



Research Article

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A Qualitative Content Analysis to Investigate 21st Century Skills in Learning Outcomes of High School Biology Course Curriculum

Melek Yaman Kasap^{1*}

Bilge Acar²

Suat Kasap³

¹Prof. Dr. Hacettepe University, Faculty of Education,
Department of Mathematics and Science Education,
Beytepe, Ankara, Türkiye

²Dr. Ministry of Education,
Yenimahalle Science and Art Center,
Ankara, Türkiye

³Assoc. Prof. Dr. College of Engineering and Technology,
American University of the Middle East,
Kuwait

*Corresponding Author

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Abstract

21st century skills combine accessing information and employing it in solving problems faced in daily life, employing advanced thinking skills, working with others in harmony, effectively using technology, and being aware of global and local economic and social events. Parallel to recent educational trends in the world and in accordance with the 21st century skills, curricula in many countries have gone through substantial changes. There is an obvious need to determine how compatible learning outcomes of course curricula are with the 21st century skills. The objective of this study is to analyze learning outcomes of high school biology course curriculum within the framework of 21st century skills. The data were collected through document analysis and analyzed by the content analysis methods. In the study, each learning outcome and explanations in the biology course curriculum was analyzed in terms of their compatibility within the framework of the basic 21st century skills and related sub-skills. Results have shown that learning outcomes of the biology course curriculum are in accordance with the 21st century skills, but the distribution of the 21st century skills show different distribution (learning and innovation skills, 59%; media and technology skills, 23%; life and career skills, 18%), within the curriculum. There is no study in the literature that covers all grade levels and 21st century skills for the biology courses at the high school. This work intends to fill this gap.

Keywords: biology course curriculum, learning outcomes, 21st century skills, content analysis

1. Introduction

Generally speaking, skill as a concept denotes expertly realizing certain activities, tasks, and jobs, or having the qualification to solve problems by using certain proficiencies and knowledge used. Used in the context of teaching-learning processes skill is defined as students' proficiencies based on knowledge and performance acquired during their education, which is aimed to be transferred to actual life (Rychen and Salganik, 2003). 21st century 'skills, on the other hand, are defined as skills that people are expected to have, both now and in the future, to succeed in their social and professional lives in accordance with the everchanging conditions of today's world. 21st century skills combine accessing information and employing it in solving problems faced in daily life, employing advanced thinking skills, working with others in harmony, effectively using technology, and being aware of global and local economic and social events. Several institutions and organizations such as International Society for Technology in Education (2007) and World Economic Forum (2015) put determining and classifying 21st century skills on their agenda and they have identified several frameworks. The main objective of these institutions and organizations that work on 21st century skills is to determine according to which criteria the new generations can be trained keeping in mind the current circumstances and expectations of the times. Among the classifications concerning 21st century skills that correspond to three main headings and their subskills for eleven subheadings (Trilling and Fadel, 2009), known as *P21 framework*, under these were determined to be basic skills necessary for students to succeed in their personal and professional lives from kindergarten to the end of year 12. Three main headings and their eleven subheadings of P21 framework can be briefly explained as below.

- I. *Learning and Innovation Skills*: They include the ever-important skills that are significant for students who are getting ready for a complex social and professional life. These skills consist of the following three subheadings;
 - i) *Critical Thinking and Problem-Solving Skills* include skills such as questioning information, opinions, and thoughts, analyzing based on evidence, establishing relationships, evaluating and making decisions. It also includes identifying problems and producing effective solutions to them.
 - ii) *Creativity and Innovation Skills* include mental activities such as being open to new and different ideas, developing, organizing, analyzing, and evaluating them, and transforming them into products.
 - iii) *Communication and Collaboration Skills* refer to communicating effectively by using written, verbal, non-verbal and visual forms of communication and being able to work responsibly, respectfully, willingly, openly to compromise and effectively with different groups to achieve common goals.
- II. *Information, Media, and Technology Skills*: People in the 21st century live in a world where technology and media is omnipresent and access to technology is easy, collaboration and personal contribution gains importance and where technological tools change rapidly. To be successful in the 21st century, citizens and workers should be able to effectively use information, media, and technology; they are also expected to be productive with these. These skills consist of the following three subheadings;
 - i) *Information Literacy* includes being conscious regarding information sources, accessing information, and being able to evaluate and use the information obtained critically and competently.
 - ii) *Media Literacy* covers all the skills needed to use all kinds of visual, written, and electronic media actively and consciously, to critically evaluate media content and messages, and to use media tools for communication purposes.
 - iii) *Information, Communication, and Technology Literacy* include skills related to using digital technologies appropriately for purposes such as accessing information, organizing, evaluating, and communicating information.

III. *Life and Career Skills*: Developing the necessary life and career skills is important to succeed. These skills consist of the following five subheadings;

- i) *Flexibility and Adaptability* can be defined as adapting to changing conditions, roles, and responsibilities. Being able to work flexibly, harmoniously, and effectively with different groups and different teammates in learning environments is also considered within the scope of this skill.
- ii) *Initiative and Self-Direction* include the ability of individuals to take initiatives to improve themselves in line with their goals, to monitor and evaluate their own performance, to work towards the goal, to take and use initiative, to use time effectively, and decision making.
- iii) *Social and Cross-Cultural Skills* include exhibiting appropriate behavior in the community, speaking and listening appropriately, being able to convey one's views, being respectful of others' ideas and culture, and being able to work harmoniously and productively with others, even if there are social and cultural differences.
- iv) *Creativity and Accountability* include planning the work done according to the objectives, carrying out the activities meticulously and in accordance with business ethics, being able to produce alternatives for obstacles and problems, taking responsibility and being accountable for the results.
- v) *Leadership and Responsibility* include skills such as convincing others to achieve a common goal, directing the knowledge and skills of others to achieve goals, exhibiting honest, responsible, and ethical behavior, and prioritizing the benefit of the group and society.

As can be seen, 21st century skills determine individuals' knowledge, skills, and behavior which they are expected to have and develop both during their education and elsewhere. Although not completely new, these skills framework include skills, such as information, communication, and technology literacy, which are a requirement of almost every sector today in addition to such skills as cooperation, critical thinking and communication, which have been and still are important (Trilling and Fadel, 2009).

With the circumstances change, so does the framework of knowledge, skills, and proficiencies which are expected of an individual, creative, entrepreneur and production-focused individuals are needed today. The repercussions of change have been rapidly felt in education institutions which are responsible for training qualified individuals that would meet the needs of society. To improve students' 21st century skills, these institutions, which have the potential to reach every single individual in society, have initiated change and improvement works at every level of the education system such as curricula, class activities, and course materials. Parallel to recent educational trends and in accordance with the 21st century skills, curricula in many countries have gone through substantial changes. 21st century skills that students should acquire are also underlined in the recent curricula update studies in Turkey, too. In this respect, there is an obvious need to determine how compatible learning outcomes of course curricula are with the 21st century skills. Science courses (physics, chemistry, and biology) provide important opportunities in terms of content and method in gaining 21st century skills. In order to benefit from these opportunities, learning outcomes of science courses curricula must include 21st century skills and enable practices suitable for the development of skills. However, the number of studies examining 21st century skills are limited for science courses and especially in biology. There is a need to study that covers all grade levels and 21st century skills for the biology courses at the high school. This study target to fill this gap. The objective of this study is to analyze learning outcomes of the current biology course curriculum within the framework of 21st century skills. The following research questions were sought to be answered in the study:

1. Do learning outcomes of the current biology course curriculum include 21st century skills?
2. How is the distribution of 21st century skills in learning outcomes of the current biology course curriculum?

2. Review of Related Literature

Among the classifications concerning 21st century skills, skills framework prepared within the context of “Partnership for 21st century skills” was designed with the collaboration of various companies in the United States such as Microsoft, Cisco Apple, Intel, Dell, and Adobe. The detailed and comprehensive report was widely accepted and was taken as a reference point in many studies (Brown, 2018; Trilling and Fadel, 2009). Skills framework designed by Trilling and Fadel (2009) defines the skills and proficiencies needed by students to succeed in their personal and professional lives (Voogt and Roblin, 2012). The time spent in education institutions is not sufficient to catch up with the ever-advancing technologies nor is it sufficient to absorb the ever-increasing information. Thus, expectations from these institutions as well as their tasks and responsibilities have increased. Schools are expected to prepare students to the complex social life and the competitive work life (Lemke, 2010); they are expected to bring in their students the key skills necessary to succeed in personal and professional life (Gunes, 2012). Students should be prepared for such adult roles as citizen, parent, employer, employee, administrator, and entrepreneur so that they could deal with future difficulties. On the other hand, the private sector and various state institutions as well as politicians expect education institutions to train individuals who have 21st century skills (Pellegrino, & Hilton, 2012).

Evidently, changes in curriculum are required so that 21st century skills are provided during education (European Parliament and the Council, 2006; Jacobs, 2010; Voogt and Roblin, 2012). To this end, curriculum in countries such as Canada, Finland, Australia, Belgium, Hong Kong, and Singapore have gone through substantial changes. In literature, the number of studies examining 21st century skills are limited, and the existing ones focus mostly on Turkish courses and social sciences courses (Bal, 2018; Belet-Boyacı and Özer, 2019; Kayhan, Altun and Gürol, 2019; Otuz, Kayabaşı and Ekici, 2018). When studies on biology courses are examined, the limited number of studies conducted in the 21st century skills (Atli, 2019; Hiong and Osman, 2013), it is seen that there is no study that covers all grade levels and 21st century skills for the biology courses at the high school. This study target to fill this gap.

3. Research Design and Methodology

Different research patterns are used in qualitative studies. In this study, theoretical analytical survey pattern was used. In such pattern, the existing situation is analyzed and determined by examining documents and texts. The analytical survey conducted in this study was realized within the frame of document analysis. Document analysis involves doing a comprehensive assessment of resources that include pertinent information pertaining to the subject of study (Patton, 2002; Yıldırım & Şimşek, 2016). Content analysis as a research methodology entails a systematic and objective approach to the description and quantification of various phenomena. The process of analysing documents is commonly referred to as such (Elo and Kyangas, 2008). Qualitative Content Analysis is an essential tool for a systematic analysis of textual materials such as documents and especially important researches in education (Mayring 2014; Mayring, 2023). This study practices deductive content analysis to examine the learning outcomes of the current biology course curriculum (Ministry of Education, 2018) according to 21st century skills to investigate the existing situation by examining documents and texts. This study is divided into the following steps as indicated by Zhang and Wildemuth (2009).

Step 1: Prepare the Data: Data/documents of the study consist of the learning outcomes of the current biology course curriculum (Ministry of Education, 2018). The number of learning outcomes of the curriculum are 11, 17, 34, and 29 for each grade from 9 to 12 respectively. In addition to the learning outcomes, there are explanations related to each learning outcome. These explanations, sometimes indicating a limitation and sometimes framing the content, include detail information about the learning outcome. In this respect, these explanations were also included in the analyses so

as not to have data loss even when they are not reflected in the total number of learning outcomes.

Step 2: Define the Unit of Analysis: Each sentence in learning outcomes of the current biology curriculum and learning outcome explanations was used as analysis unit.

Step 3: Develop Categories and a Coding Scheme: Learning outcomes were analyzed within the P21 framework. Categories correspond to three main headings and their subheadings of 21st century skills. Coding was performed by authors separately.

Step 4: Test Your Coding Scheme on a Sample of Text: During the coding, one coding was done for each associated skill category when a learning outcome covers more than one category. Therefore, sometimes the number of codes (skills) was higher than the number of learning outcomes. The sample coding for the learning outcomes of the curriculum related to three main headings and their subheadings of 21st century skills are shown in tables 1, 2, and 3. Note that, four numbers such as 10.2.1.2. in front of the sample learning outcomes at these tables are given to indicate the location of the learning outcomes in the curriculum. The meaning of four numbers are the grade, unit number, topic, and learning outcome.

Table 1: Sample Learning Outcomes Related to Learning and Innovation Skills in the current Biology Course Curriculum

Sample Learning Outcomes and Their Explanations	Related Learning and Innovation Skills
10.2.1.2. Question the role of genetic variations in explaining biological diversity. <i>Facilitate discussion on the sources of variations (independent distribution of chromosomes and crossing over). Mutation types are not included in discussions.</i>	Critical Thinking and Problem Solving Communication and Collaboration
10.3.1.3. Analyse the flow of matter and energy in ecosystems. c. <i>Students are encouraged to do research and have a discussion on the negative effects of bioaccumulation on humans and other living beings. d. Students are encouraged to design a food network that shows the nutrition relations among living beings.</i>	Critical Thinking and Problem Solving Creativity and Innovation
11.1.1.4. Makes inferences related to what needs to be done to protect the health form of the nervous system.	Critical Thinking and Problem Solving Communication and Collaboration
12.1.1.3. Draws a meronymy in the organisation of the genetic material in the cell. <i>Genetic material organisation from nucleoid, DNA to chromosome is modelled.</i>	Critical Thinking and Problem Solving
12.3.2.4. Designs an experiment on the transportation of water and elements in plants.	Creativity and Innovation

Table 2: Sample Learning Outcomes Related to Information, Media, and Technology Skills in the current Biology Course Curriculum

Sample Learning Outcomes and Their Explanations	Related Information, Media, and Technology Skills
11.1.1.2. Explains endocrine glands and the hormones secreted from them. <i>Visual aids, graphics, e-learning objects applications are employed in teaching about endocrine glands and the hormones they secrete.</i>	Information, communication, and technology literacy
11.1.1.6. Explains disorders/conditions related to sense organs. a. <i>Students are encouraged to do research and make presentations on disorders/conditions such as colour blindness, myopia, hypermetropia, astigmatism, hearing loss, and balance loss.</i>	Information literacy
11.1.1.7. Makes interference on what to do to preserve the healthy state of sensory organs. <i>Students are encouraged to do research on the technological developments on the treatment of sensory disorders/conditions.</i>	Information literacy
12.2.2.2. Explains the photosynthesis process on a scheme. <i>Photosynthesis process is explained by utilising visual aids, graphics, e-learning objects, and applications.</i>	Information, communication, and technology literacy

Table 3: Sample Learning Outcomes Related to Life and Career Skills in the current Biology Course Curriculum

Sample Learning Outcomes and Their Explanation	Related Life and carrier skills
12.1.2.4. Examines the effect of genetic engineering biotechnology applications on human life. <i>How the socio-economic and cultural context affects the development of biology is emphasised.</i>	Social and Cross-Cultural Skills
12.3.1.1. Explains the structure and functions of the main parts of a flowery plant. <i>Students are encouraged to share on social media photos they have taken/found on plant diversity</i>	Initiative and Self-Direction
9.3.1.2. Explains by examples the categories used in classifying plants and the hierarchy between these categories. <i>Students are encouraged to prepare a video or a product on the world of beings by the photos they have found/taken.</i>	Productivity and Accountability
10.3.2.2. Questions his/her own role as an individual in the emergence of environmental problems. <i>a. Applications about ecological footprint and water footprint are carried out.</i> <i>b. Students are encouraged to develop solution suggestions to minimise ecological footprint, water footprint, and carbon footprint.</i>	Leadership and Responsibility

Step 5: *Code All the Text:* Data were analyzed by MaxQDA 11.

Step 6: *Assess Your Coding Consistency:* Learning outcomes were examined by two researchers separately and to ensure cod reliability Miles and Huberman's (1994) reliability formulation was used and it was calculated to be 0.89. Sections where the researchers were not in consensus were re-evaluated; a consensus was reached, and the examination got its final form.

Step 7: *Draw Conclusions from the Coded Data:* Skills were quantified by the frequencies and percentages and they were presented in tables according to the subcategories belonging to three skill groups and their distribution in grade levels at the next section.

Step 8: *Report Your Methods and Findings:* This step is also seen in the next section.

4. Research Results and Discussion

In this section, results obtained from analyzing the learning outcomes of the current biology course curriculum according to three main headings and their eleven subheadings of the 21st century skills are presented and discussed. 21st century skills are coded in each grade as 16, 40, 42, and 31 from 9 to 12 respectively as shown in Table 4.

Table 4: Distribution of learning outcomes of the biology curriculum related to 21st century skills by grade

Grades	Learning & Innovation skills		Information, Media & Technology skills		Life & Career skills		Total skills	
	F	%	f	%	f	%	F	%
9 th	13	81.25	3	18.75	-	-	16	12.40
10 th	23	57.50	5	12.50	12	30.00	40	31.01
11 th	20	47.62	15	35.71	7	16.67	42	32.56
12 th	20	64.52	7	22.58	4	12.90	31	24.03
Total	76	58.91	30	23.26	23	17.83	129	100

Of the 129 skills, 76 of them belong to the main heading of learning and innovation skills, 30 of them belong to knowledge, media, and technology skills, and 23 of them belong to life and career skills. In other words, the three main headings were not distributed equally in the learning outcomes of the biology course curriculum. Although they show different distribution percentages (learning and innovation skills, 59%; information, media, and technology skills, 23%; life and career skills, 18%), all

three main headings of the 21st century skills have been included in the curriculum. In a report prepared on the integration of STEM education into the science curriculum, science teachers stated that course curriculum do not focus on 21st century skills and reported this as a problem for the curriculum (Akgündüz, Ertepinar, Ger & Türk, 2018). The results of our research show that there is positive differentiation for the biology course curriculum for the integration of 21st century skills into the curriculum, although the distribution of the main headings is different and that the curriculum significantly covers the 21st century skills. There are similar researches for different courses in the literature. For example, in a study where the 8th grade Turkish course curriculum was analyzed, and the results indicated that 36 of 76 learning outcomes in the curriculum were not related to any 21st century skills (Kayhan, Altun & Gürol (2019). Similarly, examining the learning outcomes of the Turkish course curriculum in terms of 21st century skills, Bal (2018) argued that although 21st century skills are on the fore in the basic skills section, there are shortcomings when it comes to learning outcomes. Findings of our study does not match with these studies. According to Stevens (2012), 21st century skills are comprehensive and general rather than aimed at a specific discipline. They should be taught to students at every level of education, from pre-school to higher education, at every course and grade (Alkılınç, 2019; Trilling and Fadel, 2009; Stevens, 2012). Despite these general recommendations in the literature, it is usual to differ in the distribution of 21st century skills in various disciplines. For example, it is not surprising that learning and innovation skills are predominant in biology, which is one of the basic science courses. Because, as in all branches of science, the content and methods used in the biology course are very suitable for transferring learning and innovation skills, and it is an expected case that this skill is predominant in the curriculum due to the nature of the course. When the three main headings of 21st-century skills were examined based on the number of learning outcomes in different grades, it was seen that the distribution is not homogenous and learning and innovation skills are dominant to other two main headings. Information, media, and technology skills are dominant to life and career skills except 10th grade. In some studies, from literature which were carried out in other disciplines, it was also indicated that learning and innovation skills are first in line, which is followed by media and technology skills; it was maintained that life and career skills were rarely included (Belet-Boyacı and Özer, 2019; Bal, 2018). It can be noted that our results are in line with theirs. While analyzing 21st century skills according to grades, it was seen the most frequently in the 10th and 11th grades which are followed by the 12th grade. Finally, it was seen the least frequently in the 9th grade. Even there is no life and career skills are not coded at 9th grade. It is important that 21st-century skills not conglomerate in the learning outcomes of certain class levels but be distributed in a planned and systematic manner in all class levels so that students acquire these skills systematically. In this respect, it is much more effective to integrate 21st-century skills homogenously at every class level in the learning outcomes.

In addition to analysis of three main headings of 21st century skills, subheadings of each main headings of the 21st century skills are analyzed in detail below. In Table 5, distribution of learning outcomes of the biology curriculum related to learning and innovation skills by grades were presented.

Table 5: Distribution of learning outcomes of the biology curriculum related to learning and innovation skills by grades

Grades	Critical Thinking & Problem-Solving		Creativity & Innovation		Communication & Collaboration		Learning & Innovation Skills (Total code)	
	F	%	F	%	F	%	F	%
9 th	7	53.85	4	30.77	2	15.38	13	17.10
10 th	9	39.13	7	30.43	7	30.43	23	30.26
11 th	11	55.00	2	10.00	7	35.00	20	26.32
12 th	9	45.00	5	25.00	6	30.00	20	26.32
Total	36	47.37	18	23.68	22	28.95	76	100.00

According to our analysis results concerning sub skills of learning and innovation skills, critical thinking and problem-solving sub skill is the most frequently coded one, 36 times. It is followed by communication and collaboration sub skill with 22 times coding and creativity and innovation sub skills with 18 times coding. One can see that critical thinking and problem-solving sub skills dominate the other subskills at each grade. Learning and innovation skills are necessary both in daily life and in professional environments in a world that has become more complex. According to Seferoğlu and Akbıyık (2006), one of the most important objectives of education is to raise individuals who can adapt to different situations and who have the critical and flexible thinking skills in solving a problem. Moreover, the contribution of critical and creative ideas to invention, technology, and production would positively reflect in the long run on the economic growth and social welfare (Erdoğan, 2006). In this respect, critical and creative thinking skills being adequately included in curriculum is important for a prosperous society and for raising individuals who can overcome problems (Trilling and Fadel, 2009; Martinez, 2022). Therefore, it can be stated that satisfying results that learning and innovation skills and all subheadings related to this group are detected in the learning outcomes of the biology course curriculum at every grade level. As seen in Table 5, creativity and innovation are related with fewer outcomes in the curriculum than other subheadings. Today, in the global world, being creative, adapting to/coping with ever-changing environmental conditions, and adapting to rapidly advancing technology have become much more important than in the past. Creativity and innovation skills are the skills students need to adapt to these conditions (Glassman & Opengardt, 2016). Due to the content of science courses, there are many activities and content that allow students to develop these skills. For this reason, the number of coding associated with creativity and innovation skills is not sufficient. Like the other two subskills, creativity and innovation skills should find more space in the program. Especially, 11th grade learning outcomes for the creativity and innovation skills should be increased. In similar approach, can also be applied to communication and collaboration subskills at 9th grade. Examining learning and innovation skills according to grade levels, it was seen the most frequently in the 10th grade and it was followed by the same 11th and 12th grades. Finally, it was seen the least frequently in the 9th grade. Examining the subheadings of learning and innovation skills from Table 5, it was seen that critical thinking and problem solving and communication and collaboration skills are more to the fore.

In Table 6, distribution of learning outcomes of the biology curriculum related to information, media, and technology skills by grades were presented.

Table 6: Distribution of learning outcomes of the biology curriculum related to information, media and, technology skills by grades

Grades	Information literacy		Media literacy		Information, communication & technology literacy		Information, media & technology skills (Total code)	
	F	%	F	%	F	%	f	%
9 th	1	33.33	-	-	2	66.67	3	10.00
10 th	3	60.00	-	-	2	40.00	5	16.67
11 th	6	40.00	-	-	9	60.00	15	50.00
12 th	3	42.86	-	-	4	57.14	7	23.33
Total	13	43.33	-	-	17	56.67	30	100.00

According to our analysis results concerning sub skills of information, media and technology skills, information, communication, and technology literacy sub skill was the most frequently coded one, 17 times. It is followed by information literacy sub skill with 13 times coding. However, there was no code to media literacy sub skill in any of the learning outcomes. 'Media literacy' is a fundamental skill for students like 'information literacy' and 'information, communication, and technology literacy' and is a much sought-after skill in professional life. Nowadays, the condition of following the changing

and developing information and technology and being aware of social developments and innovations is to use media and communication tools effectively and efficiently. Therefore, in a world where accessing information is both easy and available through various channels, it is a necessity for students to effectively use, analyze, and evaluate information, media, and technology (Trilling and Fadel, 2009). For that reason, to have individuals who can correctly analyze and evaluate media, media literacy should be integrated into learning outcomes of the biology curriculum when the future curriculum update studies. While integrating media literacy to the curriculum, one should pay attention to distribute in a balanced way to all grade levels. Examining information, media, and technology skills according to grade levels, it was seen the most frequently in the 11th grade learning outcomes which was followed by the 12th grade learning outcomes and by the 10th grade learning outcomes. Finally, it was seen the least frequently in the 9th grade learning outcomes. However, it should be noticed that half of the skills are coded at the 11th grade which is a clear unbalanced distribution to grade levels. This issue should also be considered for the future curriculum update studies.

In Table 7, distribution of learning outcomes of the biology curriculum related to life and career skills by grades were presented.

Table 7: Distribution of learning outcomes of the biology curriculum related to life and career skills by grades

Grades	Flexibility & adaptability		Initiative & self-direction		Social & cross-cultural		Productivity & accountability		Leadership & responsibility		Life & carrier skills (Total code)	
	f	%	F	%	F	%	F	%	f	%	f	%
9th	-	-	-	-	-	-	-	-	-	-	-	-
10th	-	-	-	-	-	-	7	58.33	5	41.67	12	52.17
11th	-	-	-	-	-	-	3	42.86	4	57.14	7	30.43
12th	-	-	1	25	1	25	2	50	-	-	4	17.39
Total	-	-	1	4.35	1	4.35	12	52.17	9	39.13	23	100

According to our analysis results concerning sub skills of life and career skills, productivity and accountability sub skill and leadership and responsibility sub skill were the most frequently coded ones, 12 and 9 times respectively. They are followed by initiative and self-direction and social and cross-cultural sub skills coded only once. Note that, there was no coding to flexibility and adaptability sub skill in any of the learning outcomes. Wrahatnolo (2018) explains flexibility and adaptation as students being able to adapt to various changes and being flexible while doing activities in the team and in the learning process. According to Trilling and Fadel (2009), this skill is seen as a basic skill for learning, working and even citizenship in the 21st century. In today's world to become cross-culturally fluent and socially adapt professionals are more important than ever. In the contemporary professional landscape, the acquisition of abilities pertaining to flexibility and adaptability has become imperative. The swift rate at which technology advancements occur necessitates prompt adaptation to novel modes of communication, education, employment, and lifestyle. The acquisition of abilities such as flexibility and adaptation, initiative and self-direction, and social and cross-cultural skills can significantly enhance students' personal development and contribute to their success in both their daily life and future professional endeavors. These skills can be best taught at educational institutions. Hence, it is a significant shortcoming because the biology curriculum lacks or minimally incorporates learning outcomes pertaining to flexibility and adaptability, initiative and self-direction, and social and cross-cultural abilities. Moreover, biology courses are very suitable for teaching these skills due to their content. These skills are skills that can be easily adapted to the individual and group studies and activities in the laboratory environment that are expected to be carried out while teaching biology course content. Examining life and career skills according to grade

levels, it was seen the most frequently in the 10th grade learning outcomes which was followed by the 11th grade learning outcomes and the 12th grade learning outcomes. There was no learning outcome explanation related to life and career skills in the 9th grade curriculum. Since university and career choices are made through near to the end of the 12th grade namely high school graduation, at first glance, it can be stated that the 9th grade is an early period for life and career skills. It was thought that the fact that life and career skills are more in the upper grade levels may be related to the preparation of students for the choice of profession. However, providing students with life and career skills that can contribute significantly to their individual development from an early age will help them in their career choices in the future. For this reason, not including life and career skills in the 9th grade can be considered as a shortcoming of the curriculum. In addition, it should be noticed that more than half of the skills are coded at the 10th grade which is a clear unbalanced distribution to grade levels. These issues should also be considered for the future curriculum update studies.

21st century skill has a critical importance within the whole system. Acquiring one skill would not alleviate the lack of another skill that has not been acquired. In this respect, although the representation of all skills seems to be sufficient in the totality of the 9th - 12th grade high school biology course curriculum, one can see that some subskills of the three basic skills are not associated with the curriculum outcomes. Studies in literature also argue that skills should be considered holistically and be acquired by being related to one another (Chu, et al., 2017; Suto, 2013). In this regard, it is thought that the 9th - 12th grade high school biology course curriculum should present three main headings and eleven subheadings of 21st century skills holistically. In this respect, it is much more effective to integrate 21st century skills homogenously at every grade level in the learning outcomes.

5. Conclusions and Recommendations

In this study, the classification put forth in the Partnership for 21st century skills are adopted and learning outcomes of the 9th - 12th grade biology course curriculum are examined. A qualitative content analysis is performed to investigate learning outcomes of the 9th - 12th grade biology course curriculum and their compatibility within the framework of the basic 21st century skills and related sub-skills by considering three main headings and their eleven subheadings. One can see that one of the contributions of this study is about the distribution of the three main headings of 21st century skills in the learning outcomes of the biology course curriculum according to grade level was not homogenous (learning and innovation skills, 59%; media and technology skills, 23%; life and career skills, 18%). While the distribution of main headings of 21st century skills vary, it was determined that learning outcomes of high school biology course curriculum, with few exceptions, include three main headings of 21st century skills. However, when their subheadings were examined, it was seen that some subheadings (for example, flexibility and ability, initiative and self-direction, social and cross cultural, media literacy) were not represented with the curriculum outcomes at all or were very few in number. In this regard, it is recommended that the 9th - 12th grade high school biology course curriculum should present three main headings and eleven subheadings of 21st century skills holistically. The fact that the content and methods of biology are compatible with 21st century skills is believed to play a role in biology course curriculum including almost all three main headings and eleven subheadings of 21st century skills. In the learning outcomes of high school biology course curriculum, life and career skills are the least well represented compared to other skills. Although they are not included in the 9th grade, these skills, which can be detected in upper grade level curricula, are important for students to be successful in their social and professional lives now and in the future. In biology course curriculum, the distribution of 21st century skills in learning outcomes should be as even as possible. In this respect, since "information media and technology skills" and "life and career skills" are important for students to succeed in their current and future social and working lives, they should be given more place in the upcoming updates in the curriculum. Examining to what extent the changes and innovations including 21st century skills are reflected in

curriculum can contribute to the Ministry of Education's future curriculum update studies. It is recommended that life and career skills should be considered from the 9th grade level in the biology course curriculum to be prepared later and to be included more in the curriculum. In this context, while educators, curriculum developers, and policymakers are updating biology curriculum, taking 21st century skills into consideration holistically for the learning outcomes to be included in the programs will provide students with the opportunity to acquire needed skills to succeed in their professional lives.

According to the findings and results of this study, future research recommendations are given below:

- It can be claimed that it may not be enough on its own that only biology course curriculum sufficiently includes these 21st century skills. Biology textbooks should also be prepared in accordance with these 21st century skills. In this respect, biology course books should also be examined in terms of whether they include 21st century skills.
- Similar studies can be carried out to determine the proficiencies of teachers, who are the practitioners of the curriculum, in teaching these 21st century skills.
- Studies focusing on measuring 21st century skills can be carried out, and to what extent students have acquired these skills mentioned in the curriculum can be determined.
- Science classes are quite convenient to acquire 21st century skills due to the nature of positive sciences and the scientific skills used in science education. It is suggested that there should be different studies to examine whether this is also true for physics and chemistry classes.

Overall, all three main headings of 21st century skills and many of their subskills were included, albeit in different weight, in the 9th - 12th grade biology course curriculum. Students acquiring only some of the 21st century skills are not enough to succeed either in their professional or personal lives. 21st century skills are skills that should be acquired until the end of high school beginning from the pre-school period. Moreover, it should not be expected that 21st century skills could be acquired in just one lesson. In this respect, 21st century skills that are deemed necessary to be acquired should be planned collaboratively according to grade levels and courses.

References

- Akgündüz, D., Ertepinar, H., Ger, A. M., & Türk, Z. (2018). Integration of STEM education into curriculum: Workshop report. Istanbul Aydın University, Istanbul
- Alkılıç, S. (2019). An investigation of teachers' views on stem in-service trainings & stem integration into their courses [MSC Thesis, Balıkesir University Institut of Science]. <https://dspace.balikesir.edu.tr/xmlui/handle/20.500.12462/5607>
- Atlı, K. (2019). Evaluation of biology curriculum in terms of creativity skills from 21st century skills, *Anatolian Journal of Teachers*, 3(1), 85-104.
- Bal, M. (2018). Investigation on the 21st century skills of turkish language course. *Turkish Studies*, 13(4), 49-64.
- Belet Boyacı, Ş. D. & Güner Özer, M. (2019). The future of learning: Turkish language course curricula from the perspective of 21st century skills. *Anadolu Journal of Educational Sciences International*, 9(2), 708-738.
- Brown, S. (2018). *Best practices in 21st century learning environments: A study of two P21 exemplar schools*. [Phd thesis, Brandman University].
- Chu, S. K. W., Reynolds, R. B., Tavares, N. J., Notari, M., & Lee, C. W. Y. (2017). *21st Century Skills Development Through Inquiry-Based Learning: From theory to practice*. New York: Springer Science
- Elo, S. & Kyngas, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing* 62(1), 107-115.
- Erdoğan, Y. (2006). Relationships between creativity, teacher behaviours and academic success, *Electronic Journal of Social Sciences*, 5(17), 95-106
- European Parliament and The Council. (2006). *Key competences for lifelong learning - A european reference framework*. Brüksel: Official Journal of the European Union
- Glassman, A. M., & Opengart, R. (2016). Teaching innovation and creativity: Turning theory into practice. *Journal of International Business Education*, 11, 113.

- Güneş, F. (2012). Skills and competencies set forth by Bologna process in higher education. *Journal of Higher Education and Science*, 2(1), 1-9.
- Hiong, L. C., & Osman, K. (2013). A conceptual framework for the integration of 21st century skills in biology education. *Research Journal of Applied Sciences, Engineering and Technology*, 6(16), 2976-2983.
- International Society for Technology in Education. (2007). *National educational technology standards for students*. ISTE (Interntl Soc Tech Educ).
- Jacobs, H. H. (2010). A new essential curriculum for a new time. In H. H. Jacobs (Eds.), *Curriculum 21: Essential education for a changing World*. (pp. 7-17). Alexandria, VA: ASCD
- Kayhan, E., Altun, S. ve Gürol, M. (2019). Evaluation of eight grade Turkish curriculum (2018) in terms of century skills. *Adnan Menderes University Journal of Educational Sciences* 10, 20-35.
- Lemke, C. (2010). Innovation through technology. In J. Bellanca, & R. Brandt (Eds.), *21st century skills: Rethinking how students learn* (pp. 243-274). Indiana: Solution Tree
- Martinez, C. (2022). Developing 21st century teaching skills: A case study of teaching and learning through project-based curriculum. *Cogent Education*, 9(1), 2024936.
- Mayring, P. (2014). Qualitative content analysis: theoretical foundation, basic procedures and software solution. Klagenfurt: Austria.
- Mayring, P. (2023). Qualitative content analysis, in Robert J Tierney, R. J., Rizvi, F., & Ercikan, K. (eds), *International Encyclopedia of Education* (Fourth Edition), (pp. 314-322), Elsevier. (<https://www.sciencedirect.com/science/article/pii/B9780128186305110310>)
- Miles, M. B. & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, CA: Sage Publications
- Ministry of Education [Milli Eğitim Bakanlığı (MEB)]. (2018). High school Biology 9-12 Curriculum. <http://mufredat.meb.gov.tr/Dosyalar/20182215535566-Biyoloji%20d%C3%B6neme%20C3%B6p.pdf>
- Otuz, B., Görkaş-Kayabaşı, B., & Ekici, G. (2018). Analysis of the Skills and Values of the 2017 Social Studies Curriculum in Terms of Key Competencies. *Journal of Theoretical Educational Science*, 11(4), 944-972.
- Patton, M.Q. (2002). *Qualitative Research and Evaluation Methods*. Thousand Oaks, CA: Sage.
- Pellegrino, J. W., & Hilton, M. L. (Eds.) (2012). *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*. Washington DC: The National Academies Press
- Rychen, D. S., & Salganik, L.H. (Eds.). (2003). *Key competencies for a successful life and a well-functioning society*. Germany: Hogrefe & Huber.
- Seferoğlu, S. S., & Akbıyık, C. (2006). Teaching critical thinking. *Hacettepe University Journal of Education*, 30(30), 193-200
- Stevens, R. (2012). Identifying 21st century capabilities. *International Journal of Learning and Change*, 6 (3-4), 123-137. doi:10.1504/IJLC.2012.050857
- Suto, I. (2013). 21st century skills: Ancient, ubiquitous, enigmatic? *Research Matters*, 15, 2-8
- Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. John Wiley & Sons.
- Voogt, J., & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies. *Journal of Curriculum Studies*, 44 (3), 299-321
- World Economic Forum. (2015). *New vision for education: Unlocking the potential of technology*. Cenevre: World Economic Forum. http://www3.weforum.org/docs/WEFUSA_NewVisionforEducation_Report_2015.pdf
- Wrahatnolo, T. (2018). 21st centuries skill implication on educational system. In IOP Conference Series: Materials Science and Engineering (Vol. 296, No. 1, p. 012036). IOP Publishing.
- Yıldırım, A., & Şimşek, H. (2016). *Qualitative research methods in social sciences*, Ankara: Seçkin Publishing
- Zhang, Y. and Wildemuth, B.M. (2009). "Qualitative analysis of content", in Wildemuth, B. (Ed.), *Applications of Social Research Methods to Questions in Information and Library Science*, Libraries Unlimited, Westport, CT, pp. 308-319.