Science Curriculum in Turkey from 21st Century Skills’ Perspective

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Abstract. The purpose of this study is to analyze science education curriculums in Turkey (2005, 2013, 2017, and 2018) in terms of 21st-century skills. For this purpose, document analysis, one of the qualitative research methods, was used. The study’s documents consist of the science curriculums of 2005, 2013, 2017, and 2018. Descriptive analysis was used in the analysis. The study results were grouped under four themes, involving how 21st-century skills are covered in science curriculums’ 1) objectives, 2) vision and competences, 3) field-specific skills, and 4) measurement and evaluation approaches. It has been found that the objectives, vision and competences, and field-specific skills of all curriculums include 21st-century learning and innovation skills; information, media, and technology skills; and life and career skills. Regarding curriculums’ measurement and evaluation approaches, information, media, and technology skills are not included in the 2017 and 2018 curriculums, whereas all these skills are included in the 2005 and 2013 curriculums.

Keywords: 21st century skills, primary school science curriculum, learning and innovation skills, information, media and technology skills, life and career skills.

Introduction

People felt the need to transfer their experience and knowledge gained throughout history to future generations and made efforts in this direction. This need for experi-
ence and knowledge transfer, which is essential for future generations to survive and overcome difficulties, brought the teaching. The search for transferring the existing experience and knowledge to future generations in a better, more useful, and more professional way has led to the emergence of the concept that is called educational sciences. In the 21st century, we are witnessing many radical developments and changes in terms of the features that educational science and teachers, who are its cornerstones, should have. The life culture brought by the modern world, the accumulation of knowledge, technological developments, and the new generation that emerged in parallel with these developments have made the updating of the features that the teachers and the curriculums they are entitled to teach should have more important than in all ages. The rapidly changing and transforming global world requires the adaptation of teachers and curriculums to the age requirements. The period we are in is known as the Industry 4.0 Age; in order to progress in this age, qualified people trained in informatics, technology, industry, and education are needed. There are some skills that people who are qualified in these fields should have. These skills are generally considered as “21st Century Skills” (Benek, 2019).

The modern age's needs have led to the emergence of the concept called “21st Century Skills”. Since “21st Century Skills”, which are valid for all categories of modern life and contribute to many aspects such as people's life quality, production skills, etc., are transferred to people through the education system, the education aspect of the job is of great importance. Modern societies expect individuals to adapt to contemporary developments in all aspects, be productive, make the right decisions, and possess the new requirements that society needs (Belet & Güner, 2019). Many frameworks have been proposed for the 21st-century skills category. The most emphasized of these is the competence and skills framework named “Partnership for 21st Century Skills”, abbreviated as P21 (Cansoy, 2018). P21 is an American framework that comprehensively describes the skills, knowledge, and specialties students need to master in business and life by dividing them into three main categories. This framework’s objective, which is very close to the Lifelong Learning Skills Framework of Europe, defines a basic framework for curriculum development in school education. The P21 framework's presentation has been combined with various tools and guidelines, allowing it to be used by politicians, teachers, and parents (Council Recommendation on Key Competences for Lifelong Learning, 2018). The core subjects of the P21 framework cover various subjects such as English, language and reading arts, world languages, arts, mathematics, economics, science, geography, history, state, and civic knowledge; besides, it consists of three main skill areas, namely learning and innovation skills, information, media and technology skills, and life and career skills (Partnership for 21st Century Skills, 2013; Yalçın, 2018; Bircan, 2019; Yeniay Üsküplü, 2019).

The learning and innovation skill category of the P21 framework expresses people’s readiness for work environments, learning about life, which is getting more and more
complex, and improving people’s innovation capacity (Yalçın, 2018). This skill area includes creative thinking, critical thinking, problem-solving, communication, and collaboration dimensions (Partnership for 21st Century Skills, 2013; Trilling & Fadel, 2009). These skills are the key to creative thinking and lifelong learning (Trilling & Fadel, 2009).

The information, media, and technology skills category include information literacy and media literacy skills that people should have in line with the current era and rapidly advancing technological developments. This skill area addresses information literacy, media literacy, informatics literacy (information, communication, and technology) skills (Partnership for 21st Century Skills, 2013; Trilling & Fadel, 2009). The last category, namely life and career skills, includes the behaviors and skills that enable people to succeed and maintain their jobs and daily life. Adaptability, risk-taking, and responsibility skills of the individuals who make up the society belong to this category (Cansoy, 2018). According to P21, the life and business environments of our age require much more than thinking skills and content knowledge. The rapidly changing, challenging living conditions and the ability to manage daily life and business life require students to be equipped with the necessary life and career skills. In this respect, the skills to have can be listed as; flexibility and adaptability, entrepreneurship and self-orientation, social and intercultural skills, productivity and accountability, and leadership and responsibility (Partnership for 21st Century Skills, 2013; Trilling & Fadel, 2009). Another point to be noted here is that some features cannot coexist together in an individual. Therefore, the designers of the P21 set some standards to facilitate the applicability of the framework and make it more efficient; they have created support programs such as assessment of 21st-century skills, curriculum, professional development, and learning (Yeniay Üsküplü, 2019).

Science education is of great importance for continuing progress in science and technology (Demir & Çelik, 2020; Kırtak & Er, 2011). Science is a field that aims to raise science-literate individuals; it is effective in understanding science and technology and sheds light on 21st-century skills (İşman, Baytekin, Balkan, Horzum & Krier, 2002). Therefore, science curriculums that will enable the development of science gain great importance. Continuous improvement of science accelerates the curriculum development studies and requires it to be shaped within the framework of the 21st-century skills. With the curriculums implemented in 2005, 21st-century skills started to be included in the education system (MoNE, 2006). For this reason, it is thought that studies that will reveal how much these skills are included in the science curriculums of 2005, 2013, 2017, and 2018 will provide originality and contribution to the literature. Therefore, this study is aimed to investigate Turkey’s science curriculums (2005, 2013, 2017, and 2018) in terms of 21st-century skills.
Methodology

Research Model

This study aims to investigate Turkey’s science curriculums (2005, 2013, 2017, and 2018) in terms of 21st-century skills. For this purpose, document review, one of the qualitative research methods, was used. Document review involves analyzing written papers that contain explanations about the subject’s themes to be researched. What kind of documents are necessary and useful in the research depends entirely on the research problem. In studies involving educational sciences, the documents such as textbooks, curriculums, correspondence on the school platform, meeting minutes, student records and files, student and teacher textbooks are used (Bogdan & Biklen, 1992; cited in Yıldırım & Şimşek, 2016). Consequently, 2005, 2013, 2017, and 2018 science curriculums published by the Ministry of National Education were used as documents in this study. The relevant curriculums have been accessed from the Ministry of Education Board of Education’s website (http://ttkb.meb.gov.tr).

Data Analysis

In the study, the data were analyzed using the descriptive analysis method. One of the key points of descriptive analysis is shaping and interpreting the data according to previously determined themes (Yıldırım & Şimşek, 2016). In this study, the science curriculums were examined in detail, and four related themes were specified. The themes are based on the curriculum’s sections: “objectives, vision and competences, field-specific skills and measurement and evaluation approach.” The created themes were described according to 21st-century skills; a format including the skills common to all curriculums and non-common skills was formed for each theme. 21st-century skills included in the curriculums and the extent of including them are highlighted using column charts for each theme. Finally, direct quotations are displayed within the framework of the created themes, a requirement of the descriptive analysis method.

In the study, curriculums’ analysis was categorized according to 21st-century skills. The 21st-century skills included in each theme were discussed separately by researchers. To ensure the study’s validity and reliability, researchers addressed the themes by expressing their opinions separately and matched them with 21st-century skills. Regarding the classification of the themes within the scope of 21st-century skills, the skills agreed upon were accepted, and the themes with differences of opinion were discussed again. At the last stage, the researchers who completed the assessment used the reliability coefficient formula introduced by Miles & Huberman (1994) to ensure the research’s validity and reliability. Accordingly, the analysis’s reliability was found to be 0.88, which indicates that the researchers’ coding was reliable. As a result of the analysis, four themes were formed; the figures and graphics related to these themes were created and presented in the findings section.
Findings

The findings obtained from the analysis of the science curriculums were explained in terms of 21st-century skills covered in science curriculums: 1) objectives, 2) vision and competences, 3) field-specific skills, 4) measurement and evaluation approach parts.

21st-Century Skills in the Objectives of Science Curriculums

The inclusion of 21st-century skills in the science curriculums’ objectives (2005, 2015, 2017, and 2018) is indicated in Figure 1. Accordingly, regarding the curriculum’s objectives, entrepreneurship and self-management, critical thinking, problem-solving, social skills, productivity and accountability, and leadership and responsibility skills are common in all curriculums. On the other hand, some 21st-century skills are not present in all curriculums. 2005 science curriculum includes information literacy, career awareness, and technology skills; 2013 curriculum includes technology skills, creativity and innovation, flexibility and adaptability, and life skills; 2017 curriculum includes life skills, career skills, information literacy, and innovation skills; and the 2018 curriculum, which is the last curriculum includes technology skills, creativity and innovation skills, career skills and life skills. The findings regarding how often 21st-century skills are included in science curriculums’ objectives are shown in Graphic 1.
In Graphic 1, the amount of 21st-century skills included in science curriculums’ objectives is given (according to the P21 category). Accordingly, the life and career skills category is the most used category in all curriculums, and the least used category is the information, media, and technology category. Information, media and technology skills are included more in the 2005 Science and Technology Course Curriculum’s objectives and less in other curriculums.

Below there are examples of how 21st-century skills are included in the science curriculums’ objectives (2005, 2015, 2017, and 2018):

- Providing students with the skills to construct new knowledge through research, reading, and discussion (MoNE, 2005).
- Raising awareness of how science affects society and technology and how society and technology affect science (MoNE, 2013).
- Developing career awareness and entrepreneurial skills related to science (MoNE, 2017).
- Developing reasoning skills, scientific thinking habits, and decision-making skills using socio-scientific issues (MoNE, 2018).
21st-Century Skills in the Vision and Competences of Science Curriculums

This theme covers how 21st-century skills are included in the science curriculums’ vision and competences (2005, 2015, 2017, and 2018), and it is shown in Figure 2.

The inclusion of 21st-century skills in the vision and competences of science curriculums (2005, 2015, 2017, and 2018) is displayed in Figure 2. Accordingly, the following 21st-century skills are common in all curriculums’ vision and competences: creativity and innovation, entrepreneurship and self-management, problem-solving, information, communication and technology, productivity and accountability, leadership and responsibility, flexibility and adaptability. On the other hand, some 21st-century skills are not included in all curriculums. 2005 science curriculum includes critical thinking, information literacy, and technology skills; 2013 curriculum includes collaboration, communication, social and intercultural skills; 2017 curriculum includes informatics literacy, media literacy, information literacy, social and intercultural skills, communication, critical thinking skills; and the 2018 curriculum, which is the last curriculum includes social and intercultural skills, media literacy, informatics literacy, information literacy, critical thinking, communication, and collaboration skills. The findings regarding how often 21st-century skills are included in science curriculums’ vision and competences are shown in Graphic 2.
In Graphic 2, the number of 21st-century skills included in science curriculums’ vision and competences is given (according to the P21 category). Accordingly, the life and career skills category is the most included category in all curriculums; on the other hand, information, media, and technology skills are more included in the 2017 and 2018 curriculums and least included in the 2013 curriculum. Regarding learning and innovation skills, they were included in the 2018 curriculum the most, followed by 2017, 2013, and 2005 curriculums.

Below there are examples of how 21st-century skills are included in the science curriculums’ vision and competences (2005, 2015, 2017, and 2018):

- Science and Technology’s Course Curriculum vision is educating all students, regardless of their individual differences, as science and technology literate (MoNE, 2005).
- Science literate individuals have a strong sense of knowledge, skills, positive attitude, perception, and value towards science and an understanding of the relationship between science and technology, society-environment, and psychomotor skills (MoNE, 2013).
- Qualifications Framework in Turkey has eight key competences that every individual is expected to gain within the scope of lifelong learning. These are listed as communication in the mother tongue, communication in foreign languages, mathematical competence and basic competences in science/technology, digital competence, learning to learn, social and civic competences, taking the initiative and entrepreneurship perception, cultural awareness and expression (MoNE, 2017).
- Our education system aims to raise individuals who have knowledge, skills, and behaviors integrated with competences (MoNE, 2018).
21st-Century Skills in the Field-Specific Skills of Science Curriculums

This theme covers how 21st-century skills are included in the science curriculums’ field-specific skills (2005, 2015, 2017, and 2018), and it is shown in Fig. 3.

The inclusion of 21st-century skills in the field-specific skills of science curriculums (2005, 2015, 2017, and 2018) is displayed in Figure 3. Accordingly, regarding curriculums’ field-specific skills, the following 21st-century skills are common in all curriculums: creativity and innovation, entrepreneurship and self-management, problem-solving, technology skills, and communication skills. On the other hand, some 21st-century skills are not included in all curriculums. 2005 science curriculum includes responsibility, self-management, social and intercultural skills, productivity and accountability, and information literacy skills; 2013 curriculum includes information literacy, leadership and responsibility, collaboration and social skills; 2017 curriculum includes collaboration skill; and the 2018 curriculum, which is the last curriculum includes collaboration skill. The findings regarding how often 21st-century skills are included in science curriculums’ field-specific skills are shown in Graphic 3.

Fig. 3. 21st-Century Skills in the Field-Specific Skills of Science Curriculums

The inclusion of 21st-century skills in the field-specific skills of science curriculums (2005, 2015, 2017, and 2018) is displayed in Figure 3. Accordingly, regarding curriculums’ field-specific skills, the following 21st-century skills are common in all curriculums: creativity and innovation, entrepreneurship and self-management, problem-solving, technology skills, and communication skills. On the other hand, some 21st-century skills are not included in all curriculums. 2005 science curriculum includes responsibility, self-management, social and intercultural skills, productivity and accountability, and information literacy skills; 2013 curriculum includes information literacy, leadership and responsibility, collaboration and social skills; 2017 curriculum includes collaboration skill; and the 2018 curriculum, which is the last curriculum includes collaboration skill. The findings regarding how often 21st-century skills are included in science curriculums’ field-specific skills are shown in Graphic 3.
In Graphic 3, the amount of 21st-century skills included in science curriculums’ field-specific skills is given (according to the P21 category). Accordingly, learning and innovation skills are observed to be included in all curriculums at the same level. Information, media, and technology skills occupy more space in 2005 and 2013 curriculums than in 2017 and 2018 curriculums. Life and career skills are most included in the 2005 curriculum, followed by 2018, 2013 curriculums, and least in the 2017 curriculum.

Below there are examples of how 21st-century skills are included in the science curriculums’ field-specific skills (2005, 2015, 2017, and 2018):

- Develops the knowledge and skills required to develop critical and responsible attitudes towards innovations (MoNE, 2005).
- This life skills field includes basic life skills such as analytical thinking, decision-making, creativity, entrepreneurship, communication, and teamwork related to accessing and using scientific knowledge (MoNE, 2013).
- This scientific process skills field covers the skills scientists use in their studies, such as making an observation, measuring, classifying, recording data, hypothesizing, using data and modeling, changing and controlling variables, and conducting experiments (MoNE, 2017).
- This engineering and design skills field integrates science with mathematics, technology, and engineering; brings students to the level of being able to invent and innovate with an interdisciplinary perspective on problems, and students create products by using the knowledge and skills they have acquired and develops strategies on how to add value to these products. (MoNE, 2018).
21st-Century Skills in the Measurement and Evaluation Approach Adopted in Science Curriculums

This theme covers how 21st-century skills are included in the measurement and evaluation approach adopted in science curriculums (2005, 2015, 2017, and 2018), and it is shown in Fig. 4.

The inclusion of 21st-century skills in the measurement and evaluation approach adopted in science curriculums (2005, 2015, 2017, and 2018) is displayed in Fig. 4. Accordingly, regarding the adopted measurement and evaluation approaches, collaboration, creativity and innovation skills are common in all curriculums. On the other hand, some 21st-century skills are not included in all curriculums. 2005 science curriculum includes information literacy, entrepreneurship and self-management, critical thinking and problem solving, social and intercultural skills, leadership and responsibility skills; 2013 curriculum includes technology skills, entrepreneurship and self-management, leadership and responsibility, and problem-solving skills; 2017 curriculum includes social and intercultural skills, entrepreneurship and self-management, critical thinking and problem solving, accountability, adaptability,
leadership and responsibility skills; and the 2018 curriculum, which is the last curriculum includes social and intercultural skills, flexibility and adaptability skills. The findings regarding how often 21st-century skills are included in the measurement and evaluation approach adopted in science curriculums are shown in Graphic 4.

In Graphic 4, the number of 21st-century skills being included in the measurement and evaluation approach adopted in science curriculums is given (according to the P21 category). Accordingly, learning and innovation skills are most included in 2005, 2013, and 2017 curriculums. Information, media, and technology skills are generally less included in all curriculums, even not included in the 2017 and 2018 curriculums. Life and career skills are included in the 2017 curriculum the most, followed by 2005 and 2013, and the least in 2018.

Below there are examples of how 21st-century skills are included in the measurement and evaluation approach adopted in science curriculums (2005, 2015, 2017, and 2018):

- Providing feedback to make learning more meaningful and deeper (MoNE, 2005).
- In the Science Curriculum, an understanding of measurement and evaluation has been adopted to provide continuous feedback to monitor and guide students in the process, identify and eliminate learning difficulties, and support meaningful and permanent learning (MoNE, 2013).
- The main objective is to gain knowledge, skills, and values in the curriculum at the desired level (MoNE, 2017).
No two human beings are identical. Therefore, having a curriculum and a measurement and evaluation process that are “suitable for everyone”, “valid and standard for all”, is contrary to human beings’ nature. Thus, it is essential to act with maximum diversity and flexibility in the measurement and evaluation process (MoNE, 2018).


Graphic 5 shows the percentages of 21st-century skills covered by the science curriculums. Accordingly, 21st-century skills are found to be covered in all curriculums at similar rates (27%, 24%, 25%, and 24%). The highest among these rates belongs to the 2005 curriculum (27%).

**Conclusion, Discussion, and Suggestions**

In this study, science curriculums in Turkey (2005, 2013, 2017, and 2018) are examined regarding the inclusion of 21st-century skills. In this context, the “Objectives”, “Vision and Competences”, “Field Specific Skills”, and “Measurement and Evaluation Approaches” of the curriculums are themed and evaluated. 21st-century skills included under each theme and the extent of their inclusion are also covered in the study.

First, the curriculums’ objectives are examined, and some skills are observed to be present in all curriculums. These common skills are mostly life and career skills but partly include learning and innovation skills. Information, media, and technology skills of 21st-century skills are not sufficiently included in the curriculums’ objectives. In the study handled by Boyacı & Özer (2019), it was concluded that the objectives of 2005,
2015, 2017, and 2018 Turkish language curriculums include life and career skills. In this respect, it can be said that it is parallel with the result of this research. The current curriculums, namely 2017 and 2018, are the first ones that include engineering and design skills. Therefore, information, media, and technology skills are expected to be included more in these curriculums. However, the research result does not support this expectation; information, media, and technology skills do not occupy enough space in the curriculums’ objectives. This may be due to being integrated into other parts of the program.

Regarding the “Vision and Competences” theme of the study in terms of 21st-century skills, learning and innovation skills, information, media, and technology skills, and life and career skills are included in all curriculums. However, the amount of these skills varies between curriculums. For example, the most common skill area in all curriculums is life and career skills, whereas the least covered skill area is the information, media, and technology skills. Information, media, and technology skills are included in the 2017 and 2018 curriculums at most and least in the 2013 curriculum. In this case, it can be said that the 2013 curriculum includes high-level cognitive dimensions (analysis, creation, and evaluation) in its vision and competences. In the study conducted by Yaz & Kurnaz (2017), it was concluded that in the 2013 curriculum, students were expected to have higher-order thinking skills, but this is not sufficiently included in the achievements, which supports the result of this study. Besides, in the study that Bal (2018) analyzed 21st-century skills in terms of gain, text, and activity, it was concluded that the least used skill area in the text dimension was information, media, and technology, which is in line with this study. The study revealed that the information, media, and technology skill areas were the most involved in the 2017 and 2018 programs’ vision and competences; this may be due to the “Competences” section of Turkish Qualifications Framework, which has entered the program in 2017 and kept as it was in 2018.

Regarding the “Field-Specific Skills” theme of the study, learning and innovation skills, information, media and technology skills, and life and career skills are included in all curriculums. However, the extent of these skills varies between them. For example, life and career skills are most included in the 2005 curriculum, followed by 2018 and 2013, and least in the 2017 curriculum. The 2017 curriculum was updated and published one year later under the name of the 2018 curriculum. The 2017 curriculum was updated and published one year later under the name of the 2018 curriculum. Based on this information, these two programs are expected to be parallel to each other. According to this result of the research, 2017 and 2018 curriculums differ greatly in life and career skills. The 2018 curriculum is observed to cover many life and career skills regarding field-specific skills. This may be due to the changes made in the 2017 program in the direction of life and career skills. It is also observed that information, media, and technology skills are least included in the field-specific skills of the currently used curriculum (2018 curriculum). However, to raise more sensitive and conscious students, media literacy
courses should start from primary school. The generations, who can look at the media with a critical perspective, should be raised (Kalan, 2010).

Regarding the “Measurement and Evaluation Approach” theme of the study, all curriculums’ evaluation approaches include learning and innovation skills and life and career skills, whereas information, media, and technology skills are only included in the 2005 and 2013 curriculums, but not in the 2017 and 2018 curriculums. The literature shows that information, communication, and technology literate students can solve problems and manage themselves better (Katz & Macklin, 2007; Eryılmaz & Uluyol, 2015). Therefore, these skills should be adequately included in current curriculums. In the study conducted by Boyacı & Özer (2019), it was concluded that no information, media, and technology skills are included in the evaluation part of the curriculum, which supports this study’s result. Besides, the distribution of the skills across programs also varies. For example, learning and innovation skills are sufficiently included in all programs’ measurement and evaluation approaches, whereas life and career skills are mostly included in the measurement and evaluation approach of the 2017 curriculum. Regarding the measurement and evaluation approaches of the 2018 curriculum, which is the last updated one, life and career skills are at the lowest level.

Finally, regarding the general impression of science curriculums in terms of 21st-century skills, it can be said that these skills are partially included in all curriculums. The inclusion rates of these skills were found to be close to each other in all curriculums, which may be because 21st-century skills are included in the curriculum as of 2005, and they are tried to be included in the following curriculums.

Regarding the scope of the study, the following suggestions are submitted for the researchers:

1. Science textbooks and the current science curriculum can be addressed together to perform a more comprehensive analysis of the science curriculum from the perspective of 21st-century skills.
2. Research can be conducted by interviewing science teachers and examining course activities to determine the reflection rate of 21st-century skills in the course materials.
3. It may be suggested that curriculum developers examine such studies for including 21st-century skills in future science curriculums.

References


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Santrauka


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