



## ANALYSIS OF THE SCIENCE AND TECHNOLOGY PRESERVICE TEACHERS' OPINIONS ON TEACHING EVOLUTION AND THEORY OF EVOLUTION

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### Abstract

In this study, we investigate of science and technology teachers' opinions about the theory of evolution and the evolution teaching. The aim of this study, we investigate of science and technology teachers' opinions about the theory of evolution and the evolution teaching. This study is a descriptive study. Open-ended questions were used to determine the views of pre-service teachers. Questions used in the statistical analysis of data for obtained student's through. Solution to the problems encountered in practice as a method for the production of research so descriptive research approaches used in the survey method. This study was applied Department of Science Teaching at the Faculty of Education students in the last class. Department of Science Teaching 90 students participated the study in Bayburt University. The 90 students in the sample and all of the mare 46 female and 44 male. The findings of the study about students opinion for evolution that coming from a common ancestor and such as Darwinian theory. In addition students will not be denied the fact that the evolution of science but from the point of view of society reported a negative effect on the teaching of evolution

**Key Words:** The theory of evolution, evolution education, Science and Technology preservice Teacher.

### INTRODUCTION

Human beings by nature have been curious about phenomenon in their environment and this sense of curiosity has caused the human beings to analyse this phenomenon. Human beings particularly known for their interest in living beings have observed them in their environment since the ancient times and they have tried to make deductions. Scientific disciplines intended for the observation of living beings have emerged in this process which started with the observations of living things by human beings in their environments and has continued up till now.

One of the aims to examine the living beings is to reveal the similarities and differences between the living things. This purpose is one of the fundamental functions of biology discipline. Evolution theory is one of the comprehensive theories which explain the similarities and differences of living beings in cause and effect



relationship (Alters & Nelson, 2002). The studies related to evolution are so old that the beginning of the studies conducted extends to pre-historic times. Evolution concept began to be studied scientifically in the 18<sup>th</sup> century and it involves subjects such as cell structure in biology, cell division, genetics and reproduction and concepts in detail. Therefore, this concept is a subject which has always been discussed (Aydın, 2009).

Evolution as a process has always gone on in the history of the earth and it became famous with Charles Darwin. Darwin defined evolution simply as "the change process of living and non-living beings." (Akyol, Sungur & Tekkaya, 2010). The concept of evolution is also not constant and it changes in the light of new scientific studies in time. This variation has given an opportunity to evolution to make contributions to science. Evolution has made two important contributions to science. One of them is to accumulate series of evidence which promotes organic evolution idea and present it to the science world by organizing it. The second one is to reveal the principles of "Natural Selection" which form the basis of evolution theory (Kılıç & Tekkaya, 2011). It is thought that although evolution is supported in scientific environment, it has been mostly a controversial topic in the society (Beardsley, 2004; Bishop & Anderson, 1990; Köse, 2010; Wiles, 2010). While Darwin was introducing and defending the principles, he did not take into account an important factor which is social dimensions. There are some criticisms expressed within the context of two hypotheses introduced by evolution. One of the criticisms is that evolution theory is an idea with a purpose of generalization (Çetinkaya, 2006; Kılıç, Soran & Graf, 2011) because evolution theory inks adaptation of living beings to environment and their survival. It also explains the survival of living beings with their adaptation to the environment which also makes a very important contribution to our knowledge (Demir, 2009). According to the second criticism, when this theory is particularly applied to social relations or development of civilizations, it protects the strong who eliminates the weak, and tries to legitimize them (Alles, 2001). Still another criticism at this point is whether this theory suits to our present knowledge or not. If this theory suits to our present knowledge, to what extent it suits (Kılıç, Soran & Graf, 2011). There are adverse opinions about this subject. There are opponents who support the approach that the weak who cannot compete in nature disappears. On the other hand, there are those who argue that there are observations and examples which reveal that living things protect each other according to cooperation (Akyol, Sungur, Tekkaya, 2010; Demir, 2009). These views were not only limited to the following discussion fields but also they had effects on the condition and learning process of evolution theory, an important subject in biology, in teaching environments.

There are studies conducted about teaching evolution to reveal the lack of student knowledge about evolution theory (Asghar, Wiles & Alters, 2007; Deniz, Donnelly & Yılmaz, 2008; Kılıç, Soran & Graf, 2011; Kim & Nehm, 2010; Köse, 2010; Smith, 2010). Literature suggests that the problems students have about their attitudes and perceptions towards evolution, learning and their acceptance of evolution as an important theory in biology have not completely been eliminated yet (Bishop & Anderson, 1990; Green, 1990; Settlage, 1994; Sinclair, Pendarvis & Baldwin, 1997). The results of the research conducted about the acceptance of evolution theory reveal that there is a negative relationship between the religious belief levels and positive attitudes developed towards evolution theory (Crawford et al., 2005; Sinatra et al., 2003). The main reason for this negative relationship may have resulted from different explanations of "origins of human beings" by evolution theory and belief systems (Apaydın & Sürmeli, 2009). Prejudice in the society towards evolution theory occurs as the subject is associated with religious beliefs and it is brought to agenda. This condition manifests itself in schools and the school administration and families reflect their views about evolution on the instruction in classrooms (Çetinkaya, 2006).

While teachers were giving their reasons for not preferring to teach evolution theory in literature, they gave justifications such as lack of content knowledge to teach evolution, anxiety about not being able to answer the questions of curious students, lack of guidance and support from education programs and lack of interest in the subject (Apaydın & Sürmeli, 2009; Kılıç, Soran & Graf, 2011). In this study the views of pre-service science and technology teachers about evolution theory and teaching evolution will be examined.

## METHOD

The study carried out to reveal the pre-service science and technology teachers' views about evolution theory and teaching evolution is a descriptive research. Open-ended questions were used to determine the pre-service teachers' views. Statistical analyses of the data obtained with the questions were used. Therefore, survey method, one of descriptive research methods, was chosen in order to investigate the problems encountered during implementation and generate solutions. Survey method is survey arrangements carried out on the entire population or a group or sample drawn from a population to pass general judgment in a population composed of many elements (Yıldırım & Şimşek, 2004). Generalizations are tried to be obtained over statistical analysis of the data obtained via questions. After a big picture of the situation is drawn, case studies are started by taking a very special section out of the big picture (Çepni, 2012).

### Sampling of the Research

The research was carried out with the students in the 4<sup>th</sup> year of their studies in Science Teaching Department of Bayburt Education Faculty in Bayburt University. 90 students studying in Science Teaching Department in Bayburt University participated in the study. 46 of the participants were females and 44 of them were males.

### Data Collection Tools

Five open-ended questions designed to reveal the pre-service science and technology teachers' views about evolution theory and the teaching of evolution were used as data collection tools. In addition to this, observations carried out by the research during the administration were used. The open-ended questions which were going to be asked to the students were evaluated by asking expert opinions with regard to content, language, clarity and intelligibility. Necessary changes were made and the questions were finalized in line with expert opinions.

### Data Analysis

The data obtained through interviews carried out with pre-service science and technology teachers were analyzed by content analysis method. In content analysis the data which are similar to each other are gathered within the framework of specific concepts and themes and then they are organized and interpreted clearly (Yıldırım & Şimşek, 2004). The data were classified and evaluated in line with this method. The data obtained from the answers given to the questions by the pre-service teachers were analysed and they were independently sorted out and grouped. Then these categories were compared with each other and finalized. The data were analysed and their frequencies (f) and percentages (%) were given. The responses of the pre-service teachers were also quoted.

In addition to this, while the research questions were designed, the researcher benefited from the studies conducted by Apaydın & Sürmeli (2009), Akyol, Sungur & Tekkaya (2010), Kılıç & Tekkaya (2011). The reliability of the questions used in the study was thought to be provided. Moreover, the reliability of the questions was provided by benefiting from expert opinions and the literature. The flow chart of this study was given in Diagram 1. Moreover, the findings obtained from the analysis were presented in detail in the next section of the study.

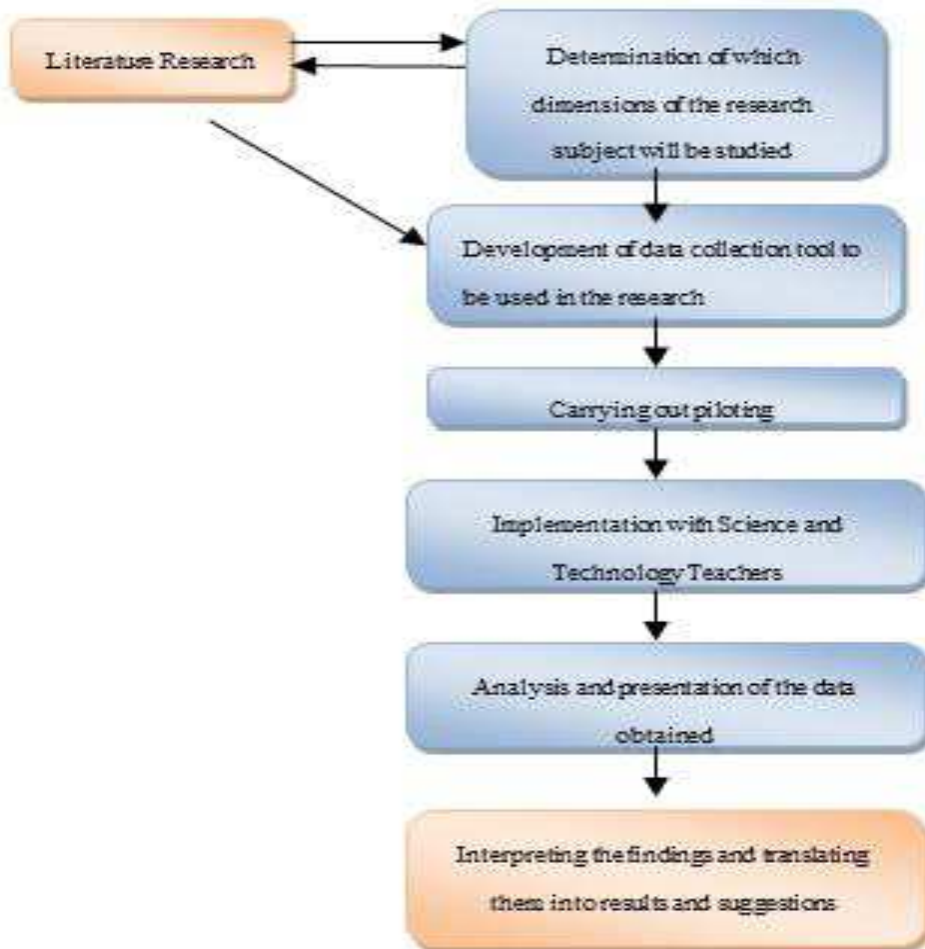


Diagram 1: Flow chart of the study

## FINDINGS

The findings obtained as a result of analysis results of the responses given to the five open-ended questions designed to determine the views of pre-service science and technology teachers about evolution theory and teaching of evolution were presented below.

### Students' views about evolution concept

Students were asked the following question: "What is the first thing that comes to your mind when you've heard evolution?" This question aimed at presenting what students understood from evolution mainly. The subjects which the students particularly emphasized were grouped and presented in Table 1.

Table 1: Students' views about evolution concept

Student Views	<i>f</i>	%
People evolved from apes	35	39
Darwin and Darwin's theory	22	25
Ideas which do not accord with a belief	9	10
Transformation of species into other species in time	20	22
Extinction of dinosaurs	2	2
Ideas which do not accord with reason	2	2

When the responses are analysed, the first idea that comes to students' mind when they have heard evolution is that "people evolved from apes." (% 39). The following statement of a university student can be given as an example: "When I first heard evolution, I think the first question that came to my mind was how we evolved from apes." Moreover, it was determined that a considerable majority of pre-service teachers (% 25) identified evolution with Darwin. For example, one of the university students said, "To me evolution means Darwin and his theory." Moreover, students evaluate evolution from the viewpoint of the phenomenon presented by this theory which says "transformation of species into other species in time." (% 22). The following statement by one of the university students explains this situation: "The idea which suggests that how origin of species derived from each other comes to my mind. Moreover, what comes to my mind is how one species descended from the other species or how a living being is formed."

#### Students' positive or negative views about revolution

Students were asked the following question: "In your opinion what are the positive or negative sides of evolution? Explain it with your reasons." This question aimed at revealing the general views of the students about evolution and underlying reasons for these views. The subjects which the students particularly emphasized were grouped and presented in Table 2.

Table 2: Students' positive or negative views about revolution

Student Views	Reasons	f	%
POSITIVE	Examination of development phases of living things	20	22
	Urge people to think	5	6
	Giving information about the recognized and unrecognized living beings	14	16
NEGATIVE	Descend from common ancestor	40	44
	Natural selection	2	2
	Unproven	9	10

When the positive or negative views of the pre-service teachers about evolution were analysed, it was revealed that more than half of the pre-service teachers had negative views. It was revealed that a majority of the students (% 44) who expressed negative views did not agree with the idea which said that living beings descended from common ancestor and they regarded the idea as negative. A university student stated, "The idea which says that human beings and some animals descended from common ancestor sounds crazy." A considerable majority of university students (%22) who had positive views stated that evolution was beneficial when the development phases of living beings were examined and it made contributions to science. For example, a university student said, "To me, the most important contribution of evolution is that it explains which living beings emerged when and it processed the development phases of living beings. Moreover, a considerable majority of students (% 16) stated that evolution gave information about the living beings that were recognized and unrecognized today. A statement of a university student which represented this situation can be given as an example: Evolution enabled us to have information about all the recognized and unrecognized living beings."

#### Students' views about scientific aspects of evolution

Students were asked the following question: "Does evolution have a scientific aspect? Explain it with your reasons." This question aimed at revealing the students' views about scientific aspects of evolution and the probable causes of their views. The subjects which the students particularly emphasized were grouped and presented in Table 3.

Table 3: Students' views about scientific aspects of evolution

Student Views	Reasons	f	%
<b>Scientific</b>	Investigation of development of natural events and living things	15	18
	Giving opportunities to generate new ideas and views	11	12
	Based on concrete data	4	4
	Based on experiments and observations	9	10
	Presenting evidence	11	12
	Being a theory	3	3
<b>Unscientific</b>	Based on an individual idea and a hypothesis	11	12
	Contradicting with religious beliefs	9	10
	Lack of conclusive evidence	12	13
	Including invalid information	5	6

Based on the question asked to the students about evolution, the students were asked to question the scientific aspects of evolution. More than half of the students stated that evolution had scientific aspects (% 59). Majority of the students who expressed that evolution had scientific aspects argued that evolution investigated development of natural events and living beings, gave opportunities to generate new ideas and views and presented evidence within its framework. In order to exemplify each situation, the following statements by university students can be given: "Evolution has a scientific aspect. With the help of scientific investigation it would not be known what the next living beings looked like before or we would not know where the extinct species lived or what they looked like from their fossils.", "Of course evolution has a scientific aspect because evolution emerged based on the results obtained from fossil evidence.", "I think that everybody should know their views about evolution and consider them. Besides, a person who investigates and thinks can find what is logical and synthesize them." %41 of the students stated that evolution did not have scientific aspects. While some of the student who explained why it was unscientific argued that evolution was based on individual ideas and hypothesis (% 12), some of them argued that evolution did not have concrete evidence (% 13). The following statement of university students can be given as examples: "I don't believe that evolution has a scientific aspect when I consider the periods in evolution because they opine and make explanations based on assumptions. For example, how do these people know what happens when a shooting start hits the Earth?", "If evolution were scientific, there would be definite and clear answers. It must be proved as the sun rises in the east. This theory had already been refuted by today's scientists."

#### Students' views about the concerns about teaching evolution

Students were asked the following question: "Do you feel concerned about teaching evolution? Explain it with your reasons." This question aimed at revealing whether students were concerned about teaching evolution or not and the probable causes of their views. The subjects which the students particularly emphasized were grouped and presented in Table 4.

Table 4: Students' views about the concerns about teaching evolution

Student Views	Reasons	f	%
<b>I am concerned</b>	Evolution involving many complicated phases	2	2
	Lead off the students with weak religious beliefs	27	31
	Students' consideration that teachers may adopt this view	8	9
	It is difficult for teachers to teach a concept /phenomenon which the teacher does not seem to accept as logical or adopt.	8	9
	Base on probabilities and lack of concrete data	4	4
	If the complicated phases are explained meaningfully and gradually, there will not be concern..	3	3
	Evolution encourages students to think and arouse curiosity and lead them to study	4	4

<b>I am not concerned</b>	Because it is a theory, evolution is science and must be taught like the other sciences	22	25
	Explain the wrong sides of the theory to the students	6	7
	The lesson should be taught in order to eliminate the prejudices	4	4
	No questions about this topic is not asked in the tests administered by the institutions	2	2

When the percentages of the students who responded to the question which asked to determine whether they felt concerned about teaching evolution or not was examined, it was discovered that more than half of the students felt concerned about teaching evolution (% 55). When the students' reasons for feeling concerned were examined, it was revealed that evolution had aspects which contradicted with religious beliefs and therefore it was believed that teaching evolution would have negative effects on the students with weakness of faith (% 31). The following statement of a university student can be given as an example: "If we compare evolution with our religion, primary students may not be able to realize the differences between evolution and religion and it may cause them to diverge to different things. That's why I am concerned." The findings obtained reveal that % 45 of the students do not have concerns about teaching evolution. When student responses which do not have concern were examined, a considerable majority of students (% 25) stated that evolution must be described as science and evolution must be taught. For example, a university student stated, "Evolution is a branch of science. Science also means sense of curiosity, questioning, and adding new information to already existing knowledge. Acquiring new information and transferring the newly acquired information to others correctly do not concern me.

#### **Students' views about importance of teaching evolution**

Students were asked the following question: "Is teaching of evolution important? Explain it with your reasons." This question aimed at revealing the students' views about importance of teaching evolution and the probable causes of their views. The subjects which the students particularly emphasized were grouped and presented in Table 5.

Table 5: Students' views about importance of teaching evolution

<b>Student Views</b>	<b>Reasons</b>	<b>f</b>	<b>%</b>
<b>NECESSARY</b>	Having vast accumulation of knowledge and being scientific	22	24
	Investigating fossils	8	9
	Important due to general knowledge	5	6
	Having knowledge about extinct animals	8	9
	Urge people to think	6	7
	Knowing about the developmental stages of nature and living beings from past to present	13	14
<b>UNNECESSARY</b>	Based on assumptions and interpretations	10	11
	Not scientific	5	6
	Having reservations in terms of religion	11	12
	Involving many different views	2	2

When the students' views about the importance of teaching evolution were examined, it was revealed that a great majority of the students stated that teaching evolution was necessary (% 69). Most of the students (% 24) who stated that teaching evolution was necessary argued that evolution had rich accumulation of knowledge and it was scientific. The following view of a university student represents the situation: "People should have information about evolution which has still been debated and has a scientific aspect. People can object to evolution which indicates that evolution has a scientific background. Moreover, taking evolution education does not mean to accept evolution. In addition to this, when the student responses who stated that teaching of evolution was unnecessary were examined, the students argued that it was mostly inconvenient in terms of religion (% 12) and evolution was based on only assumptions and interpretations (% 11). The following



statements of the university students can be given to exemplify these two conditions: "To me, it is very important and necessary because most of the things explained are only assumptions and the interpretations of the people and because you cannot know whether it belongs to the man's or living being's skull by examining the fossil evidence. You can not claim that it is the ancestor of a former living being", "I think teaching of evolution is wrong especially at primary education in terms of religion as it says "man evolved from apes".

## DISCUSSION AND RESULTS

When the findings were examined, it was revealed that a great majority of the students attributed meanings such as Darwin's theory and descending from common ancestor. It was thought that this situation arose from the fact that evolution was only taught as a separate unit in the last grade of secondary education and therefore the subject of evolution made it difficult to establish a connection with the subject matters of biology course. It was determined that a considerable majority of students stated negative views about evolution due to the dominant idea which said that human beings descended from common ancestor. Similar situations were revealed in the study conducted by Akyol, Sungur & Tekkaya (2010).

It was thought that why the pre-service teachers disapproved of teaching the subject was that they were concerned that the people who told the subject would be branded by the society. Moreover, pre-service teachers stated that students would react to the subject due to their religious beliefs and value judgments and also the subject would cause confusion in primary students' minds. Another point which was frequently mentioned by the pre-service teachers was that society in general looks most often to the subject with prejudice. This prejudice suggests that the negative views observed with the pre-service teachers about teaching evolution might have resulted from the society's view points. There are also similar situations in literature (Akyol et al., 2010; Graf et al., 2011; Kılıç & Tekkaya, 2011).

Some students who stated the importance of teaching evolution drew the attention on the fact that evolution is a science and it cannot be denied. When they indicated that the wrong aspects of this theory should be revealed and taught to students, it was thought that they acted upon the refutability quality of scientific knowledge while evaluating evolution (Popper (1979). In addition to this, it can be implied that a considerable majority of the pre-service teachers thought that evolution has a scientific aspect which led the great majority of teachers to state that teaching evolution is essential. The view which pre-service teachers who stated that evolution did not have a scientific aspect relied on the basis that evolution was completely proved. It can be stated that formation of such a way of thinking with the pre-service teachers arises because pre-service teachers see scientific knowledge substantially as a common property of a society or as nothing (Kuhn, 1970). The results obtained from the study reveal that the scientific and pedagogical knowledge of pre-service teachers is important to deal with the difficulties students have in understanding evolution and the concepts of scientific theory. The research has made important contributions to the institutions which train teachers. It is also considered that the findings obtained will make contributions to the development of the programs, such as in-service training, courses, seminars, which will promote the professional development of teachers. This study is limited to pre-service science and technology teachers. It is suggested that more teachers and pre-service teachers should be included in the sampling of the study.

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