



Impacts of Anti-Evolutionist Movements on Educational Policies and Practices in USA and Turkey

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ABSTRACT. This paper discusses the place of evolutionary theory in science curriculum and teaching practices in USA and in Turkey. Anti-evolution works of similar institutions both in USA and Turkey are also compared. The controversy regarding the teaching of evolution has been an issue in both countries. However, legal actions and educational research about the factors affecting the teaching of evolutionary theory in classrooms took place mostly in USA. In the article five main topics were addressed: (a) importance of evolutionary theory in science, (b) controversy on teaching of evolution (c) place of theory of evolution in elementary and secondary science curriculum in USA and in Turkey, (d) teachers' attitudes toward theory of evolution, and (e) students' understanding about the theory of evolution and related topics. Factors and policies affecting the teaching of evolution in classroom in Turkey are also discussed. In conclusion, anti-evolution movements in Turkey which shows similarities with the anti-evolution propaganda in USA was found effective in terms of influencing educational policies and practices about the teaching of evolutionary theory in classrooms as well as public opinion on evolution.

Key Words: Evolution, creationism, controversy, science curriculum, teacher's attitudes, students' understanding

INTRODUCTION

Teaching evolutionary theory in science classrooms is a controversial issue. Studies conducted in USA show that public opinion is mostly in favor of teaching creationism in the classrooms rather than teaching evolutionary theory. In current years some State Education Boards in USA have excluded evolution from their science curriculum. Reasons for the conflict regarding this issue may originate from the clash of different worldviews and religious beliefs. However, the importance of teaching evolutionary theory cannot be denied in a world which constantly changes in every aspect. In order to understand the classroom aspect of this conflict and its related problems, teachers' and students' beliefs, and opinions on evolutionary theory have recently been a focus in science education research areas. Teachers' beliefs, knowledge, and acceptance as well as students' understanding of evolutionary theory offers important evidence regarding why and how the theory of evolution should be taught in classrooms.

This article discusses the importance of teaching of evolutionary theory in terms of scientific, political and social perspectives. Significance of evolutionary theory in science as a unifying concept deserves a great deal of attention in science curriculum. However, political agendas from past till today and structure of societies which are shaped heavily by religion not only put evolution into the middle of a great controversy but also affect public opinion on general science. In order to understand the relationships among dynamics of the debate on teaching about evolution, similarities between the 'created' controversy in USA and Turkey, scientific significance of theory of evolution, problems regarding the teaching of evolution in the classroom, teachers' attitudes and beliefs of evolution and students' understandings on the theory of evolution are examined in the following sections of this paper.

Why Do We Need to Know about Evolution?

Evolution is the central organizing principle that scientists use to understand the living world. Charles Darwin and Alfred Russel Wallace were the first scientists who proposed the theory of evolution by natural selection in 1859. Darwin's book, *On the Origin of Species*, outlined the details of the theory. In the 1930s Mendel's work on inheritance was combined with Darwin's natural selection. This combination

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resulted in the formation of “the modern evolutionary synthesis.” The modern evolutionary synthesis refers to a set of ideas from several biological specialties that were combined to form a unified theory of evolution, which is accepted by a great majority of working biologists.

National Academy of Science (NAS) (1998) stated that the importance of the theory of evolution is grounded in its function and power in explaining the similarities among living things, the diversity of life, and many features of the physical world we inhabit. Explanation of these phenomena in terms of evolution draws upon physics, chemistry, geology, many areas of biology, and other sciences. To teach biology without explaining evolution deprives students of a powerful concept that brings order and coherence to the understanding of life (NAS, 1998). Dobzhansky (1973) indicated that:

Seeing in the light of evolution, biology is, perhaps, intellectually the most satisfying and inspiring science. Without that light it becomes a pile of sundry facts- some of them interesting or curious but making no meaningful picture as a whole (p.129).

Ayala (2000) stated that the theory of evolution must be taught in schools, because nothing in biology makes sense without it. She maintains that students need to study the empirical evidence and concept central to scientific knowledge in order to acquire suitable job skills, professional training, and to become informed and responsible citizens.

Biological evolution is clearly one of the most unifying ideas in science. The theory not only has broad explanatory power, but also inspires fruitful research programs in biology as well as several other science disciplines. Clough (1994) indicated that students who are denied an introduction to biological evolution not only receive a false impression of modern science, but also miss one of the most comprehensive frameworks ever conceived by human intellect. Evolution provides a basic understanding of the fundamental characteristics of life at all levels. Thus, students cannot adequately understand the relationships of organisms to each other and to their environment without substantial knowledge of evolutionary theory and population dynamics (Cherif, Adams, & Loehr, 2001).

The importance of the knowledge about human origins and evolution also makes teaching the theory of evolution an essential practice in the classroom. Alles and Stevenson (2003) stated that “the beliefs we hold about ourselves drive our attitudes and our actions and, such as, determine the kind of people we are and ultimately the kind of society we have.” The controversy about the teaching of evolutionary theory in the science classroom is grounded in the false representation of evolution as a belief system opposite of religious beliefs. They argued that scientific knowledge of human origins need not replace faith in the moral teaching of any belief system. However, they indicate that knowledge that creates the theory of evolution is the most valuable knowledge human kind can possess and teach our students (Alles & Stevenson, 2003).

Creationism in Turkey and in the USA

Although teaching of evolutionary theory in school was controversial in the USA for a long time, it has become an explicit argument, which gathered public attention recently in Turkey. Edis (1999) indicated that except the occasional anti-evolutionist movements by Jewish people in Israel, and Muslims in France controversy about the theory of evolution is considered as an American phenomenon. He also indicated that controversy about evolution, anti evolutionist propaganda and Islamic political movements started to grow parallel to each other in Turkey showing similar patterns with the controversy in the USA. After the 1980's military coup in Turkey, government policies provided new opportunities for Islamists to integrate their worldview into educational policies and decisions. Therefore theory of evolution lost its place in the curriculum to “state supported translation and distribution of Institute for Creation Research (ICR) publications” which covered evolution with a highly creationist point of view (Edis,1999).

For the last ten years creationists in Turkey found ways to get public attention and also financial support (Edis, 1999). Bilim Arastırma Vakfi (BAV; the Science Research Foundation), an organization which

declare that their purpose is to protect national and moral values of Turkish Republic, organized conferences in almost every major city including Istanbul and Ankara in 1998 with a title of “The Collapse of the Theory of Evolution: The Facts of the Creationism”. BAV claims that the Theory of Evolution is “supposedly scientific” foundation of the materialistic philosophy that damages the social values and provides ideological base for terrorism in Turkey. BAV also indicates that it is their duty to inform Turkish society about the invalidity of the theory of evolution in the realm of science (BAV, 2008). The honorary president of BAV Adnan Oktar, an interior designer, who uses the pseudonym “Harun Yahya” is the “supposed” author of more than 283 religious, political, and creationists books which were translated more than ten languages and distributed all over the world free of charge. One of his recent publications, *The Atlas of Creation*, comes in 2 volumes, each is about 870 pages and weighs six kilogram, was distributed to every school, and every biology teacher in Turkey and many scientists around the world. The Atlas aims to provide “evidence” against evolution by presenting fossil records that “proves” evolution has never occurred. It is suggested in the Atlas that living things are exactly the same today as they were hundreds of millions of years ago and that life forms emerged suddenly with all their complex structures. However, the Atlas not only provides false information about evolution but also has numbers of mistake against its own claims. Anti-evolutionist publications of Harun Yahya includes books such as “Collapse of the Theory of Evolution,” “Darwinism Refuted,” “The Evolution Deceit,” “The Error of the Evolution of Species” etc. (BAV,2008).

Edis (1999) pointed out the similarities between the ICR arguments and Yahya’s books. He indicated that arguments such as “lack of transitional fossils,” “the impossibility of functioning intermediate forms,” “the fraud of human evolution,” “the unreliability of dating methods” and “the statistical impossibility of evolution at the molecular level” are copied modifications of ICR’s supposedly “scientific” materials, therefore are unoriginal. Sayın and Kence (1999) pointed out that BAV’s publications from the varied fields under the name of Harun Yahya indicate that the author of all these publications cannot be a single person but a commission among politicians, religious figures and fundamentalist media. They also indicated that BAV and ICR has a contact which was apparent in Duane Gish and Henry Morris’s (former presidents of ICR) visits to Turkey to attend the conferences hold by BAV in Istanbul and contributions for the publications (Sayın & Kence, 1999).

Similarity between the works of BAV in Turkey and ICR in the USA points out an obvious conclusion that creationists in both countries follow the same methodology in order to expand their propaganda against the theory of evolution and its teaching in schools. Miller, Scott and Okamoto (2006) stated that Turkey and the USA are the two countries in which the acceptance of evolution is lower than other European countries and Japan. Moreover, acceptance of evolution is lower in Turkey than it is in the USA. Miller et al., (2006) indicated that low acceptance of evolution among Americans is a combined result of pervasive fundamental religious beliefs, the politicization of evolution and a poor understanding of genetics among adults. Considering the result of this study, Turkish public opinion on the theory of evolution may also have been affected by similar reasons. In addition, Sayın and Kence (1999) indicated that “BAV does not face the difficulty of opposing a highly trained and prominent scientific community, as does the ICR in the US where some of the world's most sophisticated scientific knowledge is produced.” The researchers pointed out that scientists and academics as well as science institutions such as TÜBİTAK (the Turkish Scientific and Technical Research Council) and TUBA (the Turkish Academy of Science) published a declaration against Islamic scientific creationists and protested the pseudoscience of BAV in late 1998; however, BAV has not faced strong oppositions from universities and other institutions before this date. Campaigns organized by TÜBİTAK and TUBA against BAV will be discussed in the following sections.

Conflict over the Teaching of Evolution

The state of the conflict over teaching of the evolutionary theory has changed over the time in USA. Antolin and Herbers (2001) indicated that, large numbers of people in USA misunderstand scientific

processes therefore fail to understand how evolution fits into mainstream science. The result is that teaching the science of evolution is endangered in American public schools, despite having survived numerous courtroom challenges. In several states such as Michigan, Texas, Arizona, Illinois, Alabama, New Mexico, Kansas, Nebraska, Idaho, and Kentucky members of state Board of Education and people from the public attempted to change the place of evolution in science standards. These attempts include adoption of textbook disclaimers or anti-evolution policy statements, opposition to use of textbook with good coverage of evolution, various forms of anti-evolution legislations, and pressuring teachers to water down or eliminate teaching about evolution (NCSE, 2008). Direct support for teaching creationism in science classrooms is another important issue. Teachers' use of phrases such as "creation science," "intelligent design theory," "alternatives to evolution" or "evidence against evolution," invited presentations of religious views, or attempts to have creationist books in the classrooms are among the strategies used by creationists. Many of these attempts have resulted in courts. Among these court cases one is especially important in terms of its ruling. In 1967 an Arkansas schoolteacher, Susan Epperson, faced disciplinary action for teaching evolution in her high school biology classes because teaching about evolution was banned with law in Arkansas since 1920s. Epperson sued on the grounds that the state statute was unconstitutional. The State court ruled against Epperson, however the United States Supreme Court ruled in her favor. This case was the first with its ruling in the legal debate over creationism. Now known "as the Epperson ruling," it affirmed that laws which banned teaching of evolution were unconstitutional. Following the Epperson ruling in several other legal cases (*Lemon v. Kurtzman*, 1971; *Daniel v. Waters*, 1975; *McLean v. Arkansas Board of Education*, 1981; *Edwards v. Aguillard*, 1987; *Peloza v. Capistrano Unified School District*, 1993; *Freiler v. Tangipahoa Parish Board of Education*, 1999), tactics to push creationist ideas into science classroom were declared against the Constitution and/or violation to First Amendment.

As a part of science education reform movements American Association for the Advancement of Science (AAAS) and National Research Council (NRC) created projects to standardize the teaching of science in the whole country. Both organizations published their work regarding the importance of science and science education. Project 2061 (AAAS, 1989, p.64) states;

The modern concept of evolution provides a unifying principle for understanding the history of life on earth, relationships among all living things, and the dependence of life on the physical environment. While it is still far from clear how evolution works in every detail, the concept is so well established that it provides a framework for organizing most of biological knowledge into a coherent picture.

The NRC of the USA states that natural selection is the principal mechanism of evolution, and the theory of evolution is of great importance as a unifying theory in biology education according to the National Science Education Standards (NSES) (NRC, 1996). Evolution and the nature of science are major topics in the content standards. The first mention of evolution is in the initial content standards, entitled "Unifying Concepts and Processes." These standards point out that conceptual and procedural scheme unify science disciplines and provide students with powerful ideas to help them understand the natural world. According to the NSES in USA, topics, which need to be addressed in K-12 classroom, are those of diversity and adaptation, the nature of science, history of science, biological evolution, origin and evolution of the earth system, and origin, and evolution of the universe. However, a recent U.S. state by state evaluation of the treatment of evolution in science standards determined that "more than one third of all states do not do a satisfactory job," and "ten states never use the E-word" (Lerner, 2001).

Teaching of evolutionary theory in schools is not banned by laws in Turkey; however, anti-evolutionist propaganda and Islamist political influence on the curriculum created a false image of the theory. As a result, public opinion on evolution was limited to a simple phrase: "it is just a collapsed theory." Moreover, many people including students in higher education think that scientists reject the theory of evolution. Research indicated that their understanding about the topics related to evolution is unsatisfactory (Apaydın & Sürmeli, 2006; Türkmen, Göz & Demir, 2008). In 1998, Sayın and Kence (1999) organized an independent commission including university professors, scientists, TUBA and

TUBITAK in order to “answer the arguments of BAV and to warn the public about the pseudoscience of Islamic scientific creationism” (Sayın & Kence, 1999). This commission made two declarations to oppose the Islamic creationists’ claims about the validity of the theory of evolution. Another declaration published by TUBA in September, 1998 emphasized on the scientific importance and value of the theory of evolution in terms of providing well supported explanations by respected scientists and science institutions to the questions related to life on earth, offering variety of new research areas other than biology, and presenting the developmental stages of transfer of information. TUBA’s declaration also pointed out that the propaganda which claims the theory of evolution lost its validity and was proven to be wrong is completely out of scientific reality. The authors of the declaration indicated that people of this country have the right to learn the methods of science and the ways of scientific thinking in order to contribute to the process of doing science as well as benefiting the technological outcomes of it. It was also argued that unscientific elements should be removed from the educational programs and public should be aware of the real purpose this anti-evolution propaganda which aims to create a society with scientifically illiterate individuals (TUBA, 1999).

Pressure on the teachers in terms of teaching of the evolutionary theory has been another obstacle in Turkey. Turkish teachers have similar problems their American colleagues faced during 1925 when Butler Act was ruled as a law which prohibited public school teachers to teach evolution in Tennessee. After eighty years of Butler Act, five Turkish elementary school teachers and their school principal faced disciplinary actions based on the claim that they have taught theory of evolution in their classes in 2005 (Milliyet, 2005). Although there are no laws forbidding the teaching of evolutionary theory, the applications of rules, and practice of rights may be influenced by the political agenda.

In Turkey, educational programs, curriculum, and policies change under the influence of every new government. The Ministry of National Education (MEB) in collaboration with universities prepares the national curriculum for the current science and technology course which is taught in grades 4-to-8 in elementary education and biology course which is taught in grades 9-to-12 in secondary education. Evolution is not found as a separate unit or a subunit in any of the grade levels in the recent national curriculum which was designed in 2005. Units related to Biology in elementary education curriculum include Reproduction, Growth, and Development for Living Things (Grade 6), Body Systems (Grades 6 and 8), What the Lithosphere is Made of? (Grade 6), Man and Environment (Grade 7), and Cell Division and Heredity (Grade 8). Among these units, the 6th grade unit on Lithosphere mentions about fossils. The learning outcomes for this unit indicate that at the end of this unit students will be able to (1) explain how fossils were formed, (2) indicate that remains of living organisms from prehistoric times such as bones, skeletons, leaves, shells etc. are called fossils, (3) state that some fossils are used to determine the age of the stone in which they were hardened, (4) explain how fossils can be used to learn about past with examples, and (5) state that scientists who work with fossils are called “paleontologists.” The curriculum suggests a number of activities to teachers that will support their students in reaching these learning outcomes. However, neither the learning outcomes nor the suggested activities refer to evolution. The 8th grade’s Cell Division and Heredity unit is another unit one might want to see some reference to theory of evolution (MEB, 2005). The authors indicated that the purpose of the unit is to help students to understand the steps of meiosis and mitosis (without going into detail), the importance of sexual and asexual reproduction, how genetic information is passed from one generation to the next by genes, the importance of adaptation in terms of variation and evolution, relations between the technological development in genetic, and how these developments affect today’s world (See Table 1). One of the goals of this unit is to give students an opportunity to identify and compare the contemporary ideas and theories that are proposed and accepted on natural phenomena which are related to adaptation of living organisms to their environment. “Adaptation and evolution” is also *suggested* as a topic. Under the learning outcomes section for this unit there are four outcomes related to living organisms’ adaptation to their environment and evolution. These outcomes state that at the end of this unit students will be able to 1) explain living organisms’ adaptation to their environment with examples, 2) indicate why different organisms in the same environment develop similar adaptations, 3) give examples how adaptation of living organisms to

their environments can contribute the biological variation and evolution, and 4) give examples of different opinions on evolution. The explanations for these learning outcomes state that the teacher should not go in detail on the different opinions about evolution (MEB, 2005). The word “evolution” is used only a few times in the program. In addition, it is worth to note that 2006 version of the curriculum for elementary science and technology course do not include “evolution” at all as a topic like suggested in the previous version or in any other way.

Table 1. *Units and objectives related to biology and evolution in Elementary Science and Technology Course Curriculum (6-7-8 Grades)*

Units	Grade 6	Grade 7		Grade 8	
	Objectives	Units	Objectives	Units	Objectives
Reproduction, Growth and Development		Man and Environment		Body Systems	
Body Systems					
What the Lithosphere is made of?	Fossil formation Fossil characteristics Age determination based on fossils Use of fossils Paleontologists			Cell Division and Heredity	Mitosis and Meiosis Sexual and Asexual Reproduction Adaptation <i>Variation and Evolution</i> Genetics and Technology

As far as the curriculum for the secondary education is concerned, the status of evolution is not any different. Secondary education biology curriculum for grades 9-to-12 includes three main content areas. One of these content areas has the title of “Biological Variation, Genetics, and Evolution”. However, except this title the word “evolution” is not found anywhere in the curriculum for secondary education prepared by the Ministry of National Education in 2006. It can be seen that this was not the case for the secondary education curriculum prepared by the same ministry under a different government in 1997. 1997 curriculum for the biology course in secondary education included explicit objectives in terms of students’ understandings on the concept of evolution. Section IX of the program for Grade 11 in 1997 version of the curriculum aimed to introduce students the ideas about the beginning of life. Under this section understanding on ideas about the evolution of living organisms, Lamark’s and Darwin’s ideas on evolution are provided as section objectives. Yet the place of the evolutionary theory on the curriculum was unsatisfactory. Suggested class time for this section of the unit was only two hours at the very end of the academic calendar (MEB, 2008; MEB, 2006; MEB 1997).

In the United States, NSES and Project 2061 provide guidelines for educational administrators, curriculum developers, and teachers in terms of teaching about evolution. Although teaching of evolution is a controversial topic in some states, in many other states theory of evolution find its place in the state science standards. On the other hand, The Ministry of National Education’s publication of national science and technology curriculum for elementary, and secondary grade levels does not address evolution as a unifying theory. Moreover, the elementary curriculum indicates that there are “different opinions” about evolution and advocates the teaching of these “different opinions”. However, it is unknown what these “different opinions” are to the audience. In addition, providing an “explanation” in the curriculum guide, it is stated that “different opinions on evolution should not be discussed in too much detail.” Unfortunately, providing such a vague statement is not only insufficient guidance for the teachers but also an open door for some who wish to create a conflict by misrepresenting the science of evolution.

Considering the current state of theory of evolution in educational programs and public perception on the validity of the theory, it is not surprising that classroom practice also has various problems in terms of teaching of the theory of evolution. Studies conducted both in the USA and Turkey provide insights on the

teachers' ideas, attitudes, and teaching practices regarding the theory of evolution and students' understandings about evolution and related concepts. Following sections will explore on these topics.

Teachers' attitudes toward evolution

Acceptance of the validity of evolutionary theory among teachers was found related to various factors such as training in science and understanding of theory of evolution, and nature of science. Nevertheless these factors are not always positively correlated with the acceptance of the theory of evolution (Osif, 1997; Rutledge & Warden, 2000; Zimmerman, 1987; Aguillard, 1999). Research has indicated that significant percentages of high school teachers are not convinced that evolution is a central concept to biology and/or are of the opinion that creation science should be taught in public school science classes (Osif, 1997; Rutledge & Warden, 2000). Osif (1997) conducted a study among high school science and English teachers in Pennsylvania. The purpose of the study was to look at several aspects of religious beliefs and affiliations, opinions on creation and evolution, and at the interaction of religious beliefs and subject matter taught. One of the important results of this study showed that 66.7% of participating English teachers and 68.4% of participating science teachers think that the theory of evolution is central to the study of biology. However, results also indicated that one-third of the teachers did not agree to this statement. Although English teachers in this study agreed on the statement that "creation science should be taught in science classroom" more favorably than science teachers, there was no difference for the statement that "creation science should be taught in public school" between two groups of teachers. Therefore, teachers' view of the importance of evolution to the study of biology does not appear to change based on the study of biology. Based on his study he concluded that there is a need for the inclusion of the study in the philosophy and methodology of science in teacher education. Training in the sciences does not necessarily lead in acceptance in the theory of evolution.

Research studies have shown that to accept the evolutionary theory, first, one should have an accurate understanding of evolution theory and nature of science. In a study conducted by Rutledge and Warden (2000), high school biology teachers were surveyed to determine their degree of acceptance of key aspects of evolutionary theory, and factors correlating to their acceptance or non-acceptance. This study showed that there is a significant correlation between the non-acceptance of evolutionary theory, misunderstanding of evolutionary theory, and basic misunderstanding of the nature of science itself (Rutledge & Warden 2000).

Zimmerman (1987)'s study reports the results of a questionnaire distributed to every high school biology department in the state of Ohio. Mainly, participating teachers were teaching at three different types of schools; public, private sectarian, and private nonsectarian. The questionnaire used in this study was used in an attempt to indicate whether a section on evolution and/or creationism was included in biology course offered, and determine the respondents' thoughts about scientific foundations of both evolution and "creation science." Respondents' opinions regarding the inclusion of religion in public schools and whether they had ever felt pressure either to teach or not to teach evolution and /or creation science were also targeted in this study. Results of this study showed that a majority of teachers (78.2%) accepted the modern theory of evolution. The study also indicated that 17 % of the teachers taking the survey felt that creationism was built on a strong scientific foundation and included "creation science" as a part of their evolution unit. Teachers who work in private sectarian school were least likely to accept evolution theory. Half of respondents (51.5%) were in agreement that bringing creationism into the classroom meant bringing religion into the classroom. Teachers working in public and private nonsectarian schools were more likely to agree with this statement than teachers working in private sectarian schools. Zimmerman also reports that 10% of the respondents indicated that they had been under some pressure not to teach evolution and 11% indicated that they had received pressure to teach creationism (Zimmerman, 1987).

A similar study conducted by Aguillard (1999) among high school science teachers in Louisiana more than a decade later than Zimmerman's study indicated that 84% of survey respondents agreed that the

theory of evolution has a valid scientific foundation. Ten percent reported “not sure” regarding scientific validity and six percent reported that the theory of evolution is not scientifically valid. In addition, 77% of the participants reported moderate to strong emphasis for teaching evolution in the science classroom (Aguillard, 1999).

The research mentioned above indicates an increase in the percentage of science teachers who agreed on the scientific validity of evolution theory during the twelve years between the two studies. A biology teacher’s acceptance or rejection of an evolutionary theory as a scientifically valid explanation is potentially important to the position that evolution takes in curriculum. In addition, student knowledge structures have been found to approximate those of their teachers. Therefore, a teacher’s attitude towards evolution may impact students’ understanding of this powerful and unifying idea (Rutledge & Mitchell, 2002). In their study Rutledge and Mitchell surveyed total of 552 public high school biology teachers in Indiana. Results of this study indicate that there is a significant relationship between teacher acceptance of evolutionary theory and the amount of time devoted to evolution in the school year. Participant teachers who do not accept evolution theory tend to have a poor understanding of the status of scientific theories. On the other hand, teachers who accept evolution theory showed a strong knowledge base about the mechanism of evolution and the process of natural selection (Rutledge & Mitchell, 2002). The authors also stated that fostering of prospective biology teachers’ understandings of evolution and nature of science should be a priority of biology departments.

In all of the empirical studies, all groups of opinions (acceptance, non-acceptance, and undecided) were represented among teachers. In addition, these studies reported some level of misunderstanding and lack knowledge about evolution and related topics (Osif, 1997; Rutledge & Mitchell, 2002; Rutledge & Warden, 2000; Zimmerman, 1987). Research indicated that acceptance or non-acceptance of evolutionary theory is significantly correlated with misunderstanding of evolution and nature of science. However, training in the sciences itself does not necessarily lead in acceptance of the theory of evolution. Therefore, it is not surprising to see diversity among science and/or biology teachers in terms of acceptance of evolutionary theory. The importance of acceptance of evolutionary theory is evident in the instructional approach and time spent on this topic by teachers. It can be concluded from the literature that teacher education programs should educate teacher candidates in philosophy of science as well as science content. Professional development opportunities that promote an understanding of evolution and nature of science as well as effective teaching practices must additionally be made available for the science and biology teachers who are already in the classrooms.

Students’ understanding and acceptance of theory of evolution and related concepts

Students’ perceptions about how the world works are shaped before they come to the classroom. Bransford, Brown and Cocking (2000) indicate that if students’ initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of the test but relapse to their preconceptions outside the classroom (Bransford et al., 2000). Alters and Nelson (2002) pointed out that prior conceptions related to evolution, scientific epistemology, view of the biological world, religious orientation often support students’ misunderstanding of the evolutionary concepts. They also emphasized that some of these supporting misconceptions may be fundamental to learning evolutionary concepts. These misconceptions included ideas such as mutations are always detrimental to fitness; evolution is predictably progressive, Lamarckian idea of inheritance of acquired characteristics and/or coexistence of dinosaurs and humans.

One of the most prevalent misconceptions is evolution’s status of being “only” a theory. Many students believe that the difference between a theory and a law is that a theory is merely a hypothesis that has possibly been tested a few times, and that a law is nearly a scientific fact because it has been successfully tested many times. Using these meanings, students often consider that evolution is not a law but “only” a theory, therefore setting evolution into a supposedly inferior category than if it were a law. This characterization of the scientific use of the words “theory” and “law” has led students to believe that

if scientific theories had enough evidence and were tested sufficiently with resulting supporting outcomes, then scientific theories would become scientific laws (Alters & Nelson, 2002). In alternative usage, a theory is an “educated guess” or supposition, such as a theory of how a crime was committed or why our favorite sports legend failed to score the winning points. However, in science, theory is considered as a logically consistent statement about nature that has withstood multiple empirical tests (Antolin & Herbers, 2001).

Brickhouse, Dagher, Letts and Shipman (2000) conducted a study in order to investigate the general trends among college students regarding three aspect of nature of science; nature of theories, the role of evidence in theory building and the relationship between science and religion. They also explored the development of students’ views of nature of science over the semester as a result of the astronomy course designed for this study. The driving questions for the course were used to examine the nature of black holes, the beginning of the universe, and the origin of life. Theory of evolution was included into this astronomy focused course because of its relation to the origin of the universe. The main purpose of the course was to have students understand how scientists explore the big questions about the universe and use the scientific approach as well as the content knowledge about the these topics. Constructing background knowledge and conceptual understanding about the use of evidence to justify claims, creation and nature of theories and acceptance of theories by the scientific community were among the objectives of the course. A significant amount of the class time devoted of the relationship between theories and evidence. The researchers interviewed 20 voluntary students during the study. Only six of them were with an education major. Data were collected by three structured interviews, field notes taken by one of the researchers, and document collection among the artifacts of the lectures. Results of the study supported to widespread misconception among individuals about the view that facts and laws are absolute, whereas theories and hypotheses are tentative. The researchers indicated that it is hard to change students’ prior ideas. They also stated that when examining students’ views about the nature of science, using a context in which particular theories or pieces of evidence are the subject would provide more opportunities for students to talk about theories and evidence in a more meaningful way (Brickhouse et al., 2006).

The National Science Board (NSB) (2000) reported that a majority of college graduates hold misconceptions about basic concepts of evolution. Thirty-five percent of college graduates think that “the earliest human lived at the same time as the dinosaurs” and 42% indicated that they do not think of “human beings, as we know them today, developed from earlier species of animals.” This figure is hardly distinguishable from what public think about evolution (NSB, 2000, p. A-549). In their study, Bishop and Anderson (1990) looked at college students’ understanding of the topic of evolution by natural selection in a non-major biology course. The course included instruction on evolution and natural selection. The curricular materials and format of instruction used in the course were explained in *Evolution by natural selection: A teaching module* (Bishop & Anderson, 1986). The theoretical framework for the module was adapted from the conceptual change theory by Posner. The materials in the teaching module were designed to “help instructors accomplish three tasks essential to overcoming critical barriers to student learning: diagnosing student deficiencies, creating dissatisfaction with misconceptions, and providing opportunities for application and practice” (Bishop & Anderson, 1986, p.i). The researchers gathered their data by applying pre and post testes. Tests consisted of essays and multiple-choice questions along with an additional question asking students whether they believe the theory of evolution to be true. The result of this study showed that although students believed that they have a basic understanding of the process of evolution by natural selection, and their ideas about how and why evolution occurred were very different from those accepted by the biologist. The three major areas were identified in which students have inaccurate knowledge: origin and survival of new traits in population, the role of variation within a population, and evolution as the changing proportion of individuals with discrete traits. One of the interesting results of this study was that the amount of previous biology instruction had little or no effect on students’ conceptions (Bishop & Anderson, 1990).

As a replication of Bishop and Anderson (1990)'s study, Demastes, Settlage and Good (1995) conducted their study to examine the effect of the same conceptual teaching method, used in Bishop and Anderson (1990)'s study, on students' conceptions of natural selection and its role in evolution. Results from Demastes et al. (1995)'s study are not different than those from Bishop and Anderson (1990)'s. Both studies indicated that independent from previous biology course work, college students have poor levels of understanding of evolution, and related issues addressed in these studies when they entered the course (Demastes et al., 1995).

In a study conducted by Greene (1990), pre-service elementary education students' misunderstandings of natural selection have been examined. As a result of analyzing 322 students responses to evolution problems as a part of normal testing procedure, it has been stated that only three percent of the students have a true understanding of natural selection. While 43% of the students hold a functional understanding within a typical framework, 17% of the students used a Lamarckian explanation for natural selection. In an earlier study Brumby (1984) identified that the majority of first year medical students who participated in her study, came to college believing that evolutionary change occurs as a result of need, a Lamarckian view (Brumby, 1984). Similarly, Lord and Mario (1993) found that 40% of the college students who participated in their study hold Lamarckian ideas about natural selection. The study indicated that while nearly three quarters of the students said they believed in the theory of evolution, most do not understand the mechanism behind it. Among the college students they have surveyed, about a third of the students felt that creationism was not based on "scientific principles," therefore should not be taught in science classrooms. However, approximately 25% of the students felt that creationism did have a scientific foundation, even though it is impossible to test (Lord & Marino, 1993).

Students' profiles in cited research are similar to those of teachers'. It seems logical to conclude that teachers' understanding, knowledge, and acceptance of evolutionary theory may have an effect on students' understanding and acceptance of evolution. However, understanding and content knowledge do not necessarily lead into acceptance of evolution. There are number of research studies which indicate that students can have a clear understanding of evolution without accepting it (Bishop & Andersen, 1990; Sinatra, Southerland, McConaughy, & Demastes, 2003). Sinatra et al., (2003) examined the intersection of students' understanding and acceptance of evolution and their epistemological beliefs and cognitive dispositions. The researchers found that there is no evidence of a relationship between understanding evolution and its acceptance. It seems that students may have an understanding of evolutionary theory without accepting its validity, or alternatively, they may accept the validity of the construct with a poor understanding of it. Either way knowledge of evolution was not related to their acceptance of this construct (Sinatra et al., 2003).

As far as the studies in Turkey are considered, Apaydın and Sürmeli (2006) investigated students' level of understanding of topics regarding evolution such as natural selection, adaptation, and mutation prior to a formal course on evolution. Participants for this study were selected from the biology department (77 students) and science education department (78 students). The researchers also aimed to see if there was a difference between students' level of understanding about the mentioned topic based on their major. Results of the study showed that most of the students' ideas about evolution were not consistent with scientifically accepted views on evolution. The researchers indicated that most of the students from both departments answered incorrectly the questions regarding why and how evolution occurs. Apaydın and Sürmeli (2006) indicated that students showed alternative conceptions regarding adaptation and mutation. According to their results, the students indicated that organisms are able to change and adapt to their environment in order to survive. Results also showed that students from both the biology department and science education department hold alternative conceptions regarding the evolutionary theory. The researchers suggested that students' understanding about the essential concepts of evolution is unsatisfactory. Apaydın and Sürmeli concluded that educational programs prior to college and during college do not focus on evolution as a part of the biology curriculum. Moreover, researchers

suggested that biology education should be designed with a perspective, which takes the theory of evolution as a base.

In their study Deniz, Donnelly, and Yılmaz (2008) investigated the factors effecting acceptance the theory of evolution among preservice biology teachers. The researchers indicated that they were interested in whether participants accepted evolution as the best valid scientific explanation based on available evidence. Deniz et al. (2008) identified nine factors that affect one's acceptance of evolutionary theory based on the literature. In their study, they choose to examine the effects of three factors such as understanding of evolution, epistemological beliefs, and thinking dispositions on Turkish preservice biology teachers' acceptance of the theory by using quantitative methods. Participants for this study were chosen from a biology education program in the Collage of Education at a university in western Turkey. A total of 132 students (95 women, 37 men) from all educational levels (freshmen 28%, sophomores 26.5%, juniors 19.7%, and seniors 25.8%) participated in the study. Deniz et al. (2008) found that there was a significant correlation between participant's knowledge about evolution and their acceptance of the theory of evolution. They indicate that participants who had more knowledge about evolution were more likely to accept the theory of evolution. Their results contradicted with the research conducted by Sinatra et al. (2003) which suggested that there was no evidence on the positive correlation between knowledge and acceptance of evolution. They also found that thinking dispositions such as cognitive flexibility and openness to belief change were positively correlated factors to one's acceptance of evolutionary theory. Deniz et al. (2008) stated that as an independent variable in their study, parents' educational level was found positively correlated to participants' acceptance of evolution.

Türkmen, Göz and Demir (2008) investigated Turkish preservice elementary teachers' ideas on the theory of evolution after they have completed a science education methodology course in a College of Education at a university in western Turkey. By asking the participants about their ideas regarding the theory of evolution explicitly with an open ended question, Türkmen et al. (2008) found that only eight out of 103 preservice elementary teachers consider the theory evolution scientifically valid. Six of the participants indicated that they are undecided about the acceptance of the theory. The majority of the preservice teachers (75 out of 103) indicated that they do not accept the theory of evolution as scientifically valid. Among the reasons they provided the most common was that the theory of evolution was not proved and it was rejected (Türkmen et al., 2008).

Research about the students' understanding and acceptance of the theory of evolution focused mainly on college level students. Research indicated that misconceptions about evolutionary theory among students including science majors, medical students, and preservice teachers are common. Many of these misconceptions were found related to the participants' misunderstandings of the nature of science and nature of scientific theories. Research also indicated that students hold misconceptions about evolution regardless of their previous or current education on biology. The acceptance of evolutionary theory was also investigated among college students including preservice elementary students. Although research studies indicated opposing results about the relationship between understanding and acceptance of evolution, it is important to note that in some cases students rejected the theory of evolution, even though they have a clear understanding of the mechanisms of evolution. Studies from both USA and Turkey addressed that preservice elementary students showed little understanding of evolution. In addition, acceptance of evolutionary theory among these students was less common.

CONCLUSION

Theory of evolution is one of the well-supported and scientifically strong bodies of knowledge which explains many aspect of life on earth. There are scientific discussions about how evolution works among scientists; however, there is no debate over the occurrence of evolution in the scientific community. The problems begin when it comes to teaching of evolution. This situation points to an obvious miscommunication between scientists and public. Of course, there are explicit attempts to keep public learn scientific value of the theory of evolution. Propaganda against the teaching of evolution takes place

both in the United States and Turkey as well as other parts of the world. Although these attempts to eliminate the theory of evolution from the curricula show similar patterns in both countries, Turkey is more vulnerable to these attempts because of the nationwide curriculum, which might be influenced by political changes.

Research indicated that college education which include heavy load of science course such as biology and medicine do not significantly change students' understanding of evolutionary theory. It was also stated that students who hold unsatisfactory understandings about nature of science tend to have misconceptions about the theory of evolution and related topics. Therefore, it may be said that college education by itself (even in science majors) does not provide sufficient opportunities to educate students and student teachers about the nature of science and scientific value of the theory of evolution. These fundamental problems might be originated from the lack of attention to the theory of evolution in elementary and secondary science curriculum. In order to overcome these problems, science curriculum should include the theory of evolution as a unifying theme.

Teaching about evolution is the most and maybe the only issue discussed among that of other topics in science. I think it is very unfortunate that this unifying theory is subject to political propaganda, which results in keeping students learning from one of the most intellectual body of knowledge human kind ever possessed. Research studies show that teaching of evolution in the classroom has many obstacles including the curriculum, school administrations, teachers', and students' understanding of science and personal beliefs. I believe that the concept of evolution has a power which leads us to an understanding of our past and gives us an opportunity to prepare ourselves for our rapidly changing world brings in the future. Having our children grow without understanding this most essential aspect of contemporary science today can only mean that we are leaving them without the critical skills to construct tomorrow's world.

In order to gain a deeper understanding about the teaching of evolutionary theory in classrooms and effects of anti-evolutionist propaganda on curricular materials, text books prepared and distributed by the Ministry of Education can be examined in a future research study. In-service elementary and secondary science and biology teachers' attitudes towards evolution and their awareness about the anti-evolutionist attacks toward Turkish education system also need attention by researchers.

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Amerika ve Türkiye’de Evrim Karşıtlığının Eğitim Politikaları ve Uygulamalarına Yansıması

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ÖZ. Bu makalede ABD ve Türkiye’deki fen eğitim programları ve öğretim uygulamalarında evrim teorisine nasıl yer verildiğinin karşılaştırılması amaçlanmıştır. Ayrıca, ABD ve Türkiye’de birbirine benzer özellikler taşıyan kuruluşların verim teorisi karşıtı çalışmaları da incelenmiştir. Evrim teorisinin öğretimi her iki ülkede de tartışmalı bir konudur. Fakat, bu konudaki yasal düzenlemeler ve evrim öğretimini etkileyen faktörler hakkındaki eğitim araştırmaları daha çok ABD’de yapılmıştır. Makalede ele alınan konu şu beş başlık altında incelenmiştir; (a) evrim teorisinin bilimsel önemi, (b) evrim öğretimi tartışmaları, (c) ABD ve Türkiye’deki ilköğretim ve ortaöğretim programlarında evrim teorisinin yeri, (d) öğretmenlerin evrim teorisine karşı tutumları ve (e) öğrencilerin evrim teorisine ve bununla ilgili konular hakkındaki bilgileri. Bunların yanı sıra Türkiye’de okullarda evrim öğretimini etkileyen faktörler ve bu konudaki eğitim politikaları da tartışılmıştır. Sonuç olarak Türkiye’de sürdürülen ABD’dekine benzer evrim karşıtı çalışmaların evrim teorisinin okullarda öğretilmesi açısından eğitim programlarını ve uygulamalarını ve aynı zamanda toplumun evrim teorisine konusundaki görüşlerini olumsuz etkilediği görülmektedir.

Anahtar Sözcükler: Evrim, yaratılışçılık, tartışma, fen programı, öğretmen tutumu, öğrenci bilgisi

ÖZET

Amaç ve Önem: Bu çalışmanın amacı, ABD ve Türkiye’deki fen eğitim programları ve öğretim uygulamalarında evrim teorisine nasıl yer verildiğini karşılaştırılmaları olarak incelemektir. Evrim teorisinin fen derslerinde öğretimi tartışmalı bir konudur. ABD’de yapılan çalışmalar kamu oyunun evrim teorisine yerine yaratılışçı yaklaşımın sınıflarda öğretilmesini tercih ettiğini ortaya koymuştur. Son yıllarda ABD’deki bazı eyaletlerde evrim teorisine Eğitim Kurulları tarafından programdan çıkarılmıştır. Bu tartışmalı konunun sınıf ortamındaki yansımalarını daha iyi anlayabilmek için öğretmen ve öğrencilerle yapılan çalışmalar fen eğitimi alanındaki araştırmaların odağı olmuştur. Öğretmenlerin evrim teorisine hakkındaki inanışları, bilgileri ve kabul edilebilir düzeyleri ve öğrencilerin evrim teorisine anlam düzeyleri üzerine yapılmış çalışmalar evrim teorisinin neden ve nasıl öğretilmesi konusunda önemli ipuçları sunmaktadır. Bu konuda kamuoyunun görüşü ve fen eğitimi programlarında evrim teorisinin yer alması da önemli görülmektedir.

Yöntem: Bu çalışma alanyazınına dayalı betimsel bir derleme çalışmasıdır. Amerika’daki fen eğitimi standartları ve Türkiye’deki ilköğretim fen ve teknoloji dersi öğretim programları ile ortaöğretim biyoloji dersi öğretim programları incelenmiştir. Programların incelenmesine evrim teorisine ünite ve hedefler bazında ayrılan yer dikkate alınmıştır. Ayrıca Türkiye’de yürürlükte bulunan eğitim programları önceki yıllarda kullanılan programlarla karşılaştırılmıştır. Öğretmen ve öğrencilerin evrim teorisine hakkındaki inanış, tutum ve bilgi düzeylerini inceleyen alanyazını taranmış ve evrim teorisinin bireyler tarafından kabulünü etkileyen faktörler incelenmiştir.

Sonuç ve Tartışma: Evrim teorisine önemini canlı çeşitliliğini, canlılar arasındaki benzerlik ve farklılıkları ve yaşadığımız dünyanın fiziksel bir çok özelliğini açıklama gücünden almaktadır. Bu olguların açıklanması fizik, kimya, jeoloji ve biyolojinin bir çok alanı ve diğer bilimlerin çalışma konusu olmaktadır. Evrim teorisine olmaksızın biyoloji eğitimi vermek öğrencileri yaşamsal olaylara tutarlı bir açıklama getiren güçlü bir kavramdan mahrum bırakmak demektir. Araştırmacılar insan zekasını ortaya koyduğu en kapsamlı bilgi bütünü olan evrim teorisinin yer almadığı bir fen eğitimi programının öğrencilerin bilimin doğasına dair yanlış algılara yönelmesine yol açacağı konusunda hemfikirlerdir. Evrim teorisinin üzerinde gündeme getirilen evrim karşıtı çalışmaların ABD ve Türkiye’de benzerlik göstermesi bir tesadüf değildir. Amerika’da bulunan Yaradılış Araştırma Kurumu ve Türkiye’de bulunan Bilim Araştırma Vakfı evrim karşıtı yayınlar ve organizasyonlar ile evrim teorisinin bilimsel geçerliliğinin olmadığı iddiasını kamuoyuna yaymaya çalışmaktadırlar. Evrim karşıtı çalışmalar sadece bu kurumların faaliyetleriyle sınırlı kalmamakta ve eğitim programlarından evrim teorisinin çıkarılması veya yaratılış inancının evrim teorisine alternatif olarak gösterilen bilimsel bir teori olarak ortaya atılmasına kadar uzanmaktadır.

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