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Research Article

Comparison of Turkish Elementary School Science Curriculum: 2005-2013-2017

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Abstract:

Change is an inevitable reality of life. The developments in the world affect the qualities expected from individuals and this reflects on the educational systems. For this reason, the high competitiveness of the countries in the international arena requires that the education systems comply with the requirements of the age. In Turkey, it is seen that the curriculum has been changed in various times since the announcement of the Republic. In 2005, a major change was done and the curriculum was prepared in line with the philosophical and structural approach as well as the the requirements of the age. These programs were updated in 2013 by reviewing the 4 + 4 + 4 education system which was designed in 2012. In 2017, the curriculum has been updated with stakeholder's feedback in line with the problems faced by previously developed programs and practices. In this context, the aim of the study is to compare the elementary school science curriculums which were prepared based on the constructivist approach in 2005, updated in 2013 and re-revised in 2017, and to reveal their similarities and differences. In the study, the elementary school science curriculums (2005-2013-2017) were compared by investigating in terms of basic philosophy of the curriculum, the general aims of the curriculum, key competences in the curriculum, and the approaches during the teaching situations, the evaluation process, the subject areas, the achievements and the course hours. The research was carried out by document analyzing method of qualitative research methods. As a result of the study, we found out that while there was not much difference between primary school sciences curriculums in 2013 and 2017, there was a great deal of differences between the 2005 curriculum and the 2013 and 2017 curriculum especially in the number of achievements and course hours.

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INTRODUCTION

Currently, educational institutions prepare students for globalization and competitiveness in the 21st century, enable students to acquire a good science education. Rather than training only science-related and health-related career goals oriented students, programs should be designed to ensure that all students benefit from skills (such as critical thinking, analytical thinking, innovative thinking, inquiry, research, investigation, exploration, experimentation, data analysis, inventing, collaborative team work, leadership, social responsibility, oral and written communication) that science curriculum can provide. Qualified science education has an important place in students' 21st century skills (Biological Sciences Curriculum Study Organization [BSCS], 2008). For this reason, importance is given to science education both abroad and in our country, and studies are being carried out with the reforms carried out in education to train science literate individuals (Bağcı-Kılıç, Haymana ve Bozyılmaz, 2008). However, despite the radical changes and innovations in the science curriculum in our country, the desired achievement on the international scene has not been reached and according to the final Program for International Student Assessment (PISA, 2015) results report, our country is far behind in the field of science literacy, it is seen to be in the lower rank among the participant countries (Organisation for Economic Co-operation and Development [OECD], 2016; Taş, Arıcı, Ozarkan, Özgürlük, 2016). For this reason, the current curriculum should be examined again and / or the approaches applied in the teaching-learning process should be revised and / or teachers' conceptions of learning and teaching in the classroom should be reviewed.

Change is an inevitable reality of life. Countries, cultures, ways of thinking and production, relations and nature are constantly changing. The person himself is also a lifetime, constantly changing from birth to death (Erdoğan, 2012). This is a natural consequence in the world; social, economic and technological developments, a change and transformation based on knowledge is realized (Gürbüz, 2011). It is not possible to think education system independently of developments in other areas, change and transformation (Özden, 2005). This change and transformation in the world, of course, also affects the education systems and, as a result, the aims and content of education; the the roles of teachers and the school as an organization for learning needs to be reconsidered (Council of Europe, 2015). This change and transformation in the world in the 21st century differentiates the qualities of the individuals needed and causes the questioning of the education offered in the schools. In this respect, it is necessary to update the curriculums of the guidance programs offered to the schools in the direction of the developments taking place in the century we live and the developments anticipated in the future.

In 2005, the Ministry of National Education created curriculums according to constructivist understanding, updated the curriculums in line with the 4 +4 +4 education system introduced in 2013, and partially revised the curriculum in 2017 as a result of evaluations.

Purpose

The aim of the study is to compare the elementary school science lesson teaching curriculums which were designed based on the constructivist approach in 2005, updated in 2013 and re-revised in 2017 and to reveal the similarities and differences. In this direction, in this study, the elementary school science curriculums (2005-2013-2017) will be compared by investigating in terms of basic philosophy of the curriculum, the general aims of the curriculum, key competences in the curriculum, the approaches during the teaching situations, the evaluation process, the subject areas, the achievements and the course hours.

METHOD

Research Model

In the research, document analysis which is one of the qualitative research methods and one of the data collection methods was used. Document analysis is a form of qualitative research in which documents are interpreted by the researcher to mean around an evaluation topic (Bowen, 2009). In the document review method, the researcher analyzes the written materials that contain information about facts or phenomena intended to be investigated (Yıldırım ve Şimşek, 2008). Electronic resources, on the other hand, are the evaluated sources considered in the scope of the document review (Corbin & Strauss, 2008).

Data Collection Tools

Documents to be examined before the research were determined and 2005, 2013 and 2017 primary school science curriculums were used as data sources. In this respect, 2005, 2013 and 2017 primary school science curriculums were electronically obtained from the webpage of Education Board of Ministry of Education (https://ttkb.meb.gov.tr). The study was carried out in the direction of the data whose originality was checked.

This research was carried out by using;

- The curriculum of primary school science and technology curriculum for 4th and 5th gradess published in 2005 (Ministry of National Education [MEB], 2009)
- The science curriculum of primary schools and junior high schools published in 2013 (MEB, 2013).

- The science curriculum for elementary and secondary schools published in 2017 (MEB, 2017)

Data Analysis

The data obtained in the research were analyzed by descriptive analysis method. Descriptive analysis is the lowest and simplest form of analysis. Descriptive analysis is a kind of discussion where the data is shown as it is, described, figured, told, and communicated (Sönmez & Alacapınar, 2013). The purpose of descriptive analysis is to convert raw data into a format that readers can understand and use if needed. The data obtained in the descriptive analysis are summarized and interpreted according to the previously determined theme (Altunışık, Coşkun, Yıldırım & Bayraktaroğlu 2001; Yıldırım ve Şimşek, 2005).

2013 and 2017 primary science sciences curricula were examined in order to create descriptive statistics in the research. The curriculums have been compared and tabulated in terms of basic philosophies, general objectives, basic skills dealt with in the curriculums, approaches in educational situations, evaluation process, subject areas, achievements, class hours and class hours percentages. The differences in the curriculums have been explained and the reasons that constitutes the basis of these differences are examined.

RESULTS

In this section, according to the main objectives of the research 2005, 2013 and 2017 science curricula of primary schools have been compared and evaluated in terms the program's vision / basic philosophy, general objectives, teaching-learning and evaluation process, basic approaches to student and teacher role, subject areas and units, subjects and achievements, course hours.

The vision of the 2005 curriculum; (MEB, 2005) that all students are educated as science and technology literate regardless of their individual differences. The vision of the 2013 education program is to educate all students as science literate individuals (MEB, 2013). In the 2017 curriculum, the vision of the program was not addressed, and the basic philosophy of the program was touched upon.

The basic philosophy of the 2017 curriculum is; to enable individuals to gain skills, such as ability, attitude, aesthetic sensitivity especially national, spiritual and cultural values where the individuals were born into, to raise curiosity to lead the individual to learn, to develop consensual individuals who have responsibility to play an active role in today's social and economic conditions, who can solve problems, have advanced decision-

making skills, think critically and innovatively, cooperate, respect person's rights and freedom, to develop individuals who are in harmony with themselves and their society, who are aware of their responsibilities and who can fulfill their needs, who have internalized national values on the one hand and internalized universal values on the other, to develop individuals with critical and innovative thinking skills and a new understanding, original approaches, new perspectives, a way of thinking leading to brand new ways of understanding and appreciation of something and aesthetic sensitivity (MEB, 2017). Within the scope of the general objectives of the curricula; the overall objectives of the science curriculum for the 2005, 2013, and 2017 are comparatively discussed in Table 1.

Table 1

General Objectives of 2005, 2013 and 2017 Science Curriculum

2005 Curriculum	*2013 Curriculum*	*2017 Curriculum*
To enable to learn and understand the natural world, to enable them to live with this intellectual richness and excitement.	To give basic information about biology, physics, chemistry, space, sky and environmental sciences, health and natural disasters.	To give basic information about astronomy, biology, physics, chemistry, space and environmental sciences and science and engineering applications
Encourage them to develop curiosity for scientific and technological developments and events at every class level.	To adopt scientific process skills and scientific research approach and find solutions for the problems encountered in the process of discovering nature and understanding the relationship between man and environment.	To adopt scientific process skills and scientific research approach and find solutions for the problems encountered in the process of discovering nature and understanding the relationship between man and environment.
The nature of science and technology; to enable to understand the interactions between science, technology, society and the environment.	To raise awareness of how science affects society and technology, and how society and technology affect sceience.	To enable to recognize the mutual interaction between individual, environment and society; to develop sustainable development awareness of society, economy and natural resources.
To enable to acquire new knowledge structuring skills through research, reading and discussion.	To recognize the mutual interaction between the individual, the environment and the society and to develop awareness of sustainable development in society, economy, natural resources	To enable to take responsibility for everyday life problems and to use science knowledge, scientific process skills and other life skills to solve these problems
In the topics such as education and occupation selection to create a sub-structure that can enable them to create information, experience, interest	To develop science-related career awareness.	To develop career awareness and entrepreneurial skills related to science
To enable to learn to learn and to develop the capacity to adapt to the changing nature of the professions	To enable to take responsibility for everyday life problems and to use knowledge of science, scientific process skills and other life skills to solve these problems	To help them to understand how scientific information is created by the scientist, the processes in which this information is generated, and how it is used in new researches
To enable them to use science and technology to obtain new information and solve problems in unusual situations where they may encounter	To help them to understand how scientific information is created by the scientist, the processes in which this information is generated, and how it is used in new researches.	To raise interest and curiosity about the events that are happening in the nature and around them, develop attitudes.
To enable them to use appropriate scientific processes and principles when making personal decisions	To contribute to the understanding that science is the result of common endeavor of scientists from all cultures and to develop a sense of appreciation of scientific studies	To establish safe working awareness by recognizing the importance of safety in scientific studies
To enable to realize the social, economic and ethical values related to science and technology, personal health and	To ensure to appreciate science for its contribution to the development of technology, the solution of social	To develop reasoning ability, scientific thinking habits and decision making

environmental problems, to enable to take responsibility for them and to make conscious decisions	problems and the understanding of relationships in the natural world.	skills by using socio-scientific subjects
To have scientific values such as willingness to know and to understand, questioning, valuing logical value, thinking about the consequences of actions, to enable them behave in accordance with these values in society and environment relations	To develop curiosity, attitude and interest about the events that take place in the nature and to develop scientific thinking habits using socio-scientific issues	To ensure that universal moral values, national and cultural values and scientific ethical principles are adopted.
To enable them to increase their economic efficiency by using knowledge, understanding and skills in their professional life	To enable them to recognize the importance of safety in scientific studies and to contribute to implementation	

In the 2017 curriculum, unlike the 2005 and 2013 curricula, the basic skills required to be acquired by the curricula are mentioned. These skills are; basic competence in communication in mother tongue and foreign languages, mathematics, key competence in science and technology, digital competence, learning to learn, social and civic competence, initiative and entrepreneurship, cultural awareness, scientific process skills, life skills, engineering and design skills. Again, in the 2017 curriculum, values education has been introduced differently from other curriculums.

The 2005 curriculum is based on a constructivist learning approach that adopts a student-centered approach. The 2013 and 2017 curriculum is also based on a student-centered approach; but learning environments were designed to be based on learning-based inquiry, problem solving, project, argumentation and collaborative learning. The understanding of measurement and evaluation is similar in all three programs. The evaluation of the process as well as the learning outcomes, and mainly alternative assessment and evaluation techniques which enable students to exhibit their knowledge, skills, feelings and other performances rather than traditional measurement and evaluation techniques are suggested to be used. At the same time, self and peer assessment approaches are also adopted where students can evaluate themselves and their peers. Also, in 2013 curriculum, it is recommended that technological tools be used to monitor and assess the performance of students during the learning process. In the 2017 curriculum, it is sugggested that measurement-evaluation should be carried out as recognition, monitoring-shaping, result (product) oriented and that individual differences should be carefully considered in assessment and evaluation activities. Moreover, assessment-evaluating is not always about judging students; they should be in the form to lead them by supporting their academic, social or cultural development.

In all three cirruculums, teacher and student roles are treated in a similar way in general. The students are active in the process and the teacher is in the guiding role. The responsibility of the learning belongs to the student. It is expressed that while the teacher in the learning-teaching process is in encouraging and directing role, the students are in

individual role of explaining the source of information, questioning, explaining, discussing and transforming into the product. For this reason, it is mentioned that the teachers have a guiding role and share the value of science and its importance and the responsibility and enthusiasm of reaching out to the scientific knowledge and at the same time guide the research process in the class. Also in 2017 curriculum, it is aimed to enable students to look at problems from an interdisciplinary point of view by the integration of science with mathematics, technology and engineering. It is advised that teachers also should provide guidance in this issue. In addition, it is stated that teachers make contributions for creating a democratic classroom atmosphere in which students can express their views freely, the development of students' ability to express their own thoughts, and the development of reasoning and communication skills in the learning environments. In the 2017 curriculum, engineering applications that are not included in other programs are included. Through engineering applications, students are expected to establish connections between engineering and science, understand interdisciplinary interactions, and develop worldviews by bringing in what they learn in an experiential way.

While the subject areas in 2005 and 2013 curriculum are expressed as "the livings and life", "matter and change", "physical events", "world and universe", in 2017 curriculum the subject areas are "world and universe", "living things and life", "physical events", "matter and nature", "science and engineering applications". The subject areas of the three curriculums, unit titles, number of achievements, and information about the prescribed hours are given in Table 2.

When Table 2 is examined, it is seen that the numbers of acquisitions in the 2005 program are much more than the programs of 2013 and 2017. Depending on the number of acquisitions, the difference in the course hours is clearly visible. The number of acquisitions in the 2013 and 2017 curricula has been reduced considerably and the course hours have been increased compared to the acquisitions. In addition, when examining the unit headings, it can be said that the unit headings in the 2017 curriculum are expressed more simply and concretely than the 2005 and 2013 curriculum, in other words, the subjects are simplified.

With 4 + 4 + 4 education system which started to be implemented in 2012, primary school was reduced to 4 years and primary school science courses have also been included in classes 3 and 4. The science courses, which begin in the 3rd grade of primary school in 2013 and 2017 curriculums, begin with the subject of "Five Senses" in the subject area of “Living Things and Life” in 2013 curriculum, begin with the subject of "Getting to know our planet" in the subject area of "World and the Universe" in 2017 curriculum.

In 2005 Curriculum the courses begin with the subject of “Resolve our Body's Wisdom" in the subject area of “Living Things and Life” in the fourth grade of primary school. In the curriculums, topics are similar except for the first ones. Some topics are more clearly expressed in the 2017 program.

For example, in 2013 Curriculum, the unit titled “From Past to Present Illumination and Sound Technologies” is expressed as “Illumination and Sound Technologies” in 2017 Curriculum; the unit titled “Let’s Solve The Puzzle of Our Body” is expressed as "Five Senses". Changes were also made in the subject orders in the 2017 curriculum. In addition, 2017 curriculum includes the subject area of "Science and Engineering Applications" and "Science Applications" which is not in the other two curriculums.

Table 2

Subject fields, units, number of acquisitions, scheduled course hours

2005 Education Program					*2013 Education Program*					*2017 Education Program*				
Grades	**Subject Fields**	**Unit**	**The number of acquisitions**	**Course Hours**	**Grades**	**Subject Fields**	**Unit**	**The number of acquisitions**	**Course Hours**	**Grades**	**Subject Fields**	**Unit**	**The number of acquisitions**	**Course Hours**
	The living things and life	Resolve our Body's Wisdom	23	24		The living things and life	Five Senses	3	6		Earth and the Universe	Let’s Know Our Planet	5	9
	Substance and Change	Getting to know the Substance	46	36		Physical Events	Let’s Know the Force	4	15		The living things and life	Five Senses	3	6
	Physical Events	Force and Motion	13	12		Substanc e and Change	Getting to know the Substance	4	15		Physical Events	Let’s Know the Force	4	15
4	Physical Events	Light and Sound	43	20	**3**	Physical Events	Light and Sounds in the Environment	8	21	**3**	Madde ve Doğası	Let’s Know the substance	4	17
	Earth and the Universe	Our Planet Earth	17	16		The living things and life	Journey to the World of the Living	6	21		Physical Events	Light and Sounds in the Environment	8	21
	The living things and life	Let's Learn the World of the living	15	20		Physical Events	Electric Vehicles in our Life	4	21		The living things and life	Journey to the World of the Living	8	18
	Physical Events	Electricity in our lives	20	16		Earth and the Universe	Let’s Know Our Planet	3	9		Physical Events	Electric Vehicles	4	22
5	The living things and life	Resolve our Body's Wisdom	22	20		The living things	Resolve our Body's Wisdom	8	21	**4**	Earth and the Universe	Earth's Crust and the Movements of	5	15

				and life				n	the Earth		
Substance and Change	Change and Recognition of Substance	46	36	Physical Events	Force Effects	4	12	The living things	Our Food	6	18
Physical Events	Force and Motion	21	14	Substance and Change	Getting to know the substance	11	27	Physical Events	Force Effects	5	12
Physical Events	Electricity in our lives	16	12	Physical Events	From Past to Present Lighting and Sound Technologies	12	21	Substance and its nature	Properties of Substance	10	21
Earth and the Universe	Earth, Sun and Moon	19	12	The living things	Microscopic Living and the Environment	7	9	Physical Events	Lighting and Sound Technologies	12	21
The living things	Let's Learn the World of the living	33	30	Physical Events	Simple Electric Circuits	3	9	The living things	Human and Environment	2	6
Physical Events	Light and Sound	39	20	Earth and the Universe	Movements of Our World	1	9	Physical Events	Simple Electric Circuits	3	6
								Science and Engineering Applications	Applied Science	3	9

DISCUSSION, CONCLUSION AND SUGGESTIONS

In this research, which is a qualitative research method based on a document review, Turkish National Education primary science curriculum which was prepared based on constructivist approach in 2005, updated in 2013 and re-revised in 2017 has been examined comparatively. These curriculums have been comperatively analyzed in terms of basic philosophy of the curriculums, general objectives, basic skills in curriculums, approaches in educational situations, evaluation process, subject areas, acquisition and course hours. The basic philosophy of the three curriculum is based on the progressive philosophy of educational philosophies (Dewey, 1920), and the constructivist learning-teaching approach is adopted in all three programs. The vision of the 2005 and 2013 curricula was "educating all students as science literate individuals" but the vision of 2017 curriculum was not mentioned. However, the basic philosophy of the 2017 curriculum has been elaborated. The development of individuals who live and keep alive the national spiritual values, internalize universal values, have responsibility, have confidence, have critical and innovative thinking skills, have new understanding and can look at the world from different windows were expressed in the basic philosophy of the curriculum. As a matter of fact, these skills are handled in many sources as 21st Century skills (American Association of School Librarians [AASL], 2007; Partnership for 21st Century Skills [P21], 2009; Trilling & Fadel, 2009).

It is very important that the basic philosophy of the updated 2017 curriculum aims to give students 21st Century skills. In addition, in the 2017 curriculum, science and engineering applications are included in the scope of the Applied Science Unit at the 4th grade, which is not included in other curriculums. Within the scope of these applications, students are expected to work on solving the problems encountered in daily life within the scope of the topics covered in science courses and to develop product / inventions aimed at solving these problems. Morrison (2006) notes that science and engineering practices have improved students' abilities. This is in line with the development of the skills expected of the students at the core philosophy of the program. When the number of courses of instruction and the duration of course hours are examined, it is seen that the number of acquisitions in the 2005 curriculum is considerably high and the number of teaching hours per acquisition is low. In 2013 and 2017 curriculums, it is seen that the number of units and the number of subjects are significantly reduced. In the research conducted by Karaman & Karaman (2016) and Şentürk & Ciğerci (2017), the teachers stated that the topics and acquisition in some units of the science course were excessive and therefore they were not able to finish the subjects during the period stated in the program. With the revision in the curriculum in 2017, it can be stated that this negativeness will come to an end. In addition, during the practice studies to be carried out in the applied science unit which lastfor 9 course hours in the 4th grade and during the implementation exercises, repetition of the topics and reinforcements can be included.

At the end of the study, the following recommendation can be made The science curriculum that was introduced in 2017 is being implemented by teachers this year. For this reason, teachers who are practitioners of the curriculum can be consulted about the problems they encounter during the application. In addition, students' views can also be taken. In addition, the current curriculum may be subject to more extensive evaluation by experts under program evaluation principles. The areas where children experience life related to science applications have increased in recent years in Turkey. Areas such as observation areas in playgrounds, small zoo gardens, hobby gardens, science houses where science materials are found, robotic design and coding centers, science centers for children have been arranged (Şentürk, 2017). In science and practice centers students are enabled to gain experience within the scope of the applied science unit in the curriculum.

REFERENCES

Altunışık, R., Coşkun, R., Yıldırım, E. & Bayraktaroğlu, S. (2001). *Sosyal bilimlerde araştırma yöntemleri.* Adapazarı: Sakarya Kitabevi.

American Association of School Librarians [AASL]. (2007). *Standards for the 21st–Century learner.* Retrieved from, http://www.ala.org/aasl/sites/ala.org.aasl/files/content/guidelinesandstandards/learningstandards/AASL_LearningStandards.pdf [Date of access: 17.11.2017].

Bağcı-Kılıç, G., Haymana, F. ve Bozyılmaz, B. (2008). İlköğretim fen ve teknoloji dersi öğretim programının bilim okuryazarlığı ve bilimsel süreç becerileri açısından analizi. *Eğitim ve Bilim, 33*(150), 52-63.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27-40. Doi:10.3316/QRJ0902027

BSCS [Biological Sciences Curriculum Study Organization]. (2008). *Scientists in science education.* https://www.ashg.org/education/pdf/Scientist_in_Science_Education_BSCS.pdf adresinden 15.04.2017 tarihinde erişilmiştir.

Council of Europe (2015). *Education for change, change for education: Teacher manifesto for the 21st century of the conference.* The Professional Image and Ethos of Teachers, April 2014, Council of Europe, Strasbourg.

Corbin, J. & Strauss, A. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3rd ed.). Thousand Oaks, CA: Sage Publications Inc.

Dewey, J. (1920). *Reconstruction in philosophy.* New York: Henry Holt and Company.

Erdoğan, İ. (2012). *Eğitimde değişim yönetimi.* Ankara: Pegem Akademi Yayıncılık.

Gürbüz, T. (2011). *Eğitimde değişim: Bilgi yönetimi ve e-öğrenme.* XVI. Türkiye'de İnternet Konferansı, 30 Kasım-2 Aralık 2011, Ege Üniversitesi, İzmir.

Karaman, P. & Karaman, A. (2016). Fen bilimleri öğretmenlerinin yenilenen fen bilimleri öğretim programına yönelik görüşleri. Erzincan Üniversitesi Eğitim Fakültesi Dergisi, 18(1), 243-269.

MEB (2017). *Fen bilimleri dersi öğretim programı (ilkokul ve ortaokul 1, 2, 3, 4, 5, 6, 7 ve 8. sınıflar).* http://mufredat.meb.gov.tr adresinden 30.09.2017 tarihinde erişilmiştir.

MEB (2013). *İlköğretim kurumları (ilkokullar ve ortaokullar) fen bilimleri dersi (3, 4, 5, 6, 7 ve 8. sınıflar) öğretim programı.* https://ttkb.meb.gov.tr adresinden 04.03.2014 tarihinde erişilmiştir.

MEB (2005). *İlköğretim fen ve teknoloji dersi 4-5. sınıflar öğretim programı.* https://ttkb.meb.gov.tr adresinden 11.05.2017 tarihinde erişilmiştir.

Morrison, J. (2006). *TIES STEM education monograph series: Attributes of STEM education.* Retrieved from, https://www.partnersforpubliced.org/uploadedFiles/Teachingand Learning/Career_and_Technical_Education/Attributes%20of%20STEM%20Education%20with%20Cover%202%20.pdf [Date of access: 20.11.2017].

OECD [Organisation for Economic Co-operation and Development] (2016). *PISA 2015 results in focus.* Retrieved from, https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf [Date of access: 02.04.2017].

Özden, Y. (2005). *Eğitimde yeni değerler: Eğitimde dönüşüm* (6. baskı). Ankara: Pegem Akademi Yayıncılık.

Partnership for 21st Century Skills [P21]. (2009). *21st Century skills, education & competitiveness: A resource and policy guide.* Retrieved from, http://www.p21.org/storage/documents/21st_century_skills_education_and_competitiveness_guide.pdf [Date of access: 21.11.2017].

Şentürk, C. (2017). Science Literacy in Early Childhood. *Journal of Research & Method in Education, 7*(1/III), 51-67.

Şentürk, C. & Ciğerci, F. M. (2017). *Classroom teachers' opinions about renewed science teaching program.* 26th International Conference on Educational Sciences, 20-23 April 2017, Antalya, Turkey.

Taş, U. E., Arıcı, Ö., Ozarkan, H. B. ve Özgürlük, B. (2016). *Uluslararası öğrenci değerlendirme programı PISA 2015 ulusal ön raporu.* Ankara: MEB Yayınları.

Trilling, B., & Fadel, C. (2009). *21st Century skills: Learning for life in our times.* San Francisco, CA: Jossey-Bass.

Yıldırım, A. & Şimşek, H. (2008). *Sosyal bilimlerde nitel araştırma yöntemleri* (7. baskı). Ankara: Seçkin Yayıncılık.