Pegem Journal of Education and Instruction, Vol. 15, No. 4, 2025 (pp. 988-1000)

WWW.PEGEGOG.NET RESEARCH ARTICLE

2024 Yılında Güncellenen Ortaokul Fen Bilimleri Dersi Öğretim Programına 21. Yüzyıl Becerileri Işığında Bütüncül Bir Bakış

A Holistic Look at the 2024 Updated Middle School Science Curriculum in Light of 21st Century Skills

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Abstract

This study examines the 2024 revised Middle School Science Curriculum within the framework of 21st-century skills, aiming to evaluate how effectively it supports the development of students equipped to meet the demands of the modern era. Based on a qualitative research design and utilizing a descriptive method, the study directly reviews the curriculum and interprets the included skills through the lens of 21st-century competencies. According to the findings, the most emphasized skills in the program are critical thinking, problem-solving, scientific reasoning, digital and information literacy, creativity, and communication and collaboration-based learning. These skills are intended to be integrated into student learning through interdisciplinary connections and hands-on activities. While the curriculum also significantly highlights social-emotional skills, it gives relatively limited attention to other areas such as entrepreneurship, media literacy, leadership, productivity, and intercultural understanding. Overall, the program is found to be largely aligned with 21st-century skills, although certain areas remain open to further development.

Key words: Science education, 21st century skills, education, educational programs

Introduction

Every era has expected individuals to possess different skill sets. In the digital age we inhabit, skills such as collaboration, communication, critical thinking, and creativity are at the forefront. Some of these skills are imparted through education, while others are assumed to have already been acquired by students. Today, many countries aim to foster individuals with these competencies to secure a place in global competition and achieve development. Accordingly, educational policies have shifted focus away from mere knowledge transmission toward developing skills for finding and using information. In the information society, it is important not only for individuals to have knowledge but also to be able to use that knowledge effectively. Twenty-first century skills are defined as the life skills necessary for individuals to be effective, productive, and adaptive in the digital age (Belet Boyacı & Özer, 2019; Hamarat, 2019).

To adapt to the dynamics of our age, individuals need 21st-century skills. Schools play a key role in imparting these skills. In the school environment, students acquire competencies such as accessing information, receiving and using information, evaluating information, and, when necessary, transforming this information into a product (Ünlü, 2016). At this point, curricula emerge as planned learning processes that guide individual development (MEB, 2024). Beginning in primary school, curricula across all levels of education aim to provide individuals with the necessary skills. These skills are especially important at the primary level, where their foundations are laid, since they shape the individual's later learning (Silva, 2009).

An up-to-date curriculum aims to raise individuals who are more conscious, sensitive to their environment, and able to perceive changes. In this context, science education offers many opportunities to individuals, such as interacting with the environment, keeping up with technological developments, scientific thinking, and approaching information critically (Parlar, 2012). These skills are conveyed to students through the science curriculum; the program supports individuals to learn actively and adapt to the requirements of the digital age (Hamarat, 2019).

Table 1 presents the P21 framework's classification of 21st-century skills:

Table 1.

Classification of 21st-Century Skills by P21

Skill Area	Sub-Skills
Learning and Innovation Skills	Critical Thinking and Problem Solving Creativity and Innovation Collaboration and Communication
Information, Media and Technology Skills	Information Literacy Media Literacy, Information, Communication and Technology (ICT) Literacy
Life and Career Skills	Entrepreneurship and Self-Management Entrepreneurship and Self-Management Leadership and Responsibility Productivity and Accountability Social and Intercultural Skills

The P21 classification categorizes 21st-century skills under three main headings: learning and innovation, information-media-technology, and life-career skills. This structure emphasizes that individuals must possess social and cognitive competencies such as creative thinking, problem-solving, collaboration, and communication, in addition to academic knowledge. Furthermore, while media and technology literacy are prioritized in line with the requirements of the digital age, it is also important for individuals to be entrepreneurial, flexible, and responsible. Addressing these skills with a holistic approach aims to enable individuals to succeed in today's society and the uncertain conditions of the future.

Theoretical Framework

21st Century Skills

21st-century skills are critically important for individuals to adapt to current and future social, cultural, and technological conditions. These skills aim to enable success in various life domains, such as academic achievement, productivity, adaptability, effective communication, and the proficient use of technology. At the beginning of the century, experts aiming to carry educational policies into the future proposed various views on which skills should be developed in individuals, and accordingly, many framework models were developed (Chalkiadaki, 2018). Although defined differently by various researchers, there is a general consensus that 21st-century skills have an ever-changing and evolving nature (Coşkun, 2022).

These skills encompass a wide range of areas, from technological literacy to communication, from collaboration to taking responsibility, and from local and global citizenship to career planning. A report prepared by the Board of Education (Talim ve Terbiye Kurulu) indicates that these skills have measurable and teachable characteristics and therefore can be integrated into the educational process (Türel et al., 2023). One of the most common classifications, the P21 framework (Partnership for 21st Century Learning, 2019), groups these skills under three main categories: learning and innovation skills; information, media, and technology skills; and life and career skills. This comprehensive structure aims to provide individuals with the competencies to effectively address the multi-dimensional demands of the digital age.

Learning and Innovation Skills

21st-century skills are fundamental competencies that enable individuals to effectively use information, think creatively and critically, generate original ideas, and develop innovative solutions to problems. These skills are often categorized into four core areas, known as the "4Cs": Critical Thinking, Communication, Collaboration, and Creativity (Partnership for 21st Century Learning, 2019a).

Critical Thinking and Problem Solving skills involve the correct use of reasoning, the analysis of systemic relationships, decision-making, the evaluation of evidence, and the consideration of different perspectives. Communication skills include elements such as effectively expressing thoughts through written, oral, and visual means, active listening, using technology, and interacting with various media. Collaboration skills highlight an individual's ability to work respectfully, flexibly, and responsibly within a team. Creativity and Innovation skills involve generating new ideas, evaluating and developing these ideas, implementing them, demonstrating originality, and learning from failures. These skills are critically important not only for individuals' academic success but also for their effective participation in social life and the business world.

Information, Media, and Technology Skills

21st-century students, with media and technology becoming indispensable parts of daily life, have rapid and easy access to information. However, this requires not only accessing information but also the ability to select and use accurate, reliable, and functional information. In this context, information, media, and technology literacy enable individuals to analyze information with a critical perspective and to use information from various sources effectively and ethically (İhtiyaroğlu, 2022). Information literacy involves the ability to analyze information and use it effectively in solving problems (Bayrak, 2024); media literacy involves understanding the intentions behind media content and assessing their effects on individuals and society (Katıtaş et al., 2022). Information and Communication Technology (ICT) literacy requires individuals to use technological tools in a purposeful, ethical, and effective manner.

Life and Career Skills

In today's fast-paced and complex life, individuals' ability to effectively participate depends not only on academic knowledge but also on being equipped with thinking skills and socio-emotional competencies. In this context, the P21 framework outlines the fundamental skills

that individuals need to develop in order to succeed in their life and career journeys under the following headings:

- **Flexibility and Adaptability:** the ability of an individual to rapidly adapt to different conditions.
- **Entrepreneurship and Self-Direction:** the ability of an individual to set their own goals and proceed in a determined and responsible manner.
- **Social and Intercultural Skills:** skills that allow individuals to communicate effectively and collaborate in diverse social and cultural contexts.
- **Productivity and Accountability:** completing tasks on time, effectively, and with a sense of responsibility.
- **Leadership and Responsibility:** the competencies of leading communities, being active in decision-making processes, and assuming social responsibility (Özer & Bozkurt, 2024).

These skills not only strengthen individuals' professional success but also their contributions to society.

Updated Middle School Science Curriculum

The 2024 Middle School Science Course Curriculum was updated and restructured in accordance with the Maarif Model developed by the Ministry of National Education, adopting a holistic approach aimed at the full development of the individual. At the center of the curriculum is the goal of educating students who are at the focus of learning, can use scientific process skills, think critically and creatively, adhere to ethical values, and develop a positive attitude toward science. The new program goes beyond solely in-school learning environments by integrating science-art centers, museums, and other out-of-school learning environments into the process. A process-oriented assessment approach was adopted with the aim of monitoring student development at every stage of the learning process, and formative assessment practices were emphasized to provide tools through which students can demonstrate their knowledge and skills in multidimensional ways. The program aims not only for academic success but also for students to develop lifelong learning habits and be equipped with the skills required by the age (MEB, 2024). In this respect, the 2024 Science Curriculum presents an innovative and holistic vision that is in line with the fundamental principles of contemporary education.

In the context of science education, literature shows diverse insights. Koca et al. (2021) examined science teachers' views on the 2018 curriculum, finding positive feedback on content and objectives but noting some deficiencies in practical implementation. Ünsal and Bakar (2022) emphasized that while the STEM approach is included in the curriculum and textbooks, its content needs strengthening. Akıncı (2020) found that 8th-grade science outcomes, textbooks, and teacher questions mostly targeted basic skills, suggesting the need to increase content on higher cognitive skills. Başar (2021) analyzed the 302 outcomes in the 2018 Science Curriculum from the perspective of scientific process skills and found that most outcomes were linked to at least one skill; the skill most frequently related was

"classification," whereas higher-order skills like "hypothesis formulation," "experiment design," and "data presentation" were scarcely addressed.

Aim of the Science Curriculum

The Middle School Science Course Curriculum was prepared in line with the Turkey Century Maarif Model, which is centered on the all-round development of the individual. The program aims to foster student development not only academically but also socially, emotionally, ethically, and culturally. The learning process is designed to raise individuals who can work collaboratively, inquire, think critically, and be sensitive to the environment. With a holistic educational approach, students are expected to apply scientific process skills, develop self-regulation abilities, and become lifelong learners. The curriculum places special emphasis on interdisciplinary connections, scientific culture, adapting to digital transformation, and developing sustainability awareness. Students are supported in understanding the history of science, recognizing the contributions of Turkish-Islamic scientists, and being equipped with scientific ethical values. Additionally, the program ensures that students acquire fundamental knowledge in fields such as physics, chemistry, and biology, and emphasizes technology, digital literacy, and sustainability as cross-cutting themes.

Method

This study is a qualitative evaluation study employing a descriptive method within a qualitative research design. The document analysis method was chosen, using the 2024 Middle School Science Course Curriculum published by the Ministry of National Education as the basis for analysis. Document analysis involves the systematic examination of existing written, visual, or auditory materials related to the research topic. Documents that can be examined with this method include various sources such as curricula, textbooks, audio recordings, and meeting minutes (Yıldırım & Şimşek, 2013). In the analysis, the general structure of the curriculum, the orientation of learning outcomes, the relationship of learning domains to skill development, and the competency-based approach were considered. In this way, the curriculum was evaluated in a holistic manner with subjective and explanatory commentary. The obtained findings were interpreted and evaluated in an explanatory way from the perspective of 21st-century skills.

In addition to Ministry of Education documents, academic publications and scientific studies from the literature were used as supporting sources in the study. This strengthened the academic grounding of the study. In this context, the present research is an explanatory and interpretative evaluation study that aims to reveal how the 2024 Middle School Science Curriculum approaches 21st-century skills shaped by contemporary requirements and what structural reflections these skills have in the curriculum.

Findings and Evaluation

Evaluation of the Program in terms of Critical Thinking Skills

- **5th Grade:** In the updated Middle School Science Curriculum, critical thinking is progressively developed across all grade levels. At Grade 5, observation, comparison, and model construction activities are particularly prominent. Students make

generalizations by relating concepts to everyday life (e.g., friction) and reach conclusions by designing experiments, forming the first steps of critical thinking. Also at this level, including aspects such as inductive reasoning ensures that students move from observation to generalization.

- **6th Grade:** In Grade 6, numerous applications involving practical activities such as conducting experiments, making scientific inferences, and constructing models are accompanied by a focus on analysis and evaluation. Tendencies such as analytical thinking, systematicity, and asking questions support this. In this context, critical thinking includes drawing conclusions from observations and reasoning based on experimental data on topics like density and distinguishing characteristics.
- **7th Grade:** In Grade 7, particular emphasis is placed on skills such as discussion, questioning, and critical observation. Investigating and presenting topics related to public health through concepts like body systems allows students to develop critical thinking at not only an academic but also a societal level. Discussing socially relevant issues like organ donation and addiction in a discussion setting highlights the value-based aspect of critical thinking as well.
- **8th Grade:** In Grade 8, students are directed toward higher-order thinking processes through skills such as problem solving, structuring, making scientific inferences, and forming hypotheses. Specifically, developing solution proposals for current and complex problems like sustainable living and climate change enables students to use critical thinking skills at both individual and societal levels. Additionally, the presence of tendencies like “critical observation” and “original thinking” in the curriculum serves this purpose.

In conclusion, the updated curriculum structures and diversifies critical thinking skills from Grade 5 through Grade 8. At each grade level, students are intended to approach knowledge not as passive recipients, but as individuals who question, evaluate, and reconstruct it. This indicates that the program is well aligned with 21st-century skills.

Evaluation of the Program in terms of Innovation and Creativity Skills

- **5th Grade:** The middle school science curriculum provides various opportunities to develop students’ innovation and creativity skills from grade 5 onward. At Grade 5, students are introduced to experiments and model construction activities through which they can make unique contributions to scientific processes. This approach encourages them, in addition to understanding basic scientific concepts, to use creative thinking abilities to produce solutions.
- **6th Grade:** In Grade 6, experiments related to the properties of matter and more complex processes like calculating density are supported by deductive and inductive reasoning skills, with the goal of developing students’ innovative and analytical perspectives. Additionally, students are enabled to design new models by establishing interdisciplinary connections.
- **7th Grade:** In the Grade 7 curriculum, alongside physical phenomena such as light refraction and lenses, biological topics like systems in our body are examined, encouraging students to create original designs and think inquisitively and critically. In

particular, activities utilizing skills such as modeling, classification, and making scientific inferences enhance creativity.

- **8th Grade:** In Grade 8, by focusing on environmental and sustainability topics, students develop the ability to produce creative solutions to global problems and support these solutions with scientific data. Students are directed to generate innovative ideas through projects and research tasks and relate them to daily life.

Overall, the program allows students to develop creative mental processes such as curiosity, original thinking, inquiry, and problem solving. It strengthens innovative perspectives through experiments, observation, modeling, and project-based learning methods. Thus, middle school students are raised not only as learners of scientific knowledge, but as individuals who can use that knowledge in creative and innovative ways.

Evaluation of the Program in terms of Collaboration and Communication Skills

- **5th Grade:** The middle school science curriculum provides students from Grade 5 upward with opportunities to develop collaboration and communication skills. At the 5th-grade level, students learn to communicate with each other and collaborate toward common goals through group work and digital games.
- **6th Grade:** In Grade 6, activities such as experiments and model designs emphasize sharing responsibility, respectful communication, and adapting to different viewpoints.
- **7th Grade:** In Grade 7, environments like classroom discussions and interdisciplinary projects help students gain decision-making skills and social awareness, allowing them to consciously assume their roles within a group.
- **8th Grade:** In the Grade 8 program, studies on current topics such as sustainability and global climate change enable students to use their communication and collaboration skills at a higher level. In this process, students improve their abilities to clearly express their thoughts in writing and speech, to engage in discussion, and to make joint decisions.

In general, the program makes a strong contribution to students being able to communicate effectively in both academic and social settings, participate in teamwork, and act with a sense of social responsibility.

Evaluation of the Program in terms of Information, Media, and Technology Skills

The middle school science curriculum places fundamental emphasis on information, media, and technology skills. The program targets developing information literacy skills at every grade level, encouraging students' active participation in processes of collecting, analyzing, and interpreting scientific data. Starting from Grade 5, digital literacy and data literacy skills are systematically included as important components of the curriculum, ensuring that students use technological tools effectively and consciously.

Media literacy is supported through an interdisciplinary approach, especially in the context of questioning and analyzing visual and digital content. Students, integrated with social-

emotional learning skills, are encouraged to use communication tools correctly and effectively in both individual and group work.

Under the scope of information, communication and technology (ICT) literacy, the program aims for students to use technology not only as consumers but also as creative and critical users. Simulations, digital experiments, and methods of accessing information used in science classes support the development of these skills. Especially in the upper grades (7th and 8th), students are expected to use digital resources consciously in scientific research processes, to question data, and to produce scientific outputs.

In general, the program addresses information, media, and technology skills holistically in line with the requirements of the 21st century, ensuring that students are equipped with the skills demanded by the digital age alongside scientific knowledge.

Evaluation of the Program in terms of Entrepreneurship and Self-Management Skills

Promoting students' entrepreneurship and self-management skills is one of the fundamental objectives of science curricula. Students are encouraged to plan and manage their own learning during processes such as experiment design, problem solving, and research. In this way, they acquire habits of taking responsibility, setting their own goals, and following processes. Especially in experiment and project-based activities, skills to act independently and make decisions are reinforced.

The 6th-grade "Properties of Matter" unit is structured in a way that contributes to developing students' entrepreneurship and self-management skills. Throughout this unit, students are expected to conduct experiments, make observations and inferences, and produce solutions when faced with problems. This process supports their entrepreneurial skills such as creative thinking, developing original ideas, and taking risks to find new solutions. Additionally, self-awareness, self-regulation, perseverance, and determination—self-management skills—are reinforced by actively participating in processes such as planning, implementing, and evaluating experiments. Students' taking responsibility both individually and in groups, sharing their ideas, and completing tasks on time also contribute to the development of these skills. Thus, the program offers a learning environment that holistically supports both scientific and personal development.

Evaluation of the Program in terms of Flexibility and Adaptability Skills

The program includes various methods so that students can adapt to different learning environments and changing conditions. Through group work and discussions, students develop the ability to adopt different perspectives and approach new situations flexibly. This enables students to be solution-oriented when facing challenges and helps them easily adapt to changes that arise in the learning process.

Evaluation of the Program in terms of Leadership and Responsibility Skills

Leadership skills in science education are developed through active participation and sharing of tasks in group activities. Students are encouraged to take responsibility and initiative. In this process, the awareness of contributing to both individual and team success is cultivated.

A sense of responsibility is reinforced by consistent work habits, time management, and collaboration in learning processes.

Evaluation of the Program in terms of Productivity and Accountability Skills

Within the program, students are encouraged to make their learning processes efficient and to evaluate their outcomes. Students review the extent to which they have achieved the objectives in the work they have done, identify their shortcomings, and look for ways to improve themselves accordingly. This attitude fosters the development of accountability in both individual and group work. However, reviewing the 2024 Science Curriculum, it is seen that these skills are given very limited attention in the program.

Evaluation of the Program in terms of Social and Intercultural Skills

The science program supports students in communicating effectively in diverse social and cultural environments and in respecting diversity. Values such as empathy, cooperation, and social awareness are addressed in learning environments. Thus, while students learn to be open to different views, their social responsibility awareness also develops. These skills enable students to successfully interact in both academic and social life.

For example, the 7th-grade “Sustainable Living and Recycling” unit supports the development of respect for social and cultural differences, social awareness, and a sense of responsibility in students. In addition to emphasizing social-emotional skills such as communication, cooperation, adaptation, and responsible decision-making, values such as sensitivity, conservation, and patriotism are highlighted. Thus, the program aims for students to develop awareness at both local and global levels. Moreover, through topics such as zero waste, water conservation, and composting, the curriculum aims to foster students’ cultural awareness and encourage them to act with social responsibility.

Comparison of the 2018 and 2024 Science Curriculum Programs

When comparing the 2018 and 2024 Science Curriculum programs, it is seen that the 2024 program has acquired a student-centered and skill-based structure. The new program places particular emphasis on higher-order thinking skills, scientific processes, and active learning. The learning outcomes explicitly include processes such as predicting, inferring, conducting experiments, analyzing data, and formulating hypotheses, encouraging students to learn by researching. Additionally, some topic headings and grade levels have been changed; the content has been made simpler, more understandable, and more practice-oriented. Interdisciplinary connections have been strengthened, and new outcomes compatible with 21st-century skills have been added. In this context, the 2024 program aims to develop students into individuals with enhanced scientific thinking skills, who can think critically and adapt to the requirements of the era.

Discussion and Conclusion

This study has holistically evaluated the Middle School Science Curriculum updated in 2024 from the perspective of 21st-century skills. The analyses show that the program contains important steps toward meeting the requirements of the era. In particular, critical thinking,

problem-solving, making scientific inferences, digital and information literacy, communication, and collaboration skills are given considerable emphasis. The reduction in the number of learning outcomes and the explicit definition of scientific process skills such as predicting, questioning, experimenting, and data analysis in the learning outcomes demonstrate that the program has adopted a student-centered and research-based approach. In a study by Ak and Köse (2024) on teachers' views of the 2024 Science Curriculum, teachers stated that reducing the number of learning outcomes and simplifying topics would allow for full implementation of the curriculum.

Kalemkuş (2021) examined the 2018 Science Curriculum in the context of 21st-century skills and found that the curriculum did not provide a clear place for information, communication, and technology literacy—a skill considered an important component of 21st-century competencies—and that the outcomes in the curriculum were not sufficiently related to this skill and it was not evenly distributed. Looking at the 2024 Science Curriculum, it is seen that information, communication, and technology literacy is now frequently included in the curriculum. In this respect, previous deficiencies have been addressed: this skill is now frequently present in the program and is handled more systematically.

The structured learning outcomes that vary by grade level aim to equip students with higher-order thinking skills in accordance with their age and developmental characteristics. In addition, increasing interdisciplinary interactions, making elements of social-emotional learning more visible, and including current themes such as environment, energy, and sustainability indicate that the curriculum has established stronger ties with the contemporary world.

However, despite all these positive aspects, it has also been observed that some skills (for example, entrepreneurship, media literacy, intercultural understanding, leadership, and accountability) are addressed in a more limited way in the program. This suggests that the program does not offer a fully balanced distribution of skills in terms of 21st-century competencies. Therefore, giving more attention to these areas in future revisions is important for supporting students' well-rounded development.

The scattered and non-hierarchical arrangement of skills in the program makes it difficult to create a holistic and guiding framework for developing 21st-century skills among middle school students. The study by Kıryak et al. (2024) also supports this situation, drawing attention to the lack of a systematic structure for skills in the program.

Curricula being carefully designed only on the basis of contemporary approaches is not sufficient; it is also crucial that the implementation processes in the field be closely monitored and evaluated in light of the obtained data. For curricula to develop continuously, it is necessary that findings obtained during implementation be taken as guidance and reflected in the curriculum structure. At this point, the experiences and observations of teachers—those who directly implement the program—play a determining role. The views of teachers on the applicability of the program and the challenges they encounter in the field are an important resource both for identifying existing shortcomings and for enhancing the success of the

program. Therefore, establishing a flexible, evaluable, and improvable structure that takes into account teachers' views in order to create effective and sustainable curricula is inevitable.

As a result, the 2024 Middle School Science Curriculum has a strong structure that largely corresponds to the knowledge, skills, and attitudes required by the 21st century. It relates learning to life, encourages active participation, and centers on higher-order thinking skills. In the program's implementation process, structuring teacher training, providing material support, and designing assessment tools to support this approach will be necessary to ensure that the targeted outcomes are imparted to students more effectively.

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