Öğretim Programına dayalı etkinliklerin kullanıldığı kontrol grubunda yer alan öğrencilerin son test problem çözme becerisi arasında anlamlı bir fark var mıdır?" alt probleminin çözümü doğrultusunda katılımcılardan elde edilen veriler MANCOVA kullanılarak analiz edilmiştir. Analiz sonuçlarına göre katılımcıların son test problem çözme becerisi ölçeğinden almış oldukları puan ortalamalarının anlamlı düzeyde birbirinden farklılaştığı belirlenmiştir ($F_{(2,546)} = 6.48$, $p = .002$, $\eta_p^2 = .023$). Gruplar arasındaki karşılaştırmalı istatistiksel sonuçlar incelendiğinde ise probleme dayalı öğrenme ile kavram karikatürlerinin birlikte kullanıldığı deney grubu ile (deney 1) kontrol grubu arasında (*MD*= 2.44, *SE*= .721, *p*= .001) ve sadece probleme dayalı öğrenmenin uygulandığı deney grubu (deney 2) ile kontrol grubu arasında (*MD*= 1.91, *SE*= .701, *p*= .007) deney grupları lehine anlamlı bir farklılık olduğu görülmektedir. Deney gruplarının kendi arasında karşılaştırılması sonucunda ise son test problem çözme becerisi açısından anlamlı bir farklılık olmadığı tespit edilmiştir (*MD*= .526, *SE*= .722, *p*= .466). Elde edilen sonuçlara göre probleme dayalı öğrenme ile birlikte kavram karikatürü kullanımının ve sadece probleme dayalı öğrenme uygulamalarının öğrencilerin problem çözme becerisi üzerinde anlamlı bir farklılığa neden olduğu söylenebilir. Ayrıca söz konusu bulgulardan çıkarılabilecek bir diğer sonuç ise kavram karikatürlerinin probleme dayalı öğrenme içerisinde kullanımının öğrencilerin problem çözme becerisinin gelişimine doğrudan olumlu bir katkısının olmadığı yönündedir. Son test problem çözme becerisi algıları puanlarına ait varyansın %2,3'ünün gruba yani uygulanan yönteme bağlı olduğu söylenebilir. Hesaplanan etki büyüklükleri dar bir etkiyi yansıtmaktadır.

TARTIŞMA

Araştırmanın birinci alt problemi "Probleme dayalı öğrenme içerisinde kavram karikatürlerinin kullanıldığı deney grubu (Deney 1), sadece probleme dayalı öğrenmenin kullanıldığı deney grubu (Deney 2) ve sadece Fen ve Teknoloji Öğretim Programına dayalı etkinliklerin kullanıldığı kontrol grubunda yer alan öğrencilerin son test kavramsal anlama düzeyleri arasında anlamlı bir farklılık var mıdır?" şeklinde ifade edilmiş ve verilerin analizi sonucunda anlamlı bir farklılık bulunmuştur. Uygulamaların gerçekleştirildiği gruplar arasındaki karşılaştırmalar sonucunda probleme dayalı öğrenme oturumları içerisinde kavram karikatürlerinin kullanıldığı deney 2 grubunun son test düzeltilmiş puan ortalamalarının diğer gruplardan anlamlı düzeyde farklılaştığı belirlenmiştir. Sadece probleme dayalı öğrenmenin uygulandığı deney 1 grubu ile kontrol grubunun düzeltilmiş son test puanları arasında ise anlamlı bir farklılık bulunmamıştır. Kavram karikatürlerinin kavramsal anlama üzerindeki olumlu katkısına ilişkin araştırmadan elde edilen bulgular; alan yazında yer alan kavram karikatürlerinin kavram yanılgılarının giderilmesi ve kavramsal anlamanın geliştirilmesi üzerindeki etkisine ilişkin ilköğretim ve lise düzeyinde gerçekleştirilen çalışmaların bulguları

ile (Atasoy & Akdeniz, 2009; Ekici, Ekici & Aydın, 2007; Kabapınar, 2005; Saka ve diğerleri, 2006) benzer özellik göstermektedir. İnel (2012) 'Madde ve Isı' ünitesinde kavram karikatürü destekli probleme dayalı öğrenme uygulamalarının öğrencilerin kavramsal anlama düzeyleri üzerinde deney grubu lehine anlamlı farklılık yarattığını belirlemiştir. Kavram karikatürleri özelliği gereği öğrencilerin olası duruma ilişkin alternatif kavramalarına göre düzenlenmekte ve öğrencilere sunulmaktadır. Öğrenciler bu süreçte savundukları görüşlere farklı bakış açısı kazandıran görüşler ile karşılaştıklarından dolayı bilişsel çatışma durumu yaşamakta ve bu zihinsel dengesizlik sürecini gidermeye çalışmaktadırlar. Bu nedenle kavram karikatürleri, ortaya çıkarılan bilişsel çatışmanın çözümüne ihtiyaç duyulmasına ve öğrencilerin daha açık düşünmelerine yardımcı olur (Naylor, Keogh & Downing, 2003). Öğrenme sürecinde kavram karikatürleri öğrenenlerin kavramsal anlamalarını ortaya çıkarılmasında etkili bir araç olarak karşımıza çıkmaktadır (Allen, 2006; Black & Harrison, 2004; Dabell, 2004; Korkmaz, 2004; Özyılmaz-Akamca, Ellez & Hamurcu, 2009). Bu nedenle kavram karikatürleri öğretmenlerin fen eğitiminde kavramsal değişim oluşturmaları ve kavramsal yapılandırmayı arttırmaları amacıyla kullanılabilmektedir (De Lange, 2009; Naylor & Keogh, 1999). Tüm bu özellikleri göz önüne alındığında probleme dayalı öğrenme içerisinde kavram karikatürü kullanımının öğrencilerin önceki alternatif kavramalarının ortaya çıkarılmasına olanak tanıdığı; bu nedenle öğrencilerin kavramsal anlamalarına olumlu yönde katkı sağladığı söylenebilir. Aynı zamanda kavram karikatürlerinin öğrencilerin açıklamakta çekindiği düşünceleri karikatürlerde yer alan karakterler yardımıyla açıklamaya istekli olmalarının kavramsal anlamalarını arttırmaya yönelik etkilerinin olduğu düşünülmektedir.

Probleme dayalı öğrenme yöntemi açısından ilgili alan yazın incelendiğinde söz konusu bulguların alan yazın ile paralellik göstermediği söylenebilir. Alan yazında probleme dayalı öğrenmenin lise ve üstü düzeyde kavramsal anlamayı olumlu yönde etkilediğine, kavram yanılgılarının giderilmesi üzerinde etkili olduğuna ilişkin çalışmalar yer almaktadır (Eren & Akınoğlu, 2012; Bayrak & Bayram, 2011; Şahin, 2010a; Şahin, 2010b; Tarhan & Acar, 2007; Tarhan ve diğerleri, 2007). Aynı zamanda probleme dayalı öğrenmenin öğrenme üzerinde de olumlu etkilere sahip olduğu araştırmalar bulunmaktadır (Araz & Sungur, 2007; Chang, 2001; Gürses ve diğerleri, 2007; Sungur, Tekkaya & Geban, 2006; Tarhan ve diğerleri, 2008; Tatar & Oktay, 2011). Harland (2002)'a göre probleme dayalı öğrenme, problem çözmenin kavramsal anlamayı arttırmak ve geliştirmek için kullanıldığı bir süreci temel almaktadır. Bu süreçte öğrenciler, problemdeki durumu açıklamaya çalışarak problem hakkındaki bildiklerini keşfeder ve bilmediklerinin farkına varırlar (Dolmans ve Ginns, 2005). Sonuç olarak öğrenciler, uygun öğrenme kaynaklarının kullanımına ulaşma ve bulma yeteneğini kapsayan yaşam boyu öğrenme becerisini kazanırlar (Atan, Sulaiman & Idrus, 2005). Araştırmadan elde edilen sonuçlar göz önüne alındığında özellikle üst düzey düşünme becerisinin kullanımını gerektiren probleme dayalı öğrenme yönteminin öğrencilerin Piaget'in somut işlemler döneminden soyut işlemler dönemine geçiş döneminde olmaları (araştırma 11-13 yaş aralığındaki katılımcılarla gerçekleştirildi) ve bu nedenle probleme dayalı öğrenme oturumlarında gerekli olan hipotez kurma, bilimsel süreç becerisini kullanma, problem çözme, sorunu belirleme gibi becerisin kazanımında zorluk yaşamalarının kavramsal anlamalarını olumsuz yönde etkilemiş olabileceği düşünülmektedir. Araştırma bulgularından çıkarılabilecek bir diğer sonuç ise söz konusu yaş grubundaki uygulamalarda probleme dayalı öğrenme oturumlarının kullanımında karikatürler ve görsel materyaller gibi farklı öğelerin öğrenme sürecine dahil edilmesinin öğrencilerin kavramsal anlamalarını kolaylaştırabileceği yönündedir.

Araştırmadan elde edilen bulguların analizinde öğrencilerin maddenin tanecikli yapısı, ısı iletimi ve yalıtımı konularında yanılgılarının olduğu belirlenmiştir. Bu yanılgılar: "*Katı maddelerin tanecikleri hareket etmez. Maddeyi oluşturan tanecikler arasında hava bulunur. Soğukluk bir maddeden bir başka bir maddeye transfer edilebilir. Yalıtkanlar ısıyı çabuk ilettiğinden onları*

sıcak olarak hissedemeyiz. Saf su iyi ısı iletkenidir. Metaller soğuğu çeker, emer ve tutarlar. Molekülü büyük olan madde daha hızlı ısı iletir. Kazak ya da yün ısı verir. Alüminyum folyo ısıyı iletmez ve ısıyı sabit tutar. Açık renkler ısıyı tamamen soğurur, koyu renkler ısıyı tamamen iletir." dir. Kontrol ve deney gruplarının kavram yanılgılarında artış olduğu dikkat çekmektedir. Ancak bu durum ön testlerde öğrencilerin konuyu bilmemelerinden dolayı soruları boş bırakmalarından kaynaklanmaktadır.

Araştırmanın ikinci alt problemi "Probleme dayalı öğrenme içerisinde kavram karikatürlerinin kullanıldığı deney grubu (Deney 1), sadece problem dayalı öğrenmenin kullanıldığı deney grubu (Deney 2) ve sadece Fen ve Teknoloji Öğretim Programına dayalı etkinliklerin kullanıldığı kontrol grubunda yer alan öğrencilerin son test problem çözme beceri algıları arasında anlamlı bir farklılık var mıdır?" şeklinde ifade edilmiş ve gruplar arasında anlamlı bir farklılık bulunmuştur. Verilerin analizi sonucunda deney gruplarında ve kontrol grubunda yer alan katılımcıların problem çözme beceri algı ölçeğine ilişkin düzeltilmiş son test puan ortalamaları arasında anlamlı düzeyde bir farklılık olduğu belirlenmiştir. Gruplar arasındaki karşılaştırmalı istatistiksel sonuçlar incelendiğinde ise kavram karikatürleri destekli probleme dayalı öğrenme yönteminin kullanıldığı deney grubuyla (deney 1) kontrol grubu arasında ve sadece probleme dayalı öğrenmenin uygulandığı deney grubuyla (deney 2) kontrol grubu arasında düzeltilmiş son test problem çözme becerisi algı puanları açısından deney grupları lehine anlamlı bir farklılık olduğu görülmektedir. Benzer olarak İnel (2012) 'Madde ve Isı' ünitesinde kavram karikatürü destekli probleme dayalı öğrenme uygulamalarının öğrencilerin problem çözme beceri algısı üzerinde olumlu etkilerinin olduğunu ortaya koymuştur. Deney gruplarının kendi arasında karşılaştırılması sonucunda ise düzeltilmiş son test problem çözme becerisi algı puanları açısından anlamlı bir farklılık olmadığı tespit edilmiştir.

Kavram karikatürü açısından ilgili alan yazın incelendiğinde, fen bilimleri derslerinde günlük yaşama ilişkin problem çözme becerisini geliştirmek için karikatürlerin kullanılabileceğine vurgu yapan çalışmalara rastlanmaktadır (Kempton, 2004; Balım, İnel & Evrekli, 2008; Kirişçioğlu & Başdaş, 2007). Cengizhan (2011) senaryolarla birlikte kullanılan kavram karikatürlerinin öğrencilerin düşünme ve problem çözme becerisinin gelişimine katkı sağladığını ifade etmiştir. Araştırma bulguları incelendiğinde ise alan yazındaki görüşlerin aksine kavram karikatürlerinin tek başına doğrudan problem çözme becerisi üzerinde etkili olmadığı görülmektedir. Bunun nedeninin araştırmadaki değişkenler açısından problem çözme becerisi üzerinde temel etkinin probleme dayalı öğrenmeden kaynaklanması olduğu düşünülmektedir. Probleme dayalı öğrenme yöntemi açısından ise elde edilen bulgular; alan yazında yer alan probleme dayalı öğrenmenin problem çözme becerisinin gelişimi üzerine farklı öğrenim seviyelerinde gerçekleştirilen çalışma bulguları (Drake & Long, 2009; Yaman & Yalçın, 2005; Herron & Major, 2004) ile benzerlik göstermektedir. Ayrıca elde edilen bulgular araştırmaya en yakın özellikte çalışma olan İnel (2012)'in probleme dayalı öğrenme içerisinde kavram karikatürlerinin kullanımının ilköğretim düzeyindeki öğrencilerin problem çözme becerisi algıları üzerinde etkisi olduğuna ilişkin bulguları ile paralellik göstermektedir.

Günlük yaşamdan alınan senaryolar, PDÖ içinde öğrencilere problem çözme becerisini kazandırmayı amaçlamakta ve bu becerisi kazandırmada bir araç olarak kullanılmaktadır (Duch, Groh & Allen, 2001; Hsu, 2004; Neville & Britt, 2007; Uden & Beaumont, 2005). PDÖ ortamlarında senaryolarla ilgili bilgiler toplanmakta ve problem çözme becerisiyle senaryoların içeriğinin analizi gerçekleştirilmektedir (Arts, Gijselaers & Segers, 2002; Dolmans & Schmidt, 2000). Senaryo içeriğinin analiziyle bilgiler toplanmakta, yorumlanmakta, birbirleri arasında ilişkiler kurulmakta ve en önemlisi senaryonun çözümü sırasında problem çözme becerisi geliştirilmektedir (Kaptan & Korkmaz, 2002; Strohfeldt & Grant, 2010; Schmidt vd., 2009; Wood, 2003). Tüm bu açılardan düşünüldüğünde probleme dayalı öğrenme sürecinde öğrenciler etkin biçimde problem çözme becerisini

kullanmaktadırlar. Bu nedenle de probleme dayalı öğrenmenin araştırmada problem çözme becerisi üzerinde anlamlı bir farklılığa neden olduğu söylenebilir.

SONUÇLAR

Uygulama öncesinde ve sonrasında öğrencilere uygulanan kavramsal anlama testi ve problem çözme beceri algı ölçeği sonuçlarında deney gruplarında ve kontrol grubunda kavramsal anlama düzeylerinde ve problem çözme beceri algılarında artış olduğu sonucuna ulaşılmıştır.

Kavramsal anlama düzeyi açısından gruplar arasındaki karşılaştırmalı istatistiksel sonuçlar incelendiğinde ise probleme dayalı öğrenme ile kavram karikatürlerinin birlikte kullanıldığı deney grubu ile kontrol grubu arasında anlamlı bir farklılık görülürken; sadece probleme dayalı öğrenmenin uygulandığı deney grubu ile kontrol grubu arasında deney grupları lehine anlamlı bir farklılığın olmadığı anlaşılmaktadır. Deney gruplarının kendi arasında karşılaştırılması sonucunda ise son test kavramsal anlama test puanları açısından probleme dayalı öğrenme ile kavram karikatürlerinin birlikte kullanıldığı deney grubu lehine anlamlı bir farklılığın olduğu sonucuna ulaşılmıştır. Tüm gruplarda kavram yanılgılarının oranının arttığı belirlenmiştir.

Problem çözme becerisi algıları yönünden katılımcıların son test problem çözme becerisi ölçeğinden almış oldukları puan ortalamalarının anlamlı düzeyde birbirinden farklılaştığı belirlenmiştir. Gruplar arasındaki karşılaştırmalı istatistiksel sonuçlar incelendiğinde ise probleme dayalı öğrenme ile kavram karikatürlerinin birlikte kullanıldığı deney grubu ile kontrol grubu arasında ve sadece probleme dayalı öğrenmenin uygulandığı deney grubu ile kontrol grubu arasında deney grupları lehine anlamlı bir farklılık olduğu sonucuna ulaşılmıştır. Deney gruplarının kendi arasında karşılaştırılması sonucunda ise son test problem çözme becerisi açısından anlamlı bir farklılık olmadığı tespit edilmiştir.

ÖNERİLER

Araştırmadan elde edilen bulgulara göre kavram karikatürleri destekli probleme dayalı öğrenme yönteminin ve sadece probleme dayalı öğrenme yönteminin kullanılmasının öğrencilerin problem çözme becerisi üzerine olumlu etkilere sahip olduğu belirlenmiştir. Bu nedenle, öğrencilerin problem çözme becerisinin geliştirilmesi için kavram karikatürü destekli probleme dayalı öğrenme yönteminden ve sadece probleme dayalı öğrenme yönteminden faydalanılabilir.

Bu araştırma kapsamında yer alan etkinliklerin ve benzer örneklerinin “Madde ve Isı” ünitesinde kullanılmasının öğrencilerin problem çözme becerisinin olumlu yönde gelişmesine yardımcı olabileceği söylenebilir. Ayrıca öğrencilerin kavramsal anlamalarının geliştirilmesi, arttırılması amacıyla kavram karikatürlerinin fen derslerinde kullanılmasının ve ders kitaplarında kavram karikatürlerine yer verilmesinin bu anlamda yararlı olabileceği söylenebilir.

Kavram karikatürleri destekli probleme dayalı öğrenme yönteminin kullanıldığı grubu ile sadece probleme dayalı öğrenme yönteminin uygulandığı gruplarının problem çözme becerisi arasında anlamlı farklılık olmadığı tespit edilmiştir. Yapılacak olan yeni araştırmalarda görüşme, gözlem gibi nitel yöntemlerle de destekleyerek derinlemesine araştırma yapılıp bu durumun olası nedenleri ortaya konulabilir.

Araştırmada kavram karikatürleri destekli probleme dayalı öğrenme yönteminin öğrencilerin problem çözme becerisi algıları üzerindeki etkileri araştırılmış, ancak problem çözme becerisi üzerindeki etkisi belirlenememiştir. İleride gerçekleştirilecek araştırmalarda öğrencilerin problem çözme becerisini belirleme de kullanılabilecek ölçme araçları geliştirilerek söz konusu yöntemin öğrencilerin problem çözme becerisi üzerindeki etkileri belirlenebilir.

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The Effect of Concept Cartoons-Assisted Problem-Based Learning Method on Conceptual Understanding Levels and Problem Solving Skill Perceptions of Students

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SYNOPSIS

INTRODUCTION

With the developing technology, it is possible to see the effects and traces of science in every stage of life. Science education has a key role in forming the future of societies (İşman, Baytekin, Balkan, Horzum & Kıyıcı, 2002). For this reason, advancing in science and technology requires raising qualified individuals who are capable of producing information and who inquiry, criticize and solve the problems in order to use the innovations brought by the ever-evolving technology. It is considered that education and training are important components in raising such individuals.

As a result of the law that increased the duration of compulsory education up to 12 years, the 2013 Science Curriculum was developed. This curriculum aims to raise science-literate individuals who learn throughout their lives with the conscious of sustainable development, research and question, make efficient decisions, solve problems, self-reliable, open to cooperation, establish efficient communications, have the knowledge, skill, positive attitude, perception and values on science with an understanding and psychomotor skills of the relation between technology and society-environment (MEB, 2013). In this context, methods and techniques that enable the formation of learning environments that are learner-centered have come into the agenda. Today, various methods and techniques such as

cooperative learning, project-based learning, concept cartoons, concept maps, and mind maps are used as the learning approaches based on research and questioning; and studies on the various characteristics of these methods and techniques are carried out (Pekmez & Balım, 2003; Bozdoğan, Taşdemir & Demirbaş, 2006; Balım, İnel & Evrekli, 2008; Evrekli, Balım & İnel, 2009; Çıbık, 2009). One of the methods that enable the learners to research and question the learning materials is the problem-based learning method; and one of these techniques is the concept cartoons.

When the relevant literature is examined it is observed that there are studies that examine the effects of the use of problem-based learning or concept cartoons on various variables; however, there are no studies that deal with the use of concept cartoons within problem-based learning on the conceptual understanding levels of students. There are limited studies that deal with the effect of the use of problem-based learning or concept cartoons on problem solving skill perceptions, and this study has been conducted to supplement this gap.

Purpose of the Research

The purpose of the study is determining the effects of the use of concept cartoons in problem-based learning in science education on the conceptual understanding levels of the students and on their problem-solving skill perceptions.

METHODOLOGY

In this study, to determine the efficiency of the use of concept cartoons within problem-based learning, the non-counterbalanced & unequaled quasi-experimental design with pre-test & post-test control croup was used (Bulduk, 2003; Christensen, 2004; Marczyk, DeMatteo & Festinger, 2005; Cohen, Manion & Morrison, 2005; Balcı, 2005; Karasar, 2006).

a) The Study Group

Since the study has the characteristics of being quasi-experimental, the sampling-universe technique has not been used; instead, the study group has been used. The study group consisted of the 6th grade students who were studying in 27 classes from 9 schools in the city center of Izmir.

32% of the participants (n=177) were taught by using the concept cartoons in problem-based learning method; 33,8% (n=187) were taught with only the problem-based learning method; and 34,2% of them (n=189) were educated by only the science curriculum.

b) Experimental Process

In the scope of the study, total 27 classes were determined in 9 schools. Each class had 2 study groups and 1 control group. In one of the study groups, the classes were taught with the concept cartoons-supported problem-based learning method (Experimental Group 1); in the other group, the classes were taught with only problem-based learning method (Experimental Group 2); and in the control group, the classes were taught with only Science and Technology Curriculum contents and activities. In one of the study groups, the Problem-based learning Modules, which had the scenarios and the concept cartoons about the events in these scenarios, were used in teaching the science classes. The curriculum and activities of the course books organized in accordance with the acquisitions in the curriculum were taken as the basis in the control group.

c) Data Collection Tools

Conceptual Understanding Test: In the scope of the study, a conceptual understanding test, which was about the “Matter and Heat” Unit of the 6th Grade Course book, was used. The test

had 17 questions in it. The evaluations on the conceptual understanding test were made by the specialists in the study. The intra-set correlation accordance value of the specialists was determined as .86; and the Pearson correlation value was determined as .96 for the test.

Problem-Solving Skill Perception Scale: In the scope of the study, in order to observe the effects of the independent variables on the problem-solving skill perceptions of the students, the problem-solving skill perception scale, which was developed by İnel Ekici & Balım (2013) was used. The scale consisted of 22 Items and the Cronbach Alpha reliability value was .88.

d) The Statistical Methods Used in the Study

The MANCOVA (Multi-Variate Analysis of Covariance), which is one of the parametric statistical techniques, was used in the analysis of the quantitative data by examining the number of the data in the group and their normal distribution agreement indicators for the purpose of solving the sub-problems that were dealt in the scope of the study.

FINDINGS

According to the analysis results, it was determined that the average points of the participants received from the post-test conceptual understanding Test differed from each other at a significant level ($F_{(2,546)}$ = 4.55, p = .011, η_p^2 = .016). When the comparative statistical results between the groups were examined, it was determined that there was a significant difference between the study group, where the Problem-Based learning and concept cartoons were used together (Experimental Group 1) and the control group (*MD*= 2.99, *SE*= 1.30, *p*= .022); however, it was also determined that there was no significant difference between the study group where only problem-based learning was applied (Experimental Group 2) and the control group in favor of the study groups (*MD*= .742, *SE*= 1.26, *p*= .558). When the study groups were compared between themselves in terms of post-test conceptual understanding Test points, it was observed that there was a significant difference between the study group 1 in favor of this group, where the problem-based learning and concept cartoons were used together (*MD*= 3.74, *SE*= 1.30, *p*= 0.004).

According to the analyses results, it was determined that the average points of the participants received from the post-test problem-solving skill scale differed from each other at a significant level ($F_{(2,546)}$ = 6.48, p = .002, η_p^2 = .023). When the statistical results between the groups were examined, it was observed that there was a significant difference in favor of the study groups between the study group 1 where problem-based learning and concept cartoons were used together and the control group (*MD*= 2.44, *SE*= .721, *p*= .001); and between the study group 2 where only the problem-based learning was applied and the control group (*MD*= 1.91, *SE*= .701, *p*= .007). When the study groups were compared among themselves it was observed that there was no significant difference in terms of post-test problem solving skills (*MD*= .526, *SE*= .722, *p*= .466).

DISCUSSION and CONCLUSION

It was concluded with the conceptual understanding test, which was applied to the students before and after the application, and with the problem-solving skill Perception Scale results that there were increases in the conceptual understanding levels and problem-solving skill perceptions both in the study groups and in the control groups.

When the comparative statistical results between the groups were examined in terms of conceptual understanding level, it was observed that there was a significant difference

between the study group where the problem-based learning and concept cartoons were used together and the control group; however, it was also observed that there was no significant differences between the study group where only the problem-based learning was applied and the control group in favor of the study groups. When the study groups were compared between themselves, it was observed that there was a significant difference in terms of post-test conceptual understanding test points in favor of the study group where the problem-based learning and concept cartoons were used together.

It was determined that the rate of the concept errors increased in all groups. The findings obtained in the study about the positive contribution of the concept cartoons on conceptual understanding show similarities with the findings reported in the literature suggesting that concept cartoons have influences on removing the concept errors and developing conceptual understanding (Atasoy & Akdeniz, 2009; Ekici, Ekici & Aydın, 2007; Kabapınar, 2005; Saka et al., 2006). There are studies suggesting that problem-based learning influences the conceptual learning in a positive way at the high-school level, and also influential on removing the concept errors (Eren & Akınoğlu, 2012; Bayrak & Bayram, 2011; Şahin, 2010a; Şahin, 2010b; Tarhan & Acar, 2007; Tarhan et al., 2007).

It was determined that the average points received by the participants from the post-test problem-solving skill scale in terms of problem-solving skill perceptions differed from each other at a significant level. When the comparative statistical results between the groups were examined it was observed that there was a significant difference in favor of the study groups between the study group where the problem-based learning and concept cartoons were used together and the control group, and the study group where only problem-based learning was applied and the control group. It was observed upon the comparisons between the study groups that there were no significant differences in terms of post-test problem solving skills. The findings obtained on problem-based learning method show similarities with those reported in the literature and were obtained in various studies (Drake & Long, 2009; Yaman & Yalçın, 2005; Herron & Major, 2004) that were conducted at different teaching levels. There are also studies that emphasize the use of cartoons to develop daily problem-solving skills in science classes (Kempton, 2004; Balım, İnel & Evrekli, 2008; Kirişçioğlu & Başdaş, 2007).

SUGGESTIONS

According to the findings obtained in the study, it was determined that the use of the concept cartoons-supported problem-based learning method and the problem-based learning method had positive effects on problem-solving skills of the students. For this reason, the concept cartoons-Supported problem-based learning method and the only problem-based learning method may be made use of to develop the problem-solving skills of the students.

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Ekler/Appendix

Ek: *Probleme Dayalı Öğrenme Senaryo Örnekleri*

Kazanım
3. Isı yalıtımının teknolojik önemi ile ilgili olarak öğrenciler;
3.1 Yalıtımın hangi durumlarda gerekli olabileceğini tahmin eder (BSB-8, 9).
3.3 Yaygın ısı yalıtım malzemelerine örnek verir.

Ceyda, Nilay ve Buse yemeklerin sıcak kalması için gerekli önlemleri almıştı. Sıla da trafikten dolayı 1 saat gecikeceğini arkadaşlarına telefon açarak söylemişti. Elektrikler de gelmemişti. Buse buzdolabında dondurmaları kontrole gittiğinde onlarında erimeye başladığını görmüştü. Buse, "Eyvah! Elektrikler gelinceye kadar dondurmalar eriyecek..." diyerek Nilay ve Ceyda'ya koşmuştu. Üç kız arkadaş, dondurmaların erimemesi için ne yapmaları gerektiği konusunda tartışmaya başlamıştı.

1. Senaryoda ele alınması gereken problem ya da problemler nelerdir?
2.Ceyda ve arkadaşlarının problemini hangi bilgileri araştırarak çözebiliriz?
3. Neler Biliyoruz?
4.Ceyda ve arkadaşları, dondurmanın erimemesi için ne tür önlemler almalıdır? Açıklayınız.

Kazanım
1. Maddenin tanecikli yapısı ve ısı ile ilgili öğrenciler;
1.1. Gözlem yaparak maddeler ısındıkça moleküllerin hızlandığı sonucuna varır (BSB-1,11,12,13,14,30,31; TD-3).

Fatih ve arkadaşları sularını içtikten sonra yan odaya geçerler. Dört arkadaş biraz konuştuktan sonra Fatih, odanın soğuk olduğunu fark etti ve odadaki elektrik sobasını açtı. Dışarıdaki sokak lambasının ışığı sobanın üzerinden geçerek duvara yansımaktaydı. Bu durum Fatih'in dikkatini çekti. Bunun üzerine Fatih, arkadaşları ile bu durumun nedeni üzerine fikir yürütmeye başladılar.

1. Senaryoda ele alınması gereken problem ya da problemler nelerdir?
2. Fatih ve arkadaşlarının problemini hangi bilgileri araştırarak çözebiliriz?
3. Neler Biliyoruz?
4. Sokak lambasından odanın duvarına ulaşan ışığın hareketinin nedeni nedir?

TÜRK FEN EĞİTİMİ DERGİSİ
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İlköğretim Öğrencilerinin Çevre Bilgisi ve Çevresel Tutumları Üzerine Alan Araştırması

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ÖZET

Bu araştırma ilköğretim 6. , 7. ve 8. sınıf öğrencilerinin çevre bilgi ve tutum düzeylerini tespit etmek, mevcut çevre eğitiminin etkisini belirlemek amacıyla yapılmıştır. Öğrencilerin çevre bilgi ve tutumları "sınıf", "cinsiyet", "anne-baba eğitim düzeyi" ve "okul" değişkenleri açısından değerlendirilmiştir. Araştırma 2011-2012 eğitim-öğretim yılı 2. dönemde Konya merkezinde 10 ilköğretim okulunda; 6. sınıftan 329 (%39,1), 7. sınıftan 282 (%33,5), 8. sınıftan 230 (%27,3) öğrenci ile gerçekleştirilmiştir. Veriler; Leeming ve arkadaşları tarafından geliştirilen "Çocukların Çevreye Karşı Tutum ve Bilgileri" ölçeğinin Türkçe versiyonu ile elde edilmiştir. Araştırmada çevre bilgi testinin Cronbach alpha güvenirlik katsayısı 0,680 ve çevre tutum ölçeğinin Cronbach alpha güvenirlik katsayısı 0,917 olarak bulunmuştur. Öğrencilerin çevre bilgi puanları arasında; sınıf, cinsiyet, anne-baba eğitim düzeyi ve okul değişkenine göre anlamlı fark bulunmuştur. Öğrencilerin çevre tutum puanları arasında ise; cinsiyet ve okul değişkenine göre anlamlı fark gözlenmiştir.

Anahtar Kelimeler: İlköğretim; Çevre Eğitimi; Çevre Bilgisi; Çevre Tutumu.

GİRİŞ

İnsanoğlu, Dünya'daki varlığının başlangıcından günümüze kadar doğayı kendi ihtiyaçları için şekillendirmiş ve Dünya'dan yararlanmıştır. Tarım döneminde hayvancılık ve bitki yetiştirmek amacıyla ormanlar, meralar tarım arazilerine dönüştürülmüştür. Sanayi Devrimi ile makine gücü önem kazanmış bununla birlikte fosil yakıtların kullanımı artmış ve bu durumlar nedeniyle de ciddi çevre tahribatları başlamıştır.

Devletler 1970'lerde geri dönülmez çevre felaketlerinin farkına varmış ve ilk kez 1972'de Stockholm'de İnsan ve Çevre Konferansı düzenlenmiş ve çevre eğitimi düşüncesi ortaya çıkmıştır. 1975 yılında Belgrad'ta yapılan Uluslararası Çevre Eğitimi Çalıştayı ve 1978'de yayımlanan Tiflis Bildirgesi ile çevre problemlerinin çözümü için uluslararası işbirliği kararı alınmış, projeler geliştirilmiş ve bütçeler ayrılmaya başlamıştır (UNESCO-UNEP, 1976; Aktaran: Darner, 2007). Yapılan çalışmaların başarılı olması ve devamlılığı için çevre sorunlarının sebebi olan bireylerin, çözümde de sorumluluk alması gerektiği belirlenmiştir. Bunun en iyi yolunun çevre eğitimi olduğu ve okul programlarında çevre eğitimine önem verilmesi gerektiği kararı alınmıştır (Ünal & Dımışkı,1999:144-146).

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Türkiye'de 1982 yılı Anayasası'nda çevre hakkının kabulü ve çevre konusundaki anlaşmalarla ancak, 1980'li yılların sonlarına doğru çevre eğitimi gündeme gelmiştir. Buna rağmen, 1991 yılına kadar okul öncesi, ilk ve orta öğretimde çevre eğitiminden bahsedilmemiştir. 1992 yılında T.C. Milli Eğitim Bakanlığı, Çevre, Sağlık, Trafik ve Okuma derslerini ilkokulun tüm sınıflarında uygulamaya koymuş, 1997 yılında ise bu uygulamayı kaldırmıştır (Alkıs,2002).

3-14 Haziran 1992 tarihinde gerçekleşen Rio zirvesinin ardından, 1994 yılında T.C. Başbakanlık DPT Müsteşarlığı'nca yayımlanan, Yedinci Beş Yıllık Kalkınma Planı ile başlayan çevre eğitimine yönelik benzer çabaların, ülkemizde de giderek ivme kazandığı görülmektedir (Güler, 2007).

2005'te uygulanmaya başlanan yeni eğitim programında gerek okul öncesi ve ilköğretim, gerekse lise eğitim programlarında, çevre eğitimine yönelik bir ders olmamakla birlikte, çevre hakkında bilgilendirme, duyarlılık geliştirme konuları diğer derslerin programları içine dağıtılmaya çalışılmıştır.

Çevre eğitimi, bireylerin çevre sorunlarının farkına varmaları ve bu sorunların çözümüne yönelik çalışmaları yapabilecek bilgi, davranış, motivasyon ve becerilere sahip olmalarını içermektedir (Örnek,1994: 2; Ayvaz,1998: 98;Gökler,1999; 19).

Okullarda verilen çevre eğitiminin etkilerini incelemek amacıyla birçok çalışmada, öğrencilerin çevre bilgisinin genelde düşük düzeyde olduğu tespit edilmiştir (Morgil vd., 2002; Atasoy,2005; Armağan,2006). Demirbaş ve Pektaş'ın (2008) çalışmasında öğrenciler, günlük hayatta karşılaştığı ve sıklıkla gördüğü çevre sorunlarına çoğunlukla doğru cevap vermişlerdir. Ancak güncel sorunlardan olan, fakat öğretim ortamında fazlaca nedenleri üzerinde durulmadığı düşünülen; sera etkisi, küresel ısınma vb. konularında yanlış cevaplar verildiği görülmüştür. Anderson ve Wallin (2009) on beş ile on dokuz yaş arası öğrenciler ile yaptığı çalışmaya göre öğrenciler karbondioksit emisyonlarının büyük oranda azalmasının toplumda ne tür sonuçlar oluşturacağını tam olarak bilmemektedirler. Ayrıca, ozon tabakasının incelmesinin insanları nasıl etkileyeceği hakkında nadir bilgilendirildikleri ortaya çıkmıştır. İncekara ve Tuna (2010) ortaöğretim öğrencilerinin çevresel konularla ilgili bilgi düzeylerinin ölçülmesi amacıyla hazırladıkları çalışmaya göre; öğrencilerin çevre ile ilgili olarak kendilerine verilen olgularla ilgili bilgilerinin "Açıklayacak kadar biliyorum" seviyesinde olduğu, ancak öğrencilerin bazı olgularla ilgili yetersiz bilgiye sahip oldukları anlaşılmıştır. Öğrencilerin özellikle çevre ile ilgili Türkiye'yi de ilgilendiren uluslararası gelişmelere yabancı oldukları görülmüştür

Çevre eğitimi sadece bilgiye ve işlem becerilerine değil; tutuma, hayat becerilerine ve eylemlere de yön vermektedir (Braus, 1995). Literatürde çevre tutumlarını farklı değişkenler açısından inceleyen çok sayıda çalışma yapıldığı görülmüştür (Bonnet & Williams, 1997; Atasoy, 2005; Erol & Gezer,2006; Gökçe vd., 2006; Sadık & Sarı, 2007; Aslan vd.,2008; Teyfur, 2008;Kahayoğlu vd., 2008; Ek vd., 2009; Aydın & Çepni,2010; Sarkar,2011). Çalışmaların genelinde cinsiyet değişkenine göre çevreye yönelik tutumda kızların lehine anlamlı fark bulunmuştur (Atasoy,2005; Kahyaoğlu vd.,2005; Gökçe vd., 2006; Aslan vd., 2008; Kaya vd., 2009; Sarkar,2011). Erten (2002) ilköğretim altıncı, yedinci ve sekizinci sınıf öğrencilerinin çevreye yönelik davranışlarını araştırdığı çalışmada çeşitli çevreye yararlı çalışmaların; kullanılmış pillerin, plastik şişe ve kartonların geri dönüşüme verilmesi vb. gerçekleşme durumunun zayıf olduğunu tespit etmiştir. Ailelerin çevreye yönelik davranışları ile ne şekilde ve ne kadar çocuklarına örnek olduğu belirlenmiştir. Şimşekli (2002) ilköğretim okullarında "Uygulamalı Çevre Eğitimi" projesi kapsamında yapılan etkinlikler, okul yöneticisi ve görevli öğretmenlerin katkısı yönünden incelemiştir. Öğretmenlerin çevre konusunda yeterli bilince sahip olmamasının çevre eğitimini zorlaştıran etkenlerden biri olduğu gözlenmiştir. Ayrıca okullarda, öğrencilerin çevre bilincinin oluşmasına katkıda bulunacak etkinlik sayısının yeterli olmadığı gözlenmiştir.

Hızla artan çevre sorunları ile mücadele edebilmek, bu sorunların azaltılmasını sağlamak için bugünün çocukları, geleceğin yetişkinliklerinin etkili bir çevre bilincine, duyarlığına sahip olarak yetiştirilmeleri gerekmektedir. Bu bilinç ve duyarlılığın aileden sonra geliştirileceği en iyi dönem özellikle okul öncesi ve ilköğretimdir. Tüm ülkelerde olduğu gibi özellikle Türkiye gibi gelişmekte olan bir ülkenin geleceği için, çevre eğitimi müfredatı titizlikle üzerinde durulması gereken bir konudur. Bu çalışma ilköğretim okullarında verilen çevre eğitiminin etkisini, öğrencilerin çevre bilgisi ve tutumu açısından değerlendirmek amacıyla yapılmıştır. Aynı zamanda cinsiyet, sınıf, okul ve anne-baba eğitim düzeyi gibi değişkenlerin öğrencilerin çevre bilgisi ve tutumu üzerine etkisini incelenmek amaçlanmıştır. Bu değişkenlerin incelenmesi çevre eğitimi için ayrılan kaynakların; öğretmen eğitimi, okul-aile iş birliği, çevre eğitim programı ve yöntemleri, okul tasarımı gibi, doğru ve etkin yönlendirilmesini sağlayabilir. Çevre bilgisi ve tutumu üzerine etkili olan değişkenler belirlenerek çevre eğitim programı daha yararlı tasarlanabilir ve daha verimli sonuçlar elde edilebilir.

Bu araştırmanın amacı öğrencilerin çevre tutum ve bilgisinde; cinsiyet, sınıf düzeyi, anne-baba eğitim durumu ve okul değişkenleri göre anlamlı fark olup olmadığı belirlemektir.

YÖNTEM

a)Örneklem

Araştırmanın çalışma grubunu 2011-2012 eğitim- öğretim yılının ikinci döneminde Konya şehir merkezindeki Konya İl Milli Eğitim Müdürlüğü'ne bağlı rastgele seçilen 10 farklı ilköğretim okulundan 846 öğrenci oluşturmaktadır.

Tablo 1. *Öğrencilerinin Demografik Özelliklerinin Yüzde Frekans İstatistikleri*

Değişkenler	Alt Kategoriler	N	%
Cinsiyet	Kız	423	50,0%
	Erkek	423	50,0%
Yaş	11	9	1,1%
	12	295	35,0%
	13	277	32,8%
	14	222	26,3%
	15	40	4,7%
	16	1	0,1%
Sınıf	6.sınıf	329	39,1%
	7.Sınıf	282	33,5%
	8.Sınıf	230	27,3%
Baba Eğitim Durumu	İlkokul	293	35,4%
	Ortaokul	145	17,5%
	Lise	206	24,9%
	Önlisans/Üniversite	152	18,4%
	Lisansüstü	31	3,7%
Anne Eğitim Durumu	İlkokul	492	59,3%
	Ortaokul	146	17,6%
	Lise	118	14,2%
	Önlisans/Üniversite	51	6,1%
	Lisansüstü	23	2,8%
Okul*	A	84	9,9%

B	86	10,2%
C	105	12,4%
D	48	5,7%
E	96	11,3%
F	99	11,7%
G	71	8,4%
H	100	11,8%
K	82	9,7%
L	76	9,0%

* Okullar isimleri verilmek yerine, harfler ile ifade edilmiştir.

b) Araştırma Modeli

Araştırma betimsel tarama modelinde olan nicel yöntemlerin kullanıldığı bir çalışmadır. Betimsel tarama modeli kullanılan araştırmalarda konu alınan birey, olay ya da nesnenin kendi koşulları içinde olduğu gibi tanımlanmaya çalışılması, değiştirmeden ve etkilemeden, uygun bir biçimde gözlenip belirlenmesi söz konusudur (Karasar, 2008).

c) Veri Toplama Aracı

Araştırmada ilköğretim öğrencilerinin çevre bilgi ve tutum düzeylerinin mevcut durumunu tespit etmek amacıyla Çevre bilgi testi ve tutum ölçeği kullanılmıştır. Ölçekler; Leeming ve arkadaşları tarafından (1995) geliştirilen "Çocukların Çevreye Karşı Tutum ve Bilgileri" ölçeğinden (CHEAKS); Aslan, Uluçınar ve Cansaran (2005) tarafından Türkçe'ye çevrilerek, milli eğitim sistemimize göre yeniden düzenlenmiştir ve onların izni ile bu çalışmada kullanılmıştır.

c1) Çevre Bilgi Testi

Çevre bilgi testi, çoktan seçmeli olarak toplam 17 maddeden ve dört ana (genel çevre bilgisi, enerji, geri dönüşüm, kirlilik) başlıktan oluşmaktadır. Cronbach alpha güvenirlik katsayısı 0,690 olarak hesaplanmıştır. Araştırmada 846 öğrenciye uygulanan çevre bilgi testinin Cronbach alpha güvenirlik katsayısı 0,680 olarak bulunmuştur. Bilgi testi puanlaması 0-100 arasında değişiklik göstermektedir.

c2) Çevre Tutum Ölçeği

Çevre tutum ölçeği beşli likert tipi 24 sorudan oluşmuş ve Cronbach alpha güvenirlik katsayısı 0,860 olarak hesaplanmıştır. Araştırmada 846 öğrenciye uygulandığında Cronbach alpha katsayısı 0,917 olarak bulunmuştur.

Ankette kullanılan olumlu ifadeler için "tamamen katılıyorum" ve "katılıyorum"; olumsuz ifadeler için "hiç katılmıyorum" ve "katılmıyorum" ifadeleri kullanılmıştır. Bu aralığa girmeyen ifadeler için ise "kararsızım" kelimesi kullanılmıştır.

Anketteki olumlu ifadelerin puanlama sistemi şu şekilde yapılmıştır;

"Tamamen Katılıyorum": 5 puan; "Katılıyorum": 4 puan; "Kararsızım": 3 puan "Katılmıyorum": 2 puan; "Hiç Katılmıyorum": 1 puan.

Anketteki 18., 19. ve 20. maddeler olumsuz tutumları içerdiği için puanlaması tersten şu şekilde yapılmıştır:

"Tamamen Katılıyorum": 1 puan; "Katılıyorum": 2 puan; "Kararsızım": 3 puan "Katılmıyorum": 4 puan; "Hiç Katılmıyorum": 5 puan

Toplam puan madde sayısına bölünerek alınan puanlar 1-5 arasında getirildi. Dolayısıyla tutum puanları 1 ile 5 arasında değişmekte 5 e yakın ortalama; tutumun yüksek, 1

e yakın ortalama tutumun düşük olduğuna işarettir. Tutum puanları, 0-1.6 arasında ise düşük; 1,7- 3,3 arasında ise orta; 3,4-5,0 arasında ise yüksek olarak değerlendirilmiştir.

c3) Öğrenci Bilgi Anketi: Öğrencilerin çevre bilgi ve tutumunu tespit edecek ölçme araçlarına ek olarak, öğrencilerin araştırma soruları çerçevesinde demografik özelliklerini belirlemek için öğrenci bilgi anketi kullanılmıştır.

d) Veri Analizi

Ölçekler uygulanması için öğrencilere 40 dakikalık süre verilmiştir ve araştırma ile ilgili açıklamalar yapılmıştır. Verilerin analizi SPSS 15 paket programı ile frekans, yüzde istatistikleri, bağımsız örneklemler için t testi, gruplar arasında anlamlı fark olup olmadığın anlamak için tek yönlü varyans analizleri, anlamlı farkların hangi gruplar arasında olduğunu tespit için post-hoc testleri yapılmıştır.

BULGULAR

Bu bölümde öğrencilerin çevre tutum ve bilgisinde; cinsiyet, sınıf düzeyi, anne-baba eğitim durumu ve okul değişkenlerine göre anlamlı fark olup olmadığı belirlemek için yapılan analiz sonuçları bulunmaktadır.

"Öğrencilerin çevre bilgi düzeyi ve çevre tutumu genel olarak nasıldır?" sorusuna Tablo 2'deki bulgulara göre cevap verilmiştir.

Tablo 2. *Öğrencilerin Çevre Bilgisi Testi ve Çevre Tutum Ölçeğinden Aldığı Puan Ortalamalarına Ait Bulgular*

Çevre Bilgisi Testi ve Çevre Tutum Ölçeği	$\overline{X}$	S
Toplam Çevre Bilgi Düzeyi	60,53	18,10
Genel Çevre Tutum Düzeyi	3,53	0,88

Tablo 2 incelendiğinde öğrencilerin toplam çevre bilgi düzeyi puan ortalaması $\overline{X}$=60,53 olarak bulunmuştur. Yine tablo 2'deki bulgulara göre öğrencilerin genel çevre tutum düzeyi puan ortalaması $\overline{X}$ = 3,53 olarak belirlenmiştir.

Tablo 3. *Sınıf Düzeyine Göre Çevre Bilgi Testi Puan Ortalamalarına Ait Tek Yönlü Varyans Analizi Sonuçları*

Grup	N	$\overline{X}$	S	F	P
6.sınıf	329	57,38	18,76		
7.Sınıf	282	60,39	16,30	14,162	0,000*
8.Sınıf	230	65,47	17,87		

*p<.05

Tablo 3'te sınıf düzeylerine göre toplam çevre bilgi düzeyi puan ortalamaları arasında anlamlı bir fark belirlenmiştir ($F(2,838)=14,16;p<0.05$).

Bu farkın hangi sınıflar arasında olduğunu belirlemek için Dunnett T3 testi yapılmıştır. Dunnett T3 analiz sonuçlarında; sınıf düzeylerine göre toplam çevre bilgi düzeyi puan ortalamaları arasında 8. sınıflar ile 6. sınıflar ve 8. sınıflar ile 7. sınıflar arasında 8. sınıflar lehine anlamlı bir farklılık vardır ($\overline{X}_{8.sınıf}$ = 65,4731; $\overline{X}_{7.sınıf}$ = 60,3880; $\overline{X}_{6.sınıf}$= 57,3753).

Tablo 4. *Sınıf Düzeyine Göre Çevre Tutum Ölçeği Puan Ortalamalarına Ait Tek Yönlü Varyans Analizi Sonuçları*

Grup	N	$\overline{X}$	S	F	P
6.sınıf	329	3,57	0,81		
7.Sınıf	282	3,53	0,91	0,462	0,630*
8.Sınıf	230	3,49	0,90		

*p>0.05

Tablo 4'teki tek yönlü varyans analiz sonuçlarında; sınıf düzeylerine göre öğrencilerin çevre tutum düzeyleri arasında anlamlı bir fark bulunmamıştır (F(2,838)=0,46;p>0.05).

Tablo 5. *Cinsiyet Değişkenine Göre Çevre Bilgi Testi T-Testi Sonuçları*

Cinsiyet	N	$\overline{X}$	S	Sd	t	p
Kız	423	62,01	16,54	825	2,276	0,023*
Erkek	423	59,20	19,26			

*p<0.05

Tablo 5'teki bulgularda cinsiyet değişkenine göre toplam çevre bilgi düzeyi puan ortalamaları arasında kızlar lehine anlamlı fark bulunmuştur (t(825)=2,276;p<0.05).

Tablo 6.*Cinsiyet Değişkenine Göre Çevre Tutum Ölçeği T-Testi Sonuçları*

Cinsiyet	N	$\overline{X}$	S	Sd	t	p
Kız	423	3,68	0,79	821	5,017	0,000*
Erkek	423	3,38	0,93			

*p<0.05

Tablo 6'daki bulgularda cinsiyet değişkenine göre öğrencilerin genel çevre tutum düzeyi puan ortalamaları arasında kızlar lehine anlamlı fark belirlenmiştir (t(821)=5,017;p<0.05).

Tablo 7. *Anne Eğitim Düzeyine Göre Çevre Bilgi Testi Puan Ortalamalarına Ait Tek Yönlü Varyans Analizi Sonuçları*

Eğitim Düzeyi	N	$\overline{X}$	S	F	p
İlkokul	492	60,19	17,41		
Ortaokul	146	58,70	19,11		
Lise	118	62,01	16,18	3,331	0,010*
Önlisans/Lisans	51	68,63	18,02		
Lisansüstü	23	58,82	22,78		

*p<0.05

Tablo 7'ye göre anne eğitim durumuna ait toplam çevre bilgi düzeyi puan ortalamaları arasında anlamlı fark görülmüştür (F(4,825)=3,31;p<0.05).

Bu farkın hangi gruplar arasında olduğunu belirlemek için Scheffe testi yapılmıştır. Scheffe analiz sonuçlarına göre annesi ön lisans/lisans mezunu olanlar ile annesi ilkokul, ortaokul, lisansüstü olanların çevre bilgi puan ortalamaları arasında annesi önlisans/lisans

mezunu olanlar lehine anlamlı bir fark vardır ($\overline{X}_{\text{ön lisans/lisans}}$ =68,6275; $\overline{X}_{\text{ortaokul}}$ =58,7027; $\overline{X}_{\text{ilkokul}}$ =60,1865).

Tablo 8. *Anne Eğitim Düzeyine Göre Çevre Tutum Ölçeği Puan Ortalamalarına Ait Tek Yönlü Varyans Analizi Sonuçları*

Eğitim Düzeyi	N	$\overline{X}$	S	F	p
İlkokul	492	3,53	0,88		
Ortaokul	146	3,53	0,82		
Lise	118	3,52	0,86	0,358	0,838*
Önlisans/Lisans	51	3,67	0,76		
Lisansüstü	23	3,50	0,86		

*p>0.05

Tablo 8 incelendiğinde anne eğitim düzeyine ait genel çevre tutum düzeyi puanları arasında anlamlı fark bulunmamıştır (F(4,825)=0.358;p<0.05).

Tablo 9. *Baba Eğitim Düzeyine Göre Çevre Bilgi Testi Puan Ortalamalarına Ait Tek Yönlü Varyans Analizi Sonuçları*

Eğitim Düzeyi	N	$\overline{X}$	S	F	P
İlkokul	293	57,30	17,90		
Ortaokul	145	58,50	17,56		
Lise	206	63,14	17,22	7,736	0,000*
Önlisans/Lisans	152	66,02	16,98		
Lisansüstü	31	59,58	21,79		

*p<0.05

Tablo 9'dan baba eğitim durumuna ait toplam çevre bilgi düzeyi puan ortalamaları arasında anlamlı fark olduğu görülmüştür (F(4,822)=7,736;p<0.05).

Bu farklılığın hangi gruplar arasında olduğunu belirlemek için Scheffe testi yapılmıştır. Scheffe analizine göre, baba eğitim düzeyi önlisans/lisans mezunu olanlar ile baba eğitim düzeyi ilkokul, ortaokul, olanlar arasında önlisans/lisans lehine çevre bilgi testi puanlarında anlamlı fark vardır ($\overline{X}_{\text{ön lisans/lisans}}$ =66,0217; $\overline{X}_{\text{ortaokul}}$ =58,4990; $\overline{X}_{\text{ilkokul}}$ =59,2977).Baba eğitim düzeyi lise mezunu olanlar ile baba eğitim düzeyi ilkokul, ortaokul, olanlar arasında lise lehine çevre bilgi testi puanlarında anlamlı fark vardır ($\overline{X}_{\text{lise}}$ =63,1354).

Tablo 10. *Baba Eğitim Düzeyine Göre Çevre Tutum Ölçeği Puan Ortalamalarına Ait Tek Yönlü Varyans Analizi Sonuçları*

Eğitim Düzeyi	N	$\overline{X}$	S	F	p
İlkokul	293	3,42	0,91		
Ortaokul	145	3,57	0,91		
Lise	206	3,58	0,85	1,698	0,148
Önlisans/Lisans	152	3,59	0,82		
Lisansüstü	31	3,60	0,83		

*p>0.05

Tablo 10'e göre baba eğitim düzeyine ait genel çevre tutum puan ortalamaları arasında fark anlamlı değildir (F(4,822)=1,698;p>0.05).

Tablo 11. *Okul değişkenine göre çevre bilgi ve tutum testi betimsel istatistik sonuçları*

		Bilgi		Tutum	
Okul (İ.Ö.O)	**N**	$\overline{X}$	**S**	$\overline{X}$	**S**
A	84	57,7031	19,25091	3,2693	1,28170
B	86	61,7647	20,43193	3,5053	,71004
C	105	67,5070	18,16904	3,6417	,76948
D	48	59,4363	15,21592	3,3490	,76336
E	96	57,9044	17,88952	3,6432	,71123
F	99	61,0814	17,66120	3,6570	,73352
G	71	59,5692	16,48647	3,4900	,92302
H	100	62,4118	16,36019	3,6125	,91053
K	82	61,6930	17,61663	3,5051	,82880
L	76	53,0960	17,42272	3,4068	1,01242
Toplam	847	60,5320	18,10303	3,5258	,88100

Tablo 11'de okul değişkenine göre çevre bilgi ve tutum ölçeği betimsel istatistik sonuçları verilmiştir.

Tablo 12. *Okul Değişkenine Göre Çevre Bilgi ve Tutum Ölçeği Puan Ortalamalarına Ait Tek Yönlü Varyans Analizi Sonuçları*

	Varyansların kaynağı	**Kareler toplamı**	**sd**	**Kareler ortalaması**	**F**	**p**
Bilgi	Gruplararası	11393,626	9	1265,958	3,986	,000*
	Gruplar içi	265857,327	837	317,631		
	Toplam	277250,953	846			
Tutum	Gruplararası	13,453	9	1,495	1,945	,043*
	Gruplar içi	643,182	837	,768		
	Toplam	656,635	846			

*p<0.05

Tablo 12'de belirtildiği gibi öğrencilerin öğrenim gördükleri okullara göre çevre bilgi puan ortalamaları arasında istatistiksel olarak anlamlı fark bulunmuştur (F(9,837)=3,98;p<0.05). Öğrencilerin öğrenim gördükleri okullara ile çevre tutum puan ortalamaları arasında istatistiksel olarak anlamlı fark belirlenmiştir (F(9,837)=1,94;p<0.05).

TARTIŞMA ve SONUÇ

Bu çalışmada ilköğretim altı, yedi ve sekizinci sınıf öğrencilerinin çevre bilgisi ve tutumları; cinsiyet, sınıf, okul ve anne-baba eğitim düzeyi değişkenleri açısından değerlendirilmiştir.

Öğrencilerin çevreye ilişkin tutumlarının yüksek ama çevre bilgi düzeylerinin yeterli olmadığı görülmektedir. Sınıf derecesi artıkça öğrencilerin çevre bilgi düzeylerinde artış olmaktadır. Literatürde de sınıf derecesi artıkça, öğrencilerin çevre bilgi düzeylerinin de artığı gözlenmiştir (Aslan vd, 2005, Atasoy, 2005, Meydan & Doğu, 2008). Bunun nedeni öğrencilerin yaşları artıkça çevresel kavramları anlamalarının kolaylaşması olabilir. Ama genel sonuçlara göre öğrencilerin çevre bilgisi yeterli değildir. Uygulanan çevre eğitiminin

yeterli olmaması ya da fen öğretim programında çevre meselelerine yeterince değinilmemesi bu duruma neden olmuş olabilir.

Cinsiyet değişkenine göre toplam çevre bilgi düzeyi ve çevre tutumlarının puan ortalamaları arasında kızlar lehine anlamlı fark bulunmuştur. Yapılan çalışmaların genelinde cinsiyet değişkeninin, çevre bilgi ve tutumu üzerine etkili olduğu görülmektedir ve genelde kızlar lehine sonuçlar ortaya çıkmaktadır (Atasoy, 2005; Kaya vd. ,2009; Sarkar, 2011). Bu sonuç kız öğrencilerin daha duygu odaklı olması, çevrelerine karşı daha hassas yapıda olmalarından kaynaklı olabilir. Kızların özellikle ev işleriyle deneyim geçirmeleri de bu sonucu vermiş olabilir. Bazı çalışmalarda ise kız ve erkek öğrenciler arasında çevre bilgi (Alp vd., 2006; Aslan vd., 2005, Makki vd., 2004; Sadık ve Sarı, 2007) ve çevre tutumu düzeyi (Makki vd., 2004, Aslan vd., 2005; Teyfur, 2008) açısından anlamlı bir fark olmadığı bulunmuştur.

Sınıf düzeylerine göre öğrencilerin çevre tutum düzeyleri arasında anlamlı bir fark bulunmamıştır. Aslan vd. (2005)'nin çalışmasında sınıf derecesi ve çevre tutum arasında anlamlı bir fark bulunmaması, araştırma sonucunu desteklemektedir. Tutumlar yavaş olmakla birlikte, yeni bilgi ve deneyimler edindikçe değişmektedir (Davidoff, 1987, s. 569; Akt: Tavşancıl, E., 2010, s. 81). İlköğretim ikinci kademenin eğitim-öğretim süresi tutum değişimi için yeterli gelmemiş olabilir veya kullanılan öğretim programı, yöntemler etkili olmadığından böyle bir sonuç çıkmış olabilir.

Anne-baba eğitim durumuna ait toplam çevre bilgi düzeyi puan ortalamaları arasında anlamlı fark görülmüştür. Anne-baba eğitim düzeyi ve çevre bilgi testi analiz sonuçlarını destekleyen Makki vd.' nin (2004) çalışmasına göre anne-baba eğitim düzeyi, öğrencilerin çevre bilgi düzeyini etkilemektedir. Anne ve babanın eğitim düzeyleri artıkça çevre konularında farkındalıkları artmış olabilir. Anne ve babanın farkındalıkları davranışlarına yansıdıkça, çocukları bu davranışları örnek almış olabilir. Anne ve babalar çevre ile ilgili bilgilerini çocuklarına öğretmiş ve bu doğrultuda onlara yaşam ortamı, örnek davranışlar sunmuş olabilir. Aslan vd. (2005), Gökçe vd (2006), Çepni ve Aydın (2010) tarafından yapılan araştırmalara göre ise çevre bilgi düzeyi ve anne-baba eğitim seviyesi arasında anlamlı bir fark bulunmamıştır.

Anne-baba eğitim düzeyine ait genel çevre tutum düzeyi puanları arasında anlamlı fark bulunmamıştır. Erol ve Gezer (2004), Aslan vd. (2005), Gökçe vd. (2006), Sadık ve Sarı (2007), Çepni ve Aydın (2010), öğrencilerin çevre tutumları ile anne-baba eğitim düzeyi arasında anlamlı fark bulmamışlardır. Bu sonucun nedeni anne-babaların, çocuklarının tutumu üzerindeki etkisinin azalması olabilir. Genel olarak anne ve babalar çocuklarının tutumlarında etkilidir ama çocuklar büyüdükçe bu etki azalmaktadır. Özellikle ergenlik döneminin başlamasıyla diğer sosyal etkenlerin rolü giderek fazlalaşmaktadır (Tavşancıl, E. , 2010, s. 80). İlköğretim öğrencilerinin çevreye yönelik tutumlarında anne-baba eğitim düzeyinin etkili olduğunu belirten çalışmalar da bulunmaktadır (Makki vd, 2004; Şahin ve Erkal, 2009).

Öğrencilerin öğrenim gördükleri okullara ait toplam çevre bilgi testi ve çevre tutum ölçeği puan ortalamaları arasında anlamlı fark olduğu görülmektedir ($p<0.05$). Aslan vd (2005) okullara göre öğrencilerin çevre bilgi ve tutumlarında anlamlı farklılıklar tespit etmiştir. Ek vd (2009) yükseköğretim öğrencilerinin; okudukları okulun, çevre bilgi ve tutumlarını etkilediğini saptamıştır. Sadık ve Sarı (2007) çevre davranış alt ölçeğinde çevre dersi alanların lehine anlamlı farklılık bulmuştur. Öğrencilerin çevre bilgi ve tutumunda okul değişkenin etkisi görülmektedir. Bu etkinin kaynağı; okulun teknik olanakları, yerleşkesi, öğretim programı ve bu programda çevre meselelerine ne kadar yer verildiği, öğretmenleri olabilir.

İlköğretim ikinci kademede verilen çevre eğitiminin öğrencilerin çevre bilgisi üzerine yeterince etkili olmadığı görülmektedir. Bu yetersizliğin kaynağı olabilecek durumlar yeni araştırmalarla daha detaylı bir şekilde tespit edilmelidir. Örneğin çevre eğitiminde kullanılan

yaklaşımlar, yöntemler incelenmelidir. Kızlar ve erkeklerin ilgilerine göre daha çeşitli yöntemler, materyaller geliştirilmelidir. Öğretmenlerden kaynaklı olabilecek çevre eğitiminin eksiklikleri belirlenmelidir. Okul bahçesi, laboratuvar, sınıfların tasarımının ne kadar çevre dostu ve çevre için farkındalık oluşturduğu belirlenmelidir. Tutum; yaşantı ve deneyimler sonucu oluşan bir durumudur (Allport,1967,s.4; Akt: Tavşancıl, E., 2010, s. 65). Bu nedenle çevreye yönelik olumlu tutum kazandırmak için öğrencilere çevre ile deneyim yaşayacakları ortamlar sunulabilir, etkili yöntemler kullanılabilir. Anne- baba eğitim düzeyine göre, öğrencilerin çevre tutum puanları arasında anlamlı fark görülmemiştir ama öğrencilerin çevre tutum puanlarının yüksek olduğu görülmektedir. Çevreye yönelik tutumu etkileyen farklı değişkenler ve süreçler tespit edilmelidir. Öğrencilerin çevre bilgi ve tutumunda anne-baba eğitim düzeyinin, anne-babanın rolünün daha detaylı incelenmesi gerektirmektedir. Bu durum özellikle anne-babalara yönelik çevre eğitiminin gerekliliğini ve okul-veli-öğrenci iş birliğinin önemini göstermektedir.

Bireyler için ilköğretim dönemi bilgi, tutum ve davranış temellerinin atıldığı önemli bir zaman dilimidir. Yapılan önerilerin bu zaman diliminde, çevre eğitiminin niteliğini artıracağı ve yeni düzenlemelere katkı sağlayacağı düşünülmektedir.

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A Survey on Elementary School Students' Environmental Knowledge and Environmental Attitudes

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SYNOPSIS

INTRODUCTION

Human beings have shaped the nature for their needs and benefited from the world from the start of their being in the world to today. Forests, pastures have been converted into agricultural lands in the agricultural period with the aim of animal raising and plant growing. Machine power gained importance with Industrial Revolution and use of fossil fuel increased; as a result, severe ecocide has been started.

States realised those irreversible environmental disasters in 1970s and The First Conference on Human Environment was held in Stockholm in 1972 and the concept of environmental education was introduced. Decision on international cooperation was taken regarding the solution of environmental problem with the International Workshop on Environmental Education in 1975 and Tbilisi Declaration in 1975, and projects were developed and budgets were provided for this topic (UNESCO-UNEP, 1976; Aktaran: Darner, 2007). In order to be successful in the studies conducted and maintain their sustainability, it was determined that individuals who are the main reason of environmental problems should take the responsibility in the solution. The best method for this was determined as environmental education, and decision that importance should be attached to environmental education in curricula was taken (Ünal & Dımışkı, 1999:144-146).

In Turkey, environmental education came to the fore by the end of 1980s with the adoption of environmental right in 1982 Constitution and agreements on environment. However, environmental education topic wasn't included in pre-school, primary and secondary school programme until 1991. Ministry of National Education introduced the subjects of Environment, Health, Traffic and Reading in all grades of primary school in 1992 but abolished these subjects in 1997 (Alkıs,2002).

After Rio Summit held in 3-14 June 1992, efforts on environmental education seems to gain momentum gradually also in our country starting from 7th Five Year Plan issued by Prime Ministry State Planning Organisation in 1994 (Güler, 2007).

The curricula started to be applied in 2005 doesn't include any subject regarding environmental education in both pre-school and primary and high school. However, some topics such as information on environment, sensitivity development were tried to be included in the other subject's programme.

Environmental education covers information, attitudes, motivation and skills that enable people to notice environmental problems and to study on the solution of these problems (Örnek, 1994: 2; Ayvaz, 1998: 98; Gökler, 1999; 19). In most of the studies conducted to search the effects of environmental education delivered in schools, students were identified to have generally low level of environmental education (Morgil et al., 2002; Atasoy, 2005; Armağan, 2006). According to Demirbaş and Pektaş's (2008) study, children correctly answered the questions related to environmental problems they frequently encountered in their daily life. However, they answered wrongly the questions such as greenhouse effect, global warming etc. which are one of the current problems but thought not to be emphasised much in learning environment. According to the study carried out between 15 and 19 year old students by Anderson and Wallin (2009), students don't know entirely what kind of results the decrease in carbohydrate emissions create in the society. Besides, it is found out how they are rarely informed on how ozone layer depletion will affect the human beings. According to the study by İncekara and Tuna (2010) with the aim of measuring secondary school students' knowledge level on environmental issues: students' knowledge on an environmental phenomenon is at the level of "I know enough to explain", however, it was understood that they don't have sufficient information about some phenomena. Students seemed to be stranger to the international developments about environment regarding also Turkey.

Environmental education directs not only knowledge and process capability but also attitude, life skills and actions (Braus, 1995). Numerous studies have been carried out on environmental attitude in terms of different variables (Bonnet & Williams, 1997; Atasoy, 2005; Erol & Gezer, 2006; Gökçe et al., 2006; Sadık & Sarı, 2007; Aslan vd., 2008; Teyfur, 2008; Kahayoğlu et al., 2008; Ek et al., 2009; Aydın & Çepni, 2010; Sarkar, 2011). Based on the gender variable, a significant difference in favour of females was observed in studies in general (Atasoy, 2005; Kahyaoğlu et al.,2005; Gökçe et al., 2006; Aslan et al., 2008; Kaya et al., 2009; Sarkar,2011). Erten (2002) identified that realisation of various beneficial studies for environment such as recycling of waste batteries, plastic bottles and cartons etc. is weak in the study in which environmental attitude of 6^{th}, 7^{th} and 8^{th} grade students was searched. It is identified how and how much families serve as a model for their children with their attitude to the environment. Şimşekli (2002) examined the topic in terms of activities, school director and contribution of responsible teacher under the project "Practical Environmental Education" conducted in primary schools. Teachers' not having enough consciousness on environment is observed as one of the factors that make environmental education difficult. Also, it was observed that the number of the activity was not sufficient to contribute to create awareness among students in schools.

In order to struggle with environmental problems increasing rapidly and to decrease these problems, today's children as the adults of future should be brought up in a way to have an effective environmental consciousness and sensivity. The best period for developing this consciousness and sensitivity after family environment is particularly pre-school and primary school periods. Especially for the future of a developing country like Turkey, environmental education curricula is a significant topic which needs to be emphasised meticulously as it is in all other countries. This study aims to assess the impact of environmental education in primary schools from the perspective of students' environmental knowledge and attitude. Besides, it aims to analyse the effect of variables such as gender, class, school and education level of parents on environmental knowledge and attitude of students. Analysing these variables may ensure true and effective directing of resources allocated for environmental

education such as teacher training, cooperation between school and family, environmental education programme and methods, school design. Environmental education programme may be designed more beneficially and more productive results may be obtained by identifying the variables effective on environmental education and attitude.

PURPOSE of THE STUDY

The aim of this study is to determine whether there is a significant difference in environmental attitude and knowledge of students with respect to the variables such as gender, school level, educational status of parents and school.

METHODOLOGY

a) Sample:

Research was carried out in the 2nd term of 2011-2012 academic years. Sample of this study is total of 846 students; 6th, 7th and 8th grade elementary school students were randomly selected in 10 different elementary school in center of Konya.

b) Research Design

Descriptive method was used in the study. This method is used to define and make evaluations on person, event or phenomen in their own conditions without changing and affecting them (Karasar, 2008).

c) Instruments

Data were gathered by using the Children's Environmental Attitudes and Knowledge Scale (CHEAKS) developed and validated by Leeming and Dwyer (1995). The scale was translated and adopted into Turkish by Aslan, Uluçınar and Cansaran to assess students' knowledge on environmental issues and their attitudes toward the environment.

c1) Environmental Knowledge Test (EKT): The Knowledge subscale of CHEAKS consists of 17 items that measure students' knowledge regarding environmental concerns. These multiple-choice items comprise four content dependent subdomains: recycling, pollution, energy, and general knowledge on environmental issues. The Cronbach's alpha reliability of the Turkish version of knowledge subscale was calculated as 0.690. The Cronbach's alpha reliability of knowledge subscale which was applied to 846 students was 0,680. Knowledge test scores vary between 0-100.

c2) Environmental Attitude Scale (EAS): The Attitude subscale consists of 24 five point likert type items and Cronbach's alpha reliability was calculated as 0,860. When the study was applied to 846 students, Cronbach's alpha reliability was found as 0,917. "Strongly agree", "Agree" options were used for positive statements; whereas "Disagree" and "Strongly disagree" options were used for negative statements. "Undecided" option was used for the statement that doesn't exist in this range. These five-point Likert-type items (strongly agree, agree, undecided, disagree, strongly disagree) the same content-dependent sub domains as the knowledge sub domains: recycling, pollution, energy, and general attitude to environmental issues. Scoring system of the statements in the survey is as : "Strongly agree": 5 points, "Agree": 4 points, "Undecided": 3 points, "Disagree": 2 points, "Strongly disagree": 1 point.

d) Data Analysis

The participant students were informed about the purpose of the study and directed before the administration of the instrument. Students were given 40 minutes for the implementation of scale. The Statistical Package for the Social Sciences (SPSS, version 15.0) was used to analyse data. Means and standard deviations were determined through descriptive statistics to assess participants' environmental knowledge and attitudes. To determine the effect of grade level, school, and parental education level on participants' environmental knowledge and attitudes, appropriate mean scores were compared by using one-way analyses of variance (ANOVA). Post-hoc tests were conducted to determine which specific groups were significantly different from each other. Independent samples t-test analysis was used to evaluate the gender difference in environmental knowledge and attitude.

RESULTS

Students' environmental knowledge is not too high but environmental attitude is high. The significant difference is determined between students' environmental knowledge scores with respect to gender (in favor of girls), grade levels, mothers' education level, fathers' education level, and school. There is a significant difference was determined between 8^{th} grade and 6^{th} grade, between 8^{th} grade and 7^{th} grade in favour of 8^{th} grade. There is a significant difference between students' whose mother undergraduate and students' whose mother with other graduate degree in favor of undergraduate. there is a significant difference between students' whose fathers have undergraduate degree and students' whose fathers have primary, and secondary school degree in favor of undergraduate degree. There is a significant difference in environmental attitude of students is shown in the sense of gender (in favor of girls), school. Any significant difference wasn't determined between students' environmental attitude scores with respect to their grade levels, mother's education level, fathers' education level.

DISCUSSION and CONCLUSIONS

Environmental attitude of students is high, but their knowledge on environment seems to be insufficient. As long as their grade level increases, their environmental knowledge level also increases. The reason could be because it is getting easier for students to understand environmental concepts as long as they get older. However, environmental knowledge of students is not sufficient according to general results. It may be because environmental education applied is insufficient or environmental issues are not adequately addressed in science curricula.

There is a significant difference between point average of total environmental knowledge and environmental attitude in favour of girls. This may be because girls are more emotion-focused and more sensitive towards their environment. Also, experience in domestic works may also cause this result.

No statistically significant difference was found between environmental attitude levels with respect to students' grade level. Education period of the 2^{nd} grade of primary school might be insufficient for attitude change or this result may be because curriculum and methods used could be ineffective.

Statistically significant difference was found in point average of total environmental knowledge level, belonging to education status of parents. As long as education level of parents increases, their awareness on the environment might increase. As their awareness reflects on their behaviours, their children might take these behaviours as an example. Parents might teach their environmental knowledge to their children and might present habitat and model behaviours in this regard.

No significant difference was found between the points of general environmental attitude level belonging to education level of parents. The reason of this result is probably because influence of parents on their children attitude is decreasing. Parents are generally influential on the attitude of their children; however, this influence is decreasing as children grow. Particularly, the role of other social factors is increasing with the start of puberty (Tavşancıl, 2010, s. 80).

Difference between total environmental knowledge test in the school where students receive education and point averages of environmental attitude scale seems significant ($p<0.05$). The effect of school variable is seen in environmental knowledge and attitude of students. The source of this effect may be the technical opportunities of school, campus, education programme and how environmental issues are included in the programme.

Environmental education delivered in the 2nd grade of primary school seems to be inefficient enough on environmental knowledge of students. Situations which can be the source of this insufficiency should be determined with more detailed new researches. For example; approaches and methods used in environmental education should be investigated. Different methods and materials should be developed considering the interest of females and males. Insufficiencies in environmental education due to the teachers should be determined. How an environmental friendly design of school garden, laboratory, classes can be created and how awareness can be raised for the environment should be identified. Attitude is a situation resulting from life and experience (Allport, 1967, s.4; Akt: Tavşancıl, 2010, s. 65). Therefore, environments in which students can obtain experience on environment may be presented to the students in order to enable them to gain positive attitude on environment, and effective methods may be used. No significant difference was realised in environmental attitude points of students in terms of education level of parents, but environmental attitude points of students seems to be high. Different variables and processes influencing the attitude on environment should be identified. Education level and the role of parents in environmental knowledge and attitude of students should be investigated in detail. This situation particularly shows the necessity of environmental education for parents and the importance of cooperation between school-parents-students.

Primary school is an important period of time when the basis of knowledge, attitude and behaviours is established. Suggestions presented are thought to increase the quality of environmental knowledge and to contribute to new arrangements in this period.

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