International Journal of Contemporary Approaches in Education (IJCAE) 2025
Volume 4 (1) Page 63 - 80
https://doi.org/10.29329/ijcae.2025.1312.4

Recommendations for the Assessment of Inclusive 21st Century Skills Model Applications

Seda Usta Gezer [1*]

Abstract

21st century skills are generally regarded as the skills that individuals need to have in today's world, and they are categorized in various ways by different institutions and organizations. In addition to activities and applications aimed at acquiring these skills in educational environments, assessment processes have also been the subject of numerous studies. There are various 21st century skill scales available in the literature, targeting various groups. Some of these scales are developed to measure broader skill sets. In this regard, we see a broader classification of skills in the "Inclusive 21st Century Skills Model". This up-to-date model developed considering our education system consists of 7 main skills, 46 sub-skills, and 11 values. This study provides recommendations for the assessment of skills to be acquired through the use of the model in science education. In line with the purpose of this study, the definition of 21st century skills and the frameworks found in the literature will first be addressed. Then, the Inclusive 21st Century Skills Model developed for the classification of these skills will be introduced, and finally, suggestions will be presented on how this model can be integrated into assessment and evaluation processes specifically in science education.

Keywords: 21st Century Skills, Inclusive 21st Century Skills Model, Preservice Science Teachers, Science Education, Science Teachers.

Received: 27.11.2025 – **Accepted:** 23.06.2025 – **Published:** 24.06.2025

[1] **Seda Usta Gezer,** Hasan Ali Yücel Faculty of Education, İstanbul University-Cerrahpaşa, İstanbul, Türkiye. ORCID: 0000-0002-7505-0024, sedausta@iuc.edu.tr

INTRODUCTION

In today's world, it is well-known that individuals need to possess skills commonly referred as 21st century skills. Skills such as productivity, problem-solving, leadership, innovation, collaboration, entrepreneurship, and information literacy can be cited as examples of these skills (Bardak, 2018). Among the 21st century skills, there can be seen an emphasis on qualities such as adaptability to the present age, a continuous development of creativity and openness to innovations. These skills encompass both those that have emerged in the present era and those that have been passed down from earlier times (Keçeci and Kavukçu, 2023). They prepare individuals especially students for a rapidly changing world, enable them to become problem-solvers and continuous learners (Kain et al., 2024). Avdiu, Bekteshi and Gollopenia (2025), who emphasize that skills and knowledge are inseparable elements, mention in their study that critical thinking and problem solving, communication and collaboration, creativity and innovation skills are especially referred to as 21st century skills in the literature and mention the importance of having knowledge for the application of these skills. It is thought that firstly examining the 21st century skills, which are increasingly emphasized in society and educational environments and which have classifications in the literature that include different skills, will be useful for the suggestions presented for the use of the inclusive 21st century model, which is the main purpose of our study.

21st Century Skills

In the 21st century, students should possess various knowledge and skills to enhance their academic achievements and succeed in today's conditions (Ecevit and Kaptan, 2021). In order to provide these knowledge and skills, a vision for learning has been developed to assist practitioners in integrating specific skills into the teaching of core academic subjects. This vision is known as the 21st Century Learning Framework. This framework defines the skills, knowledge, and expertise that students need to be successful in work and life. It represents a blend of content knowledge, specific skills, expertise, and literacy elements (Partnership for 21st Century Skills, 2009). Griffin and Care (2014) discuss that within the scope of the Assessment and Teaching of 21st Century Skills project, 21st century skills are defined as comprehensive activities where groups work towards reaching a desired state and involve cognitive activities. Various organizations, such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Organisation for Economic Co-operation and Development (OECD), and the Partnership for 21st Century Skills (P21), propose different understandings of the 21st century (González-Salamanca et al., 2020). Cansoy (2018) provided detailed information about international frameworks such as the OECD skills framework, Wagner's skills framework, Assessment and Teaching of 21st Century Skills Framework (ATSC21) and National Research Council (NRC) skills framework as frameworks for 21st century skills. This

diveristy indicates that the models presented in different frameworks include cognitive, social and emotional skills and that the skills in these models may be related to the future life skills of individuals.

Due to the necessity for individuals to acquire new skills, the most important initiatives related with education and aimed at imparting 21st century skills in educational systems are the "21st Century Skills Partnership", the "National Educational Technology Standards" set by the International Society for Technology in Education, and the "Education and Skills Future 2030" project targeted by the OECD (Salih and Erikli Selek, 2023). These skills have been labeled as 21st century skills because they are more related to current economic and social developments rather than the skills of the past century, characterized as an industrial production style (van Laar et al., 2017). 21st century skills are necessary for individuals to confront information and attitudes ethically and humanely in a digital, sustainable, and social world (González-Pérez and Ramírez-Montoya, 2022).

According to the most widely accepted categorization by P21 (Partnership for 21st Century Skills), 21st century skills can be grouped into three main categories: Learning and Innovation Skills, Life and Career Skills, and Information, Media, and Technology Skills.

- Learning and Innovation Skills encompass creativity and innovation, critical thinking and problem-solving, communication, and collaboration.
- Life and Career Skills include initiative and self-direction, social and cross-cultural skills, flexibility and adaptability, and productivity and accountability.
- Information, Media, and Technology Skills consist of information literacy, media literacy, and ICT (Information, Communications and Technology) literacy (Partnership for 21st Century Skills, 2009).

From another perspective according to the World Economic Forum, the most essential skills that individuals need to develop include creativity, analytical thinking, innovation, active learning and learning strategies, critical thinking and analysis, complex problem-solving, originality and initiative, resilience and stress management, leadership and social influence, emotional intelligence, reasoning, persuasion and negotiation, systems analysis and evaluation (World Economic Forum, 2020).

In addition to the classification and diversification of all the mentioned skills, it is also important to examine how they are reflected in real-life societies. Let us now consider a study conducted by the OECD that reveals the distribution of some of these skills within the adult population. The high skills level of the individuals who make up society is a significant factor that affects that society. The Adult Skills Survey conducted by the OECD examined adult competencies in three areas of information processing skills, including literacy skills, numeracy skills, and problem-

solving skills in technology-rich environments. Different proficiency levels were defined to analyze different skills. The research, which involved 5,227 adults aged 16-65, produced the following results:

- When compared to other participating countries, adults in Türkiye performed below average in all three areas evaluated.
- A large proportion of adults in Türkiye have weak proficiency in all three types of skills.
- Only a small percentage of adults in Türkiye demonstrate high proficiency in literacy, numeracy, and problem-solving skills.
- In Türkiye, as in other participating countries, adults with higher levels of education have better information processing skills.
- Young adults show higher proficiency in literacy skills, while older adults show lower proficiency (Ministry of Family, Labor, and Social Services, 2016).

Many of the skills as discussed here acquired in adulthood have their foundations laid in childhood. Therefore, it is evident how important it is for these skills to be nurtured in educational settings. The 21st century skills mentioned and various related variables are assessed using various tools tailored to different groups. Some of these measurement tools are the Teacher Candidates' Perception of 21st Century Skills Competency Scale (Aygün, 2016), the Educational Manager 21st Century Skills Scale (Çoban, 2019), the 21st Century Skills Instruction Scale (Özyurt, 2020), the 21st Century Skills Scale (Gür et al., 2023), and the Middle School Students' Perception of 21st Century Skills Competency Scale (Düzgüner et al., 2022). Different sources indicate that 21st century skills are being comprehensively addressed, and various tools are proposed for measuring these skills. As examples; Kalemkuş and Bulut Özek (2021) believe that their Comprehensive 21st Century Skills Scale can more comprehensively measure the 21st century skills of middle school students. In the literature, there is also the Multidimensional 21st Century Skills Scale, developed by Çevik and Şentürk (2019), which covers the 15-25 age group. The scale consists of five dimensions: critical thinking and problem-solving, information and technology literacy, social responsibility and leadership skills, entrepreneurship and innovation, and career consciousness. The tools recommended for measuring 21st century skills generally focus on specific domains. At this point, developing models that provide a comprehensive classification of these skills gains importance, as such models can guide the development of processes aimed at measuring broader sets of competencies. In this context, the Inclusive 21st Century Skills Model, which brings together a wide range of skills, is discussed in detail below.

Inclusive 21st Century Skills Model

Especially for the Turkish Education System, an inclusive 21st century skills model is explained in the study by Türel et al. (2023). Türel et al. (2023) argue that there is a need for a new classification that defines 21st century skills clearly and comprehensibly, taking into account their similarities and differences. Therefore, a review of numerous national and international documents has been conducted, and a classification has been made regarding the 21st century skills that learners need to acquire. The sources they accessed in the course of their study were analyzed using thematic content analysis, and as a result, they proposed an Inclusive 21st Century Skills Model. In their study, the proposed model include Social and Emotional Skills, Higher-Order Thinking Skills, Working Skills, Language and Communication Skills, Learning Skills, Self Skills, and Literacy Skills. This model, which also includes domain-specific frameworks, defines a total of 46 sub-skills within these main skills and presents 11 fundamental values that surround and relate to these skills. In Table 1, it can be seen the skills included in this model called "Inclusive 21st Century Skills."

Table 1. Skills included in the Inclusive 21st Century Skills Model

Main Skill	Sub-Skills
Social and Emotional Skills	Psychological Well-being, Emotion Regulation, Planning and Organization, Empathy, Collaborative Work, Social and Cultural Awareness, Flexibility and Adaptability, Relationship Management, Conflict Resolution
Language and Communication Skills	Active Listening, Negotiation, Communication in Native and Foreign Languages
Higher-Order Thinking Skills	Creative and Innovative Thinking, Critical Thinking, Problem Solving and Decision Making, Reflective Thinking, Analytical Thinking, Metacognition
Self Skills	Resilience, Leadership, Curiosity, Motivation, Self-Control, Self-Regulation, Self-Awareness, Self-Confidence, Self-Esteem, Self-Efficacy, Perseverance, Taking Responsibility and Making Responsible Decisions
Learning Skills	Learning to Learn, Active Learning, Academic Skills
Working Skills	Entrepreneurship, Productivity, Resource Management, Accountability
Literacy Skills	Information and Communication Technologies Literacy, Financial Literacy, Media Literacy, Health Literacy, Environmental Literacy, Numeracy Literacy, Civic Literacy, Visual Literacy, Scientific Literacy

Table 1 includes skills that are encompassed by and interrelated with 11 fundamental values. While values such as love, respect, justice, honesty, friendship, patriotism, and helpfulness are included in existing curriculum programs, values like morality, conscience, etiquette, and thrift have been newly incorporated into the model (Türel et al., 2023). This model not only classifies skills but also provides guidance for instructional design processes aimed at fostering these skills in educational environments. Following the explanation of this model, which is presented as an example of the classification of 21st century skills, the next section discusses how 21st century skills in general can be integrated into classroom learning processes and developed through instructional practices.

Processes for Developing 21st Century Skills in Lessons

Contemporary approaches for teachers and learners that support 21st century frameworks aim to develop skills and competencies require the effective implementation strategies in instructional environments (González-Pérez and Ramírez-Montoya, 2022). It is believed that individuals who have confidence can effectively communicate in their environments and can develop themselves in various areas. Therefore, teachers also have a role to play in nurturing individuals who can research, plan, design, have self-confidence, demonstrate adaptability, and exercise individual self-regulation (Keçeci and Kavukçu, 2023). Teachers' attention to program and assessment processes ensures the successful acquisition of 21st century skills (Rotherham and Willingham, 2009). The importance and effectiveness of 21st century skills can vary depending on different studies and situations. However, the constant point is that skills can be diversified and evolved. The tools and approaches used to assess these skills also be diversified (Coşkun, 2022).

The 21st century education approach is project-based and research-oriented (Dursun, 2022). To ensure that 21st century skills are acquired by students and continuity is maintained, learning environments should be designed that are student-centered and technologically enriched. In educational settings, there should be resources available for students to conduct research and access information. These environments should provide opportunities for the implementation of techniques such as educational and creative drama, educational games, station techniques, allowing for active participation and freedom of movement (Çiftçi et al., 2021). Contemporary learning approaches such as personalized learning, collaborative learning, problem-based learning, project-based learning, and blended learning, as well as the active integration of mobile devices into the teaching and learning process, are among the next-generation strategies that can be effectively utilized in 21st century educational environments. Under the approach of active learning, activities such as small group discussions, experiments, simulations, project preparation, in-class presentations, debates, and simulations can be included. Classrooms should be equipped with mobile devices and books that allow for research and provide internet access. Examples of these educational environments include active learning classrooms, enriched libraries, laboratories, and workshops. In digital environments where applications can be conducted, examples include virtual laboratories, advanced search tools, mobile applications, social networks, educational digital games, web 2 tools, and augmented reality activities (Çiftçi et al., 2021, Dursun, 2022; Gültekin Talayhan and Büyükalan Filiz, 2022).

In addition to what needs to be done to develop 21st century skills, how these skills will be measured and evaluated is also crucial (Yalçın, 2018). In selecting an assessment method, the purpose and type of information to be collected about students are the important point. The assessment of 21st century skills should assist teachers and students in being aware of what is being taught and how, and

it should be planned as a process that starts with the question "why are we conducting this assessment?" (Aydın Çulha, 2022). Innovative approaches can be used for assessment processes in these active and contemporary educational environments. Teaching and learning methods guide a logical, sequential, and organized process to achieve objectives and assess learning, and the most appropriate technologies should be considered to accomplish this (González-Pérez and Ramírez-Montoya, 2022). Researchers can use personal reports, rating scales, both multiple-choice and performance-based standardized assessments, and observational measurements to measure these skills multiple-choice tests and just open-ended questions alone are not sufficient for measuring 21st century skills. Different approaches can be recommended for measuring and assessing these skills. Various assessment tools can be used to measure these skills, including situational judgment tests, rating scales, skill and ability history reviews, performance assessments and simulations, portfolios, multiple-choice, computer-assisted, open-ended and/or unstructured tasks, activities that involve real-world problem contexts, and innovative approaches with new technologies can be recommended (Lai and Viering, 2012; Yalçın, 2018). Aydın Çulha (2022) discusses the benefits of diversifying assessment methods in addition to determining the tool to be used in the assessment process. Using different methods to gather information from students increases the validity and reliability of the collected data, Using different and diverse methods for assessment involves students in the process.

It is seen that, in relation to 21st century skills, both the careful planning of activity and assessment processes and the selection of innovative approaches and technologies that can be used in these processes are important. In the planning of implementations for a model such as the Inclusive 21st Century Skills mentioned in the previous heading, it is thought that there may be a need for practical arrangements due to the intensity of the skills it includes. Based on this, in the next section, evidence based suggestions focusing especially on assessment processes have been presented, with the science course presented as a subject in which this model can be integrated. It is aimed that these suggestions, through diversification, will contribute to the integration of the model into its implementation processes.

Recommendations for Assessment of the Inclusive 21st Century Skills Model: A Focus on Science Course Implementations

A learner in science course compares the situations encountered with their prior knowledge, thinks, researches, and, most importantly, constructs new knowledge through active experiences (Briede, 2013). Successful countries in the field of science emphasize practices based on research and inquiry in their curriculums. This has led science classes to become not only about memorizing concepts, theories, and general principles but also about developing scientific thinking and process skills (Tatar, 2006). Therefore, it can be said that science classes enhance various skills. When

examining the 2018 Science Education Program (Ministry of National Education, 2018), specific skills in the field of science include Scientific Process Skills, Life Skills, Engineering and Design Skills. In terms of the skills emphasized in science education, it is essential to address the core approach outlined in the Türkiye Maarif Model's science curriculum. This model aims to holistically support students' development by integrating disciplinary skills, conceptual skills, dispositions, social-emotional skills, values, and various forms of literacy. The program aims to cultivate individuals who can utilize higher-order thinking and scientific process skills; who embrace values and who are entrepreneurial and conscious of career opportunities in the field of science. It also targets the development of individuals who participate in collaborative and group work during the learning process, possess self-regulation skills, are inquisitive, questioning, and critical thinkers, environmentally aware, exhibit scientific attitudes and behaviors and are capable of adapting to evolving technologies (Ministry of National Education, 2024). Understanding the role of science education is essential in providing a quality education that fosters 21st century skills and shaping the citizens of the new World (Aydın Ceran, 2021). In science classes where the acquisition of these skills is emphasized, assessments that provide insights into 21st century skills are also essential.

Teaching, learning and assessing 21st century skills are challenging (Saavedra and Opfer, 2012). Assessing 21st century skills is different from assessing conventional learning domains. In skill-based instructional processes, it is not sufficient to directly assess only the academic knowledge students have acquired; it is also of great importance to evaluate how they apply the skills and knowledge they have gained in real-life situations. Evaluating these skills is, therefore, more complex and displays a more dynamic structure (Vista et al., 2010). Assessments that measure multiple and especially complex competencies and align with real-world tasks often require innovative formats. Innovative assessments for this formats may require time and special resources (Aydın Çulha, 2022). The Inclusive 21st Century Skills Model, consisting of 7 main skills, 46 sub-skills, and 11 values, represents a complex structure and can be recommended in science classes through the use of innovative and contemporary learning approaches and tools that support the interpretation of various skills. However, for the implementation and assessment of this complex model, various planning strategies appropriate to the nature and purpose of the science course are required.

As an example of a study that relates 21st century skills to different science teaching approaches, the study conducted by Ecevit and Kaptan (2019) can be mentioned. In the study titled "Description of the Argumentation-Supported Research Inquiry-Based Teaching Model Designed to Acquire 21st Century Skills," the skills targeted for the stages of the approach. For example the skills related to the first stage of the lesson are targeted like this way: 1th stage of lesson: Revealing existing knowledge by questioning large group discussion. Targeted 21st century skills: Development of scientific reasoning skills, development of scientific communication skills development of critical

thinking skills development of inquisitive thinking skills development of metacognitive awareness skills and development of reflective thinking skills. When planning to implement the Inclusive 21st Century Skills Model, a step-by-step approach similar to the one used in this study can be followed. Initially, presenting information such as the lesson objectives and learning outcomes, followed by clearly identifying the targeted skills, can help make the connection between each activity and its related skill more concrete. Approaches such as the 5E Learning Model and project-based learning, which involve inquiry and research processes, can be suggested as examples for implementing skill-based activities. Due to the large number of skills included in the model, it is recommended to distribute these skills across an entire unit rather than limiting them to just one or two lessons. This phased structure can serve as a guiding framework for researchers both in planning the intended learning outcomes and in structuring the assessment processes.

Lafifa et al. (2023) also observed in their study that the STEM approach is highly effective in enhancing students' 21st century skills such as creativity, communication, collaboration, and critical thinking. Therfore it can be sugested that using STEM approach long term and making assessment processes also should be selected in accordance with this approach. In their study on comprehensive STEM schools, Stehle and Peters-Burton (2019) found similarly that STEM education environments support 21st century skills. However, the study also revealed that despite the focus on multiple 21st century skills in these environments, students demonstrated these skills at a lower level than expected during assessment processes. This finding is noteworthy. Based on the fact that the model mentioned in this study also encompasses multiple skills, it can be recommended that these skills be frequently integrated into lessons. After this long-term process, assessments are likely to yield more accurate insights into skill acquisition. Similarly, as previously mentioned, it is considered important that assessments not only measure knowledge but also evaluate skill acquisition. Therefore, it is recommended to evaluate not only the products but also the learning processes through alternative assessment tools; to encourage the use of reflective diaries related to these processes; and to utilize tools such as reflective questions that can help reveal the skills students have acquired.

Many of the skills expressed based on various classifications of 21st century skills overlap. Therefore, these skills can be combined. Even if changes are made to 21st century skill classifications, the importance of complex problem-solving skills should be emphasized. While acquired knowledge can change with new experiences, it is understood that skills such as adaptability, flexibility, and innovation are also crucial for skill development and should be given importance (Geisinger, 2016). Flexibility is an important concept in the educational environments, for providing variety according to students' interests and needs in terms of learning environments, the structure of the process, strategies used, and existing technologies enables this flexibility. Students’ seating arrangements, group workspaces, play and entertainment areas, discussion spaces, simulation rooms are examples of

flexibility in learning environments (Günüç, 2017). In this context, it is recommended to use multiple assessment tools, such as process-based rubrics, to monitor the development of skills that are particularly difficult to observe. In this way, students' awareness of skill-based processes can be increased, and the acquisition of skills can be made more visible and followed in greater depth.

Science education, requires involvement in learning through research, inquiry, problem-solving, and experimentation, and it necessitates access to laboratory equipment, scientific, technological, and digital resources. Therefore, in science education creating school/non-school systems can access these scientific resources is important (Aydın Ceran, 2021). The development of 21st century skills should be supported not only in schools but also in alternative learning environments. In the proposed model, it is recommended that each of the skills that Turkish education system aims for students to acquire be developed and used in a way that is related to fundamental values (Türel et al., 2023). Therefore, it can also be suggested that the model should be used and evaluated in out-of-school learning processes in line with this approach.

Today, the 2023 Education Vision and reports on Design Skill Ateliers guide in providing inclusive 21st century skills. The main goal of the 2023 Education Vision is to educate individuals equipped with the skills of the present and future. The vision aims to educate individuals who use this equipment for the benefit of humanity, have an interest in science, are curious and sensitive to culture, are qualified, and have morals (Ministry of National Education 2023 Educational Vision, 2019). The Vision states that in order to support the progress of students in line with their interests, abilities, and personalities, "Design-Skill Ateliers" will be established in all schools. It emphasizes an education approach that places practical experience where students can relate the knowledge they acquire in classes to real life and turn this knowledge into practical applications. Design Skill Ateliers are described as physical spaces that allow children to diversify their knowledge and skills, enabling them to turn this knowledge into practical applications and creative products (Ministry of National Education, 2021). As recommended ateliers, which are one of the educational environments for 21st century skills (Çiftçi et al., 2021), can also be considered as innovative learning environments for the implementation of the Inclusive 21st century skills model. Therefore, the model can be applied in these design skill ateliers mentioned, and assessment processes can also be selected to suit these environments. This emphasizes the importance of using these environments to acquire comprehensive skills. In the 2023 Education Vision, it is mentioned that evaluations of the practices to improve learning will be rearranged. In this regard, it is believed that the use of alternative assessment and evaluation tools in these environments will be useful in determining the status of the skills and values that the model aims to provide. When measuring 21st century skills, more integrated assessments can be made. There is no need to abandon the measurement and evaluation process that concerns the

acquisition of one skill for the acquisition of another skill (Aydın Çulha, 2022). Starting from here, assessment tools can be integrated into processes with a more holistic perspective.

In the information age, it is possible to enhance educational assessments with digital components. Care et al. (2018) who are the editors of the book called "Assessment and Teaching of 21st Century Skills", aim to introduce new assessment tools related to the assessment and teaching of 21st century skills. While emphasizing innovative assessment approaches and the use of data obtained through skill-based practices in the teaching process, chapters focuses especially on the advantages of using digital technologies in assessing academic knowledge and 21st century skills. The assessment of new and emerging skills, with a focus on the use of technology in this processes as mentioned in the book is valuable. While technological advancements will improve the quality and applicability of skill measurements, defining the skills accurately will facilitate this process (Aydın Çulha, 2022). Based on this, benefiting from digital technology support, such as Web 2.0 tool applications, can be informative for assessment by integrating them into the teaching and learning process.

In the assessment of skills and values with extensive content, students can be encouraged to self-assess based on the activities they have completed. Particularly, since it might be challenging for teachers to observe all 46 sub-skills for each student, students can be provided with a self-assessment form to assess their own skills. This way, students can express what they need to do to fill their gaps. Table 2 provides an example of a self-assessment form that can be created for sub-skills under the main skill category "Working Skills" of the Inclusive 21st century skills model. Creating such a form with other skills "social and emotional skills, higher-order thinking skills, language and communication skills, learning skills, self skills, and literacy skills" is expected to guide students in their self-assessment processes.

Table 2. A section of a self-assessment form that can be created for a lesson/an activity implementing the Inclusive 21st century skills model, "Working Skills" part example (Adapted from Türel et al., 2023)

Main Skill: Working Skills				
Sub-Skills	**Definition**	**Yes**	**No**	**What I can do to complete my deficiency?**
Entrepreneurship	I can generate ideas and set goals in activities, seizing opportunities in my environment, and convert them into social, cultural, and economic values.			
Productivity	I make plans to achieve goals and create high-quality and the desired quantity of products in activities.			
Resource Management	I effectively use different resources in activities, and when necessary, I access alternative sources and manage these resources.			
Accountability	I conduct tasks transparently, explaining the processes and outcomes of the decisions I make while accomplishing a task.			.

In Table 2, there are items related to sub-skills under the main skill category "Work Skills" of the model. It is believed that creating a form like this will guide students in their self-assessment processes, helping them express what they need to do to improve their skills. It is also recommended to develop similar self-assessment forms for different skill domains.

Sari and Handoyo (2019), recommends 21st century skills based worksheet developing process with 7 steps. Determining the goal to be achieved; describing competencies into high-level thinking indicators, identifying the 21st century skills need to be nurtured; describing selected 21st century skills as achievable indicators; integrating curriculum competency indicators with 21st century skills indicators; formulating work steps to achieve the learning objectives; and writing down the whole work steps are the steps of this process. These headings that for the process of the course, as in the previous suggestion, can be adapted to assessment processes as a form or checklist. Ceran (2021) suggests that assessment processes can be further diversified by addressing questions like "How can we enhance students' creativity and innovation skills in science education?" These questions can be integrated into the assessment process to evaluate specific skills and competencies.

Şentürk and Arslan (2020) have stated that since the Science Education course examines nature, living beings, and humans, values education should not be considered specific to certain courses, and this education should not be separated from the Science Education course. They emphasized that students will gain these values in the Science Education course by doing, experiencing, and modeling their teachers. In light of these sources, it is recommended that a checklist or observation list for values, can be prepared to assess the acquisition of values by students through

science activities. Adapted from Akyol's (2012) "Values Checklist" developed to examine values in illustrated children's books, the list can be seen in Table 3.

Table 3. A values checklist that can be created for a lesson/an acitvity implementing the Inclusive 21st Century Skills Model (Descriptions adapted from Türel et al., 2023)

Value	Criterion	Yes/No
Respect	The state of being considerate and valuing the beliefs, views, practices, rights, and privacy of others.	
Love	The state of valuing family unity, being self-sacrificing, trusting, compassionate, and loyal.	
Honesty	The state of valuing ethical and moral principles, adhering to them consistently, and being sincere, truthful, trustworthy, and humble.	
Justice	The state of having values such as being fair and treating others equally.	
Friendship	The state of trusting, being understanding, showing solidarity, loyalty, empathy, and a willingness to help.	
Generosity	The state of being generous, collaborating, doing good, being compassionate, hospitable, and sharing.	
Patriotism	The state of being hardworking, adhering to rules and laws, being loyal, sensitive to historical and natural heritage, and valuing the community.	
Morality	Beliefs, habits, and behaviors used by an individual to make decisions about right and wrong, influenced by personal, cultural, and societal values.	
Conscience	The state of recognizing others' problems, being sensitive and sympathetic towards them, and helping to solve those problems.	
Etiquette	The state of having and following the respect and courtesy behaviors that exist within a society.	
Thriftiness	The state of using various resources carefully, economically, and efficiently.	

As seen, the diverse range of competencies included in the Inclusive 21st Century Skills Model requires not only integration into instructional processes but also careful planning for their assessment. In this regard, the example tools and suggestions presented above are considered to enhance the applicability of the model, particularly in skill-based courses such as science courses.

CONCLUSION

The Inclusive 21st Century Skills Model proposed by Türel et al. (2023), consisting of 7 skill categories, 46 sub-skills, and 11 core values, is a significant model with the potential to offer students a multidimensional learning experience. The recommendations presented in the original study are aimed at planning, implementing, and evaluating teaching and learning activities in alignment with this model. In the present study, practical assessment process suggestions and ideas that can be used in evaluation processes are included, based on the model's inclusive structure and its wide range of skills. It is believed that literature-based recommendations on how the model can be evaluated when integrated into science education learning environments are of great importance.

Recent studies in the literature support the necessity of incorporating 21st century skills models, such as this model, which encompass various skills, into educational environments and skill-

based learning processes. Demir and Çetin (2023) evaluated the science curriculum in the context of P21 (Partnership for 21st Century Learning, 2019) and noted that while the curriculum includes skills such as communication, information literacy, critical thinking, social and intercultural skills, productivity, and creativity, it lacks any achievements related to media literacy. The researchers emphasized that these skills are not consistently distributed across the curriculum and recommended the development of programs in which these skills are integrated at all levels. Aydın Çulha (2022) also highlights the importance of assessment processes and stresses that the data obtained from educational environments should be used to make learning processes more effective. Similarly, Adeoye et. al.(2024) argue that in today's education systems, it is essential to adopt innovative and effective teaching techniques to equip students with the necessary knowledge and skills. They advocate for the use of authentic assessment practices that go beyond traditional methods, allowing students to demonstrate their knowledge and skills in meaningful and real-life contexts. Aydın Ceran (2021) also underlines the importance of effective communication skills in the context of science education and points out the need for practical program suggestions for integrating scientific communication skills into the curriculum. Şahin and Çelik (2024) state that although various disciplines have undertaken transformative steps in line with their own goals related to 21st century skills, there is a lack of clear information about which skills should be taught, at what stage of life, for what purpose, and through which methods.

In light of all this, it is anticipated that the Inclusive 21st Century Skills Model, with its compatibility with the Turkish education system and its broad range of skills, can offer significant contributions to educational processes, especially in science education. Enabling students to engage with these skills from an early age, integrate them into their own learning processes, and use different skills within the same activity can ease their adaptation to skill-based learning and improve their success. Today’s holistic education approach emphasizes the use of alternative and process-oriented assessments supported by innovative techniques. In this context, this study suggests innovative alternative assessment tools such as assessment forms, observation checklists, reflective questions, and digital tools for assessing the mentioned model. It is suggested that this model be incorporated into teacher education programs, supported by the development of practice-oriented instructional materials, and that assessment processes be redesigned based on a skill-focused, alternative and holistic perspective.

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