Education Mind

EDUCATION MIND
2024, VOL 3, NO 2, 251-269
DOI: 10.58583/EM.3.2.12

Research Article

Open Access

Analysis of the relationship between high school teachers' 21st century teaching and learning skills

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ARTICLE HISTORY

Received: 28.10.2024
Accepted: 19.11.2024

KEYWORDS

21st century skills
21st century teaching skills
21st century learning skills
High school teachers

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ABSTRACT

In this study, it was aimed to examine the relationship between 21st century teaching and learning skills of high secondary school teachers. In line with this main purpose, firstly, the levels of high education teachers' use of 21st century teacher and learner skills were determined; then it was examined whether the levels of use of these skills differed according to the gender, years of professional seniority and the type of school they worked in. The research was designed according to correlational research design. The participants of the study consisted of a total of 282 high education teachers working in high schools affiliated to the MoNE within the borders of Altınordu district of Ordu province in the 2023-2024 academic year. In the data analysis process, total scores, mean, and standard deviation values were calculated to determine the levels at which high school teachers use 21st-century teaching and learning skills. To identify whether the levels of 21st-century teaching and learning skills vary by gender, years of experience, and type of school where teachers work, independent sample t-tests and one-way ANOVA tests were conducted. According to the results of the study, it was determined that high school teachers used affirmative skills with the highest score, then technopedagogical skills, administrative skills, generative skills and flexible teaching skills with the lowest score among 21st century teaching skills. Among the 21st century learning skills of high school teachers, it was determined that they used cognitive skills with the highest score, then innovativeness skills, collaboration and flexibility skills and autonomous skills with the lowest score. Within the scope of the other sub-problem of the research, there was no significant difference between the gender and professional seniority variables of the teachers and the level of use of 21st century teaching and learning skills of high school teachers. According to the school type, there was a significant difference between the levels of high education teachers' use of 21st century teaching and learning skills. According to the results obtained within the scope of the problem based on the research, it was concluded that there is a significant positive relationship between the levels of use of 21st century teaching skills and 21st century learning skills of high education teachers.

Introduction

With the rapid and unpredictable changes in the world, governments in various countries are establishing high-quality education systems to equip all citizens with the skills required by the century. They consider teachers to be the fundamental element of these high-quality education systems and schools (OECD, 2018). The quality of teachers has recently become a topic of greater importance worldwide. Research indicates that teachers' pedagogical knowledge and their classroom practices have a significant impact on students' achievements (Pianta et al., 2008).

Darling-Hammond (2006) states that the pressure on teachers has increased over the last century and that teachers must prepare students to acquire high-level thinking skills and competencies in this century. The quality of the training provided to teachers must also change to equip students with the necessary skills and competencies to meet the changing conditions of the 21st century. Furthermore, it is essential not only to prepare teachers to help students acquire these 21st-century skills but also to train them to spread these skills effectively (Kim et al., 2019).

Seidman et al. (2018) emphasize that teachers play a significant role in improving the skills required in the 21st century. They note that one of the main challenges is the lack of context-specific understanding of teaching practices, and another is the absence of meaningful ways to support teachers' professional development.

Kereluik et al. (2013), who argue that teachers hold a key role in ensuring that students acquire these skills, state that teachers should create environments that allow students to gain high-level thinking skills and to deeply understand disciplinary knowledge. They also emphasize that teachers should use technology effectively in the teaching-learning process and create learning environments that enhance communication and interaction among students. Similarly, the report published by OECD (2018) states that teachers play a fundamental role in making educational changes inclusive and equitable. The report highlights the importance of empowering teachers to support the development of students with special needs, promoting inclusive teaching practices, monitoring students' learning processes inside and outside the classroom, and fostering collaboration between teachers and families to support students' skills, competencies, social, and emotional well-being.

21st Teaching and Learning Skills

The working conditions, labor force, citizenship, and individual characteristics of the 21st century differ significantly from those of previous centuries. This difference appears to stem from the need for a qualified workforce. With the acceleration of computers, artificial intelligence, and other technological advancements, the focus has shifted to creating a type of “qualified workforce” through education—individuals capable of high-level thinking processes, metacognitive reasoning, establishing and managing an effective and complex communication process, and acting according to the importance of collaborative work (Dede, 2010). Given that the labor force in most countries is evolving towards individuals possessing these skills, it can be argued that educational activities should also align with this goal; schools and, consequently, all stakeholders in education must be structured to nurture this qualified workforce emerging in the 21st century.

Many organizations and researchers have examined the skills and competencies that students are expected to possess in the 21st century, and various frameworks for these skills and competencies have been developed (Binkley et al., 2012; ISTE, 2016; OECD, 2005; 2018; Partnership for 21st Century Skills, 2019; Board of Education-MoNE, 2023; Trilling & Fadel, 2009; Turkey Qualifications Framework, 2015). Among these, the "21st Century Skills Framework" developed

under the Partnership for 21st Century Learning (P21) project is one of the most widely used and detailed learning frameworks for 21st-century skills (Dede, 2010). This skills framework is divided into three main categories: "l*earning and innovation skills, information, media and technology skills, and life and career skills*." Learning and innovation skills distinguish students who are prepared for complex work and life conditions from those who are not. The sub-skills under this essential skill category include "*creativity and innovation, critical thinking and problem-solving, communication and collaboration*." Information, media, and technology skills involve individuals' ability to be effective literate users of information, media, and technology in the 21st century, coupled with critical thinking skills. The sub-skills within this category include "information literacy and media literacy." Life and career skills relate to students' use of high-level thinking skills in modern working and living conditions, as well as the development of their emotional and social competencies. The sub-skills in this essential category are "*flexibility and adaptability, initiative and self-direction, social and cross-cultural interaction, productivity and accountability, and leadership and responsibility*" (Gelen, 2017; Partnership for 21st Century Skills, 2019; Trilling & Fadel, 2009). Apart from this classification, there are also classifications developed internationally by Binkley et al. (2012), the International Society for Technology in Education (ISTE, 2016), and the Organisation for Economic Co-operation and Development (OECD, 2005; 2018). When these frameworks are evaluated collectively, it can be argued that they provide a foundational structure that shapes various educational contexts, from the development of educational programs to instructional practices, from the development of student characteristics to the professional development of teachers and educational leaders.

In Turkey, numerous studies are being conducted by the Ministry of National Education (MoNE), various organizations, and researchers to establish a national framework for 21st-century skills and to define these skills. In 2018, the Turkey Qualifications Framework (TQF) was created in coordination with MoNE, the Vocational Qualifications Authority, the Council of Higher Education, universities, non-governmental organizations, and relevant ministries to align with the European Qualifications Framework established in 2008. The primary aim of developing this qualifications framework is to support lifelong learning processes, improve the quality of educational activities, balance employment and education, and combine the numerous and diverse qualification areas in education and vocational fields in Turkey into a unified structure (TQF, 2015). The TQF has been designed to encompass primary, secondary, high school, and higher education, with the aim of imparting these competencies to individuals through all relevant educational programs. The TQF consists of levels and level descriptors, types of qualifications, and key competencies (TQF, 2015). Additionally, Türel et al. (2023) prepared a comprehensive research report in 2023 on "21st Century Skills and Values." In this report, a literature review was conducted, 35 different 21st-century skills frameworks were analyzed, and common skill categories were created by combining skills expressed in different ways in these frameworks. The resulting framework consists of seven core skills—"social and emotional skills, high-level thinking, literacy, communication, learning, self and work skills"—and 46 sub-skills. Furthermore, values such as "respect, honesty, ethics, conscience, etiquette, thrift, friendship, justice, love, patriotism, and altruism" were added to the 21st-century skills framework.

International research on the skills and competencies that teachers should possess in the 21st century is ongoing (OECD, 2018; ISTE, 2016; Partnership for 21st Century Skills, 2019; Saavedra & Opfer, 2012; Trilling & Fadel, 2009). In these studies, various organizations and researchers present frameworks for competencies related to 21st-century teaching. When these competency areas and frameworks are examined in general, it is emphasized that teachers should adopt an equitable learning process for students with special needs and disadvantaged backgrounds, integrate project-based learning in instructional processes to enable students to acquire 21st-

century skills, ensure that curriculum outcomes are aligned with students' real-life experiences, incorporate activities for group work, design lessons with a disciplinary approach, and effectively use instructional technologies.

Teacher qualifications in the 21st century are a focal point of research in Turkey, as well. In Turkey, to support the development of teachers'/pre-service teachers' professional competencies, several studies are being conducted by organizations, including the Council of Higher Education, the Ministry of National Education (MoNE), the Turkish Education Association, the Education Reform Initiative, and the Teachers Academy Foundation. The "Teacher Strategy Document 2017-2023" published by MoNE in 2017 particularly emphasizes the professional development processes of teachers. Additionally, the document aims to employ highly qualified individuals as teachers who meet the standards for individual and professional development. Accordingly, a comprehensive "General Competencies for the Teaching Profession" framework has been developed, encompassing each teacher's competencies in their specific field. This framework includes "professional knowledge," "professional skills," and "attitudes and values" as three interrelated competency areas, consisting of 11 competencies and 65 indicators related to these competencies (MoNE, 2017). As stated in the previous paragraph, the report prepared by Türel et al. (2023) notes that teacher training will be provided to enhance the applicability of the 21st Century Skills Model proposed, and activity books on literacy skills will be prepared to serve as guides for teachers. The same report also states that the Board of Education of MoNE continues its work on how 21st-century skills can be acquired by students, with targeted initiatives for teachers and parents.

Purpose and Importance of Research

The primary objective of this study is to examine the relationship between high school teachers' 21st-century teaching and learning skills. To this end, the study first identifies the 21st-century teaching and learning skills possessed by high school teachers and then investigates how these skills vary according to certain variables.

The study aims to determine the 21st-century teaching and learning skills of teachers. The results obtained will help identify the current 21st-century teaching and learning skills that teachers possess. By doing so, teachers will become more aware of the skills they need to impart 21st-century skills to their students, recognize their strengths and weaknesses in this area, and gain insights into the professional development they need to undertake.

The research was conducted with high school teachers. One of the main reasons for choosing high school teachers as the focus of the study is that one of the researchers has long experience teaching at this level. Through their personal experience and postgraduate studies, the researcher recognized the importance of this topic and became curious about the level of teachers' proficiency in imparting 21st-century skills to their students. Additionally, secondary education is a crucial stage for university entrance in Turkey and includes a wide variety of school types. At this stage, students acquire skills that will help them make informed decisions about their professional, social, and personal lives after graduation. It is essential for teachers to identify the extent to which students possess 21st-century skills and determine which skills are most needed so that they can design lessons around these competencies to better prepare students for future job and social demands.

Upon reviewing the literature, it is observed that international studies on teachers' 21st-century teaching and learning skills (Davis, 2018; Kim et al., 2019; Martinez, 2021; O'Neal, Gibson & Cotten, 2017; Tyan et al., 2020; Varas et al., 2023; Zamora & Zamora, 2022) predominantly focus on primary and middle school teachers. These studies tend to emphasize instructional practices

related to 21st-century skills and advocate for the support of teachers' professional development in this regard. This study, however, fills a gap in Turkey by examining the existing 21st-century skills of high school teachers, contributing to the professional development of teachers based on internationally established research on this subject.

In the national literature, research has been conducted on teachers' 21st-century learning skills (Aslan & Alcı, 2023; Cemaloğlu et al., 2019; Güllü & Akçay, 2022; Dilekçi, Karatay & Tezel, 2022; Kafalı & Akçöltekin, 2024; Metin, Güler & Çevik, 2023; Özdemir, 2023), their 21st-century teaching skills (Çelebi & Sevinç, 2019; Duran, 2023; Gürültü, Aslan & Alcı, 2018; 2020; Korkmaz, 2019; Kozikoğlu & Özcanlı, 2020; Tunagür & Aydın, 2021; Uyar & Çiçek, 2021), and the relationship between these skills (Akça, 2023; Ateşoğlu, 2022; Başkurt, 2023; Coşanay, 2021; Kıyasoğlu, 2019; Yıldız-Poyraz, 2024). The primary aim of this study is to investigate the relationship between high school teachers' use of 21st-century teaching and learning skills. A review of the national literature reveals a limited number of studies (Akça, 2023; Ateşoğlu, 2022; Kıyasoğlu, 2019; Yıldız-Poyraz, 2024) examining this relationship. This study is thus expected to contribute to literature and provide insights for readers by presenting the current status of high school teachers' 21st-century teaching and learning skills and exploring the relationship between these skills.

The primary research problem in this study is defined as follows: *"What is the relationship between high school teachers' 21st-century teaching and learning skills?"* In alignment with this main research problem, the following questions were explored:

1. What are the levels of high school teachers' 21st-century teaching skills?
2. What are the levels of high school teachers' 21st-century learning skills?
3. Do the levels of high school teachers' 21st-century teaching skills vary by:
    a. gender,
    b. years of experience,
    c. the type of school they work at?
4. Do the levels of high school teachers' 21st-century learning skills vary by:
    a. gender,
    b. years of experience,
    c. the type of school they work at?
5. Is there a significant relationship between the levels of high school teachers' 21st-century teaching skills and their levels of 21st-century learning skills?

Method

Research design

This study, aimed at determining the relationship between high school teachers' use of 21st-century teaching and learning skills, is designed as a correlational research design, which seeks to identify both direct and indirect relationships among variables. Correlational research, a quantitative method, examines the existing relationships between different variables and how these characteristics affect individuals without any intervention (Büyüköztürk et al., 2013; Franken et al., 2012).

In addition to the primary research problem, the first, second, and third sub-problems of this study, which examine whether the levels of high school teachers' 21st-century teaching and learning skills vary by gender, years of experience, and the type of school they work at, are designed as survey model. Survey research model aims to capture a general view of the subject

by analyzing it in its natural state. This research type often gathers opinions on events from large samples (Şata, 2020).

Population and sample

The study population comprises high school teachers working in secondary schools under the Ministry of National Education (MoNE) in the Altınordu district of Ordu province. Initially, the number of secondary school teachers was obtained from the relevant provincial directorate of national education, and schools and teachers were then selected using a random sampling method. There are a total of 861 high school teachers in the Altınordu district of Ordu. Based on the sample size calculation with a 95% confidence interval, it was determined that 266 teachers should be reached. Considering this, data was collected from a total of 282 high school teachers. Personal information related to the participating teachers is presented in Table 1.

Table 1 Personal information of high school teachers

Categories		N	%
Gender	Female	158	56
	Male	124	44
Years of Experience	0-5 years	14	5
	5-10 years	49	17
	10-15 years	23	8
	15-20 years	58	21
	20 years and above	138	49
Type of School	Vocational and Technical High School	117	42
	Anatolian High School	101	35
	Sports High School	5	2
	Religious Vocational High School	31	11
	Science High School	23	8
	Social Sciences High School	5	2
Total		282	100

Data collection tools

For data collection, a “Personal Information Form” was used to determine personal details of participating teachers, such as gender, years of experience, and type of school they work at. Additionally, two scales developed by Orhan-Göksün (2016) were employed: the “21st Century Teaching Skills Scale” and the “21st Century Learning Skills Scale.” The 21st Century Teaching Skills Scale, organized as a five-point Likert scale, consists of 27 items and five factors: “administrative skills, technopedagogical skills, confirmative skills, flexible teaching skills, and productive skills.” The Cronbach’s alpha internal consistency coefficient for this scale was calculated as 0.870.

Similarly, the 21st Century Learning Skills Scale, also structured as a five-point Likert scale, includes 31 items across four dimensions: “cognitive skills, autonomous skills, collaboration and flexibility skills, and innovation skills.” The Cronbach’s alpha internal consistency coefficient for this scale was determined to be 0.892.

In this study, Cronbach’s alpha internal consistency coefficient was recalculated for the reliability of the 21st-century teaching and learning skills scales, and the results are presented in Table 2.

Table 2 Reliability levels of measurement tools used in the study

Measurement	Cronbach's alpha Internal Consistency Coefficient
Administrative skills	0.889
Technopedagogical skills	0.886
Confirmative skills	0.903
Flexible teaching skills	0.911
Productive skills	0.899
21st- Century Teaching Skils (Total)	0.883
Innovative skills	0.896
Collaboration and flexibility skills	0.885
Autonomous skills	0.895
Cognitive skills	0.894
21st- Century Learning Skills (Total)	0.885

Data collection and analysis

First, the necessary permissions were obtained from the relevant ethics committee of the university conducting the study and from the Provincial Directorate of National Education. After obtaining the required permissions, the scales were reproduced. Then, considering the sampling method determined in the study and the number of high school teachers to be reached in the study, the teachers in the schools determined by the first author of the study were reached. The first author of the study went to the schools one by one and distributed the scales to the teachers face to face, and the scales were collected after the process of answering the scales was completed. During the implementation process of the study, no problems were encountered during the completion of the scales by the teachers who were planning to participate in the study. The collected data was analyzed using the Jamovi 2.3.21 software.

To examine whether the data obtained in the study showed a normal distribution, skewness and kurtosis coefficients were calculated and are presented in Table 3.

Table 3 Normal distribution analysis of data

Measurements	Skewness	Kurtosis
Administrative skills	-0.600	0.479
Technopedagogical skills	-0.319	-0.068
Confirmative skills	-1.070	-0.871
Flexible teaching skills	-0.012	-0.319
Productive skills	-0.570	0.122
21st- Century Teaching Skils (Total)	-0.359	0.209
Innovative skills	-0.552	0.004
Collaboration and flexibility skills	-0.201	-0.316
Autonomous skills	-0.356	-0.047
Cognitive skills	0.733	0.866
21st- Century Learning Skills (Total)	-0.121	1.04

As seen in Table 3, the skewness values range between -1.070 and 0.733, and the kurtosis values range between -0.047 and 1.04. According to Tabachnick & Fidell (2013), when skewness and kurtosis values fall within the range of -1.5 to +1.5, data can be considered to follow a normal distribution. Therefore, Table 3 indicates that the study's data exhibits a normal distribution.

Frequency and percentage analyses were conducted to examine the demographic characteristics of high school teachers in the study. Total scores, mean, and standard deviation values were calculated to determine the levels at which high school teachers use 21st-century teaching and learning skills.

To identify whether the levels of 21st-century teaching and learning skills vary by gender, years of experience, and type of school where teachers work, independent sample t-tests and one-way ANOVA tests were conducted. Pearson correlation analysis was used to examine the relationship between high school teachers' use of 21st-century teaching and learning skills. For the interpretation of effect size in one-way ANOVA, the eta-squared (η^2) formula was applied. The eta-squared (η^2) values were interpreted as follows: .02 indicating a small effect, .13 a medium effect, and .26 a large effect.

Findings

Examination of high school teachers' levels of 21st-century teaching skills

The first sub-question of the study is stated as: *"What are the levels of high school teachers' use of 21st-century teaching skills?"* To address this research question, descriptive statistics such as arithmetic mean and standard deviation were calculated for each sub-dimension and the overall scale, and the findings are presented in Table 4.

Table 4 Levels of high school teachers' use of 21st-century teaching skills

Scale Sub-Dimensions	N	Mean	sd
Confirmative skills	282	4.63	.444
Administrative skills	282	3.85	.448
Productive skills	282	3.79	.845
Flexible teaching skills	282	3.00	.961
Technopedagogical skills	282	4.00	.565
21st- Century Teaching Skils (Total)	282	4.05	.465

As shown in Table 4, high school teachers scored the highest on confirmative skills, followed by technopedagogical skills, administrative skills, productive skills, and the lowest on flexible teaching skills. Given that the overall score for 21st-century teaching skills ($\bar{X}$ = 4.05) is above the midpoint of three, it can be stated that teachers use 21st-century teaching skills in their instructional practices.

Examination of high school teachers' levels of 21st-century learning skills

The second sub-question of the study is stated as: *"What are the levels of high school teachers' use of 21st-century learning skills?"* To address this research question, descriptive statistics such as arithmetic mean and standard deviation were calculated for each sub-dimension and the overall scale, and the findings are presented in Table 5.

Table 5 Levels of high school teachers' use of 21st-century learning skills

Scale Sub-Dimensions	N	Mean	sd
Cognitive skills	282	4.38	.459
Innovative skills	282	4.08	.743
Collaboration and flexibility skills	282	3.75	.641
Autonomous skills	282	3.74	.654
21st- Century Learning Skils (Total)	282	4.12	.452

As shown in Table 5, high school teachers scored the highest on cognitive skills, followed by innovation skills, collaboration and flexibility skills, and the lowest on autonomous skills. Since the overall score for 21st-century learning skills ($\bar{X}$ = 4.12) is above the midpoint of three, it can be stated that teachers use 21st-century learning skills at a level above the average.

Examination of high school teachers' levels of 21st-century teaching skills based on various variables

In the third sub-question of the study, the levels of high school teachers' use of 21st-century teaching skills were examined based on teachers' gender, years of experience, and the type of school where they work. To determine if there were differences based on gender, an independent samples t-test was conducted, and the findings are presented in Table 6.

Table 6 Examination of high school teachers' levels of 21st-century teaching skills by gender

Scale Sub-Dimensions	Group	N	Mean	sd	df	t	p
Confirmative skills	Female	158	4.64	.437	280	0.573	0.567
	Male	124	4.61	.453			
Administrative skills	Female	158	3.85	.433	279	0.043	0.965
	Male	124	3.84	.467			
Productive skills	Female	158	3.80	.837	279	0.239	0.811
	Male	124	3.78	.858			
Flexible teaching skills	Female	158	3.20	.924	280	-1.590	0.113
	Male	124	3.38	1.001			
Technopedagogical skills	Female	158	3.93	.570	280	-1.066	0.287
	Male	124	4.01	.558			
21st- Century Teaching Skils (Total)	Female	158	4.04	.457	278	-0.628	0.530
	Male	124	4.07	.477			

As shown in Table 6, no significant difference was found in the total scores and sub-dimensions of high school teachers' 21st-century teaching skills based on gender. This is likely due to the mean scores of female and male teachers being close to each other across all dimensions of 21st-century teaching skills.

To examine whether high school teachers' levels of 21st-century teaching skills vary by years of experience, a one-way ANOVA test was conducted. The findings are presented in Table 7.

Table 7 Examination of high school teachers' levels of 21st-century teaching skills by years of experience

Scale Sub-Dimensions	Categories	N	Mean	sd	F	p
Confirmative skills	0-5 years	14	4.64	.480	1.087	0.371
	5-10 years	49	4.71	.333		
	10-15 years	23	4.49	.531		
	15-20 years	58	4.64	.451		
	20 years and above	138	4.62	.455		
Administrative skills	0-5 years	14	3.88	.316	0.333	0.855
	5-10 years	49	3.90	.395		
	10-15 years	23	3.83	.429		
	15-20 years	58	3.85	.487		
	20 years and above	138	3.82	.466		
Productive skills	0-5 years	14	3.82	.668	0.274	0.894
	5-10 years	49	3.88	.801		
	10-15 years	23	3.76	.903		
	15-20 years	57	3.83	.923		
	20 years and above	138	3.75	.842		
Flexible teaching skills	0-5 years	14	3.14	.602	0.268	0.897
	5-10 years	49	3.20	.935		
	10-15 years	23	3.33	1.040		
	15-20 years	58	3.28	.987		
	20 years and above	138	3.30	.984		

Technopedagogical skills	0-5 years	14	4.18	.320	1.570	0.193
	5-10 years	49	3.92	.500		
	10-15 years	23	3.99	.626		
	15-20 years	58	3.93	.700		
	20 years and above	138	3.97	.533		
21st- Century Teaching Skils (Total)	0-5 years	14	4.13	.300	0.277	0.892
	5-10 years	49	4.07	.403		
	10-15 years	23	4.05	.478		
	15-20 years	58	4.05	.534		
	20 years and above	138	4.04	.472		

As seen in Table 7, no significant differences were found in the total scores and sub-dimensions of high school teachers' 21st-century teaching skills based on years of experience. This is likely due to the similar mean scores across all experience levels for 21st-century teaching skills and their sub-dimensions.

To determine if high school teachers' levels of 21st-century teaching skills vary based on the type of school they work at, a one-way ANOVA test was conducted, and the findings are presented in Table 8.

Table 8 Examination of high school teachers' levels of 21st-century teaching skills by school type

Scale Sub-Dimensions	Categories	N	Mean	sd	F	p	eta-kare (η2)
Confirmative skills	Vocational and Technical High School	117	4.58	0.466	1.43	0.255	
	Anatolian High School	101	4.67	0.448			
	Sports High School	5	4.60	0.435			
	Religious Vocational High School	31	4.72	0.386			
	Science High School	23	4.55	0.384			
	Social Sciences High School	5	4.87	0.298			
Administrative skills	Vocational and Technical High School	117	3.71	0.423	5.67	0.002*	0.073
	Anatolian High School	101	3.92	0.442			
	Sports High School	5	3.75	0.386			
	Religious Vocational High School	31	3.97	0.412			
	Science High School	23	3.96	0.523			
	Social Sciences High School	5	4.22	0.225			
Productive skills	Vocational and Technical High School	117	3.55	0.889	4.20	0.008*	0.069
	Anatolian High School	101	3.92	0.770			
	Sports High School	5	3.50	0.354			
	Religious Vocational High School	31	4.05	0.894			
	Science High School	23	4.07	0.627			
	Social Sciences High School	5	4.30	0.837			
Flexible teaching skills	Vocational and Technical High School	117	3.02	0.898	4.94	0.004*	0.085
	Anatolian High School	101	3.30	0.944			
	Sports High School	5	3.80	1.037			
	Religious Vocational High School	31	3.53	1.032			
	Science High School	23	3.87	0.815			
	Social Sciences High School	5	4.00	1.000			

Technopedagogical skills	Vocational and Technical High School	117	3.87	0.545	2.13	0.101	
	Anatolian High School	101	3.95	0.575			
	Sports High School	5	4.05	0.505			
	Religious Vocational High School	31	4.15	0.541			
	Science High School	23	4.17	0.613			
	Social Sciences High School	5	4.22	0.409			
21st- Century Teaching Skils (Total)	Vocational and Technical High School	117	3.92	0.437	4.75	0.005*	0.079
	Anatolian High School	100	4.10	0.457			
	Sports High School	5	4.04	0.453			
	Religious Vocational High School	31	4.23	0.457			
	Science High School	23	4.24	0.506			
	Social Sciences High School	5	4.41	0.308			

*p < .05

As shown in Table 8, no significant differences were found in high school teachers' levels of 21st-century teaching skills in terms of evaluative skills (F = 1.43) and technopedagogical skills (F = 2.13) based on school type (p > .05). However, significant differences were found in managerial skills (F = 5.67), productive skills (F = 4.20), flexible teaching skills (F = 4.94), and overall 21st-century teaching skills (F = 4.75) based on the type of school where teachers work (p < .05). The eta-squared values for these dimensions indicate a small effect size.

Examination of high school teachers' levels of 21st-century learning skills based on various variables

In the fourth sub-question of the study, the levels of high school teachers' use of 21st-century learning skills were examined based on teachers' gender, years of experience, and the type of school where they work. To determine if there were differences based on gender, an independent samples t-test was conducted, and the findings are presented in Table 9.

Table 9 Examination of high school teachers' levels of 21st-century learning skills by gender

Scale Sub-Dimensions	Group	N	Mean	sd	df	t	p
Cognitive Skills	Female	158	4.41	.437	280	0.927	0.354
	Male	124	4.36	.453			
Innovative skills	Female	158	4.01	.433	280	-1.836	0.067
	Male	124	4.17	.467			
Collaboration and flexibility skills	Female	158	3.73	.837	280	-0.328	0.743
	Male	124	3.76	.858			
Autonomous skills	Female	158	3.69	.924	280	-1.392	0.165
	Male	124	3.80	1.001			
21st- Century Learning Skils (Total)	Female	158	4.11	.457	280	-0.156	0.876
	Male	124	4.12	.477			

As shown in Table 9, no significant difference was found in the total scores and sub-dimensions of high school teachers' 21st-century learning skills based on gender. This is likely due to the similar mean scores between female and male teachers in all dimensions of 21st-century learning skills.

To determine if high school teachers' levels of 21st-century learning skills differ based on years of experience, a one-way ANOVA test was conducted, and the findings are presented in Table 10.

Table 10 Examination of high school teachers' levels of 21st-century learning skills by years of experience

Scale Sub-Dimensions	Categories	N	Mean	sd	F	p
Cognitive skills	0-5 years	14	4.40	.338	.593	0.669
	5-10 years	49	4.41	.377		
	10-15 years	23	4.47	.362		
	15-20 years	58	4.32	.450		
	20 years and above	138	4.39	.514		
Innovative skills	0-5 years	14	4.00	.439	1.068	0.380
	5-10 years	49	4.17	.591		
	10-15 years	23	4.11	.825		
	15-20 years	58	3.91	.871		
	20 years and above	138	4.12	.741		
Collaboration and flexibility skills	0-5 years	14	3.62	.552	0.214	0.930
	5-10 years	49	3.77	.570		
	10-15 years	23	3.77	.676		
	15-20 years	58	3.73	.731		
	20 years and above	138	3.75	.633		
Autonomous skills	0-5 years	14	3.87	.359	0.722	0.580
	5-10 years	49	3.68	.630		
	10-15 years	23	3.78	.646		
	15-20 years	58	3.68	.686		
	20 years and above	138	3.77	.677		
21st- Century Learning Skils (Total)	0-5 years	14	4.12	.301	0.344	0.848
	5-10 years	49	4.13	.384		
	10-15 years	23	4.18	.425		
	15-20 years	58	4.06	.497		
	20 years and above	138	4.13	.474		

As shown in Table 10, no significant differences were found in the total scores and sub-dimensions of high school teachers' 21st-century learning skills based on years of experience. This is likely due to the similar mean scores across all experience levels for 21st-century learning skills and their sub-dimensions.

To determine if high school teachers' levels of 21st-century learning skills vary based on the type of school they work at, a one-way ANOVA test was conducted, and the findings are presented in Table 11.

Table 11 Examination of high school teachers' levels of 21st-century learning skills by school type

Scale Sub-Dimensions	Categories	N	Mean	sd	F	p	eta-kare (η2)
Cognitive skills	Vocational and Technical High School	117	4.28	0.548	1.99	0.120	
	Anatolian High School	101	4.45	0.387			
	Sports High School	5	4.42	0.331			
	Religious Vocational High School	31	4.50	0.379			
	Science High School	23	4.41	0.318			
	Social Sciences High School	5	4.60	0.274			

Innovative skills	Vocational and Technical High School	117	4.00	0.706	1.12	0.377	
	Anatolian High School	101	4.06	0.824			
	Sports High School	5	4.20	0.570			
	Religious Vocational High School	31	4.16	0.712			
	Science High School	23	4.33	0.668			
	Social Sciences High School	5	4.30	0.447			
Collaboration and flexibility skills	Vocational and Technical High School	117	3.57	0.614	6.60	<.001*	0.093
	Anatolian High School	101	3.74	0.626			
	Sports High School	5	4.00	0.577			
	Religious Vocational High School	31	3.98	0.687			
	Science High School	23	4.20	0.460			
	Social Sciences High School	5	4.03	0.617			
Autonomous skills	Vocational and Technical High School	117	3.60	0.618	3.11	0.030**	0.049
	Anatolian High School	101	3.80	0.615			
	Sports High School	5	3.70	0.776			
	Religious Vocational High School	31	3.87	0.872			
	Science High School	23	4.07	0.517			
	Social Sciences High School	5	3.53	0.558			
21st- Century Learning Skils (Total)	Vocational and Technical High School	117	4.00	0.472	3.33	0.022**	0.059
	Anatolian High School	101	4.16	0.420			
	Sports High School	5	4.19	0.448			
	Religious Vocational High School	31	4.25	0.476			
	Science High School	23	4.30	0.338			
	Social Sciences High School	5	4.26	0.328			

*p < .001, **p < .05

As shown in Table 11, no significant differences were found in high school teachers' levels of 21st-century learning skills regarding cognitive skills (F = 1.99) and innovative skills (F = 1.12) based on school type (p > .05). However, significant differences were found in collaboration and flexibility skills (F = 6.60, p < .001), autonomous skills (F = 3.11, p < .05), and overall 21st-century learning skills (F = 3.33, p < .05) based on the type of school where teachers work. The eta-squared values indicate a small effect size for these dimensions.

Investigation of the relationship between high school teachers' utilization of 21st century teaching skills and 21st century learning skills

Within the scope of the fifth sub-problem of the study, which also represents the main research question, the relationship between high school teachers' utilization levels of 21st-century teaching skills and their usage of 21st-century learning skills has been examined. To address this research question, a correlation analysis was conducted to determine the relationship between the sub-dimensions and overall scores of high school teachers' 21st-century teaching and learning skills. The findings are presented in Table 12.

Table 12 Relationship between high school teachers' 21st-century teaching and learning skills

		Cognitive skills	Innovative skills	Collaboration and flexibility skills	Autonomous skills	21st-Century Learning Skils (Total)
Confirmative skills	r	,478	,293	,317	,164	,431
	p	<.001*	<.001*	<.001*	0.006**	<.001*
	N	282	282	282	282	282
Administrative skills	r	,637	,471	,583	,410	,681
	p	<.001*	<.001*	<.001*	<.001*	<.001*
	N	281	281	281	281	281
Productive skills	r	,370	,324	,505	,354	,478
	p	<.001*	<.001*	<.001*	<.001*	<.001*
	N	281	281	281	281	281
Flexible teaching skills	r	,211	,252	,572	,355	,401
	p	<.001*	<.001*	<.001*	<.001*	<.001*
	N	282	282	282	282	282
Tecnopedagogical skills	r	,529	,619	,614	,530	,678
	p	<.001*	<.001*	<.001*	<.001*	<.001*
	N	282	282	282	282	282
21st- Century Teaching Skils (Total)	r	,619	,557	,697	,516	,741
	p	<.001*	<.001*	<.001*	<.001*	<.001*
	N	280	280	280	280	280

As shown in Table 12, a positive and significant relationship was found between high school teachers' 21st-century teaching skills and their 21st-century learning skills ($r = 0.692$, $p < .001$). This indicates that as high school teachers' levels of 21st-century teaching skills increase, their levels of 21st-century learning skills also increase. The correlation coefficient ($r = 0.692$) suggests a moderately strong positive relationship between the two skill sets.

Discussion and conclusion

The primary objective of this study is to determine the extent to which high school teachers employ 21st-century teaching and learning skills, to examine whether these skills vary according to gender, professional seniority, and school type, and to investigate the relationship between the levels of use of these skills among teachers. In line with this objective, first, the usage levels of 21st-century teaching skills by high school teachers were examined. It was found that high school teachers use confirmative skills at the highest level, while flexible teaching skills are utilized the least. Orhan-Göksün (2016) defines confirmative skills as "displaying approved approaches to correct behaviors through teaching skills." The preference for confirmative skills among the high school teachers participating in this study can be attributed primarily to the fact that many of them have over 20 years of professional experience, leading them to favor behavior-oriented teaching. Similarly, this study's finding that teachers use flexible teaching skills less frequently can also be explained by this tendency. Flexible teaching skills involve taking the teaching process outside the classroom, making it more independent. The results derived from the participating teachers indicate that they prioritize teacher-centered instructional skills while using student-centered teaching skills less frequently. Similarly, Orhan-Göksün and Kurt (2017), in their study with teacher candidates, found that the participants predominantly used confirmative skills, in line with this study's findings. In another study with vocational teachers by Özdemir (2023), the usage levels of 21st-century teaching skills were found to be high, with

confirmative and technopedagogical skills scoring the highest. In Akça's (2023) study with geography teachers, confirmative skills again scored the highest. Similar results were obtained in studies conducted with primary school teachers by Coşanay (2021) and Kıyasoğlu (2019). Gürültü, Aslan, and Alcı (2020) also found that high school teachers used 21st-century teaching skills at a high level, scoring highest in confirmative skills and lowest in flexible teaching skills.

In line with the study's purpose, high school teachers' use of 21st-century learning skills was also examined. High school teachers were found to use cognitive skills at the highest level, while autonomous skills were used the least. Orhan-Göksün (2016) defines cognitive skills as "the processing, encoding, and awareness of products resulting from mental processes." The frequent use of cognitive skills by the participants suggests that they have not departed from the teacher-centered instructional processes they encountered during their schooling. Similarly, autonomous skills, defined by Orhan-Göksün (2016) as "independent learning through the integration of self-management, self-regulation, and the ability to work individually or in groups," are less frequently used by teachers. In Akça's (2023) study, cognitive skills again received the highest scores. Similarly, the findings by Orhan-Göksün and Kurt (2017) show that teacher candidates use cognitive skills more frequently than autonomous skills, a result that aligns with the present study's findings. In another study with primary school teachers by Kıyasoğlu (2019), cognitive skills were also the most frequently used learning skills, while collaboration and flexibility skills were used the least.

Within the scope of a sub-problem of this research, the study examined whether high school teachers' use of 21st-century teaching skills differs according to gender, professional seniority, and school type. No significant differences were found between gender and seniority variables and the level of 21st-century teaching skills usage among high school teachers. In contrast to this finding, Coşanay's (2021) study with primary school teachers reported a significant gender-based difference favoring female teachers. The study by Gürültü et al. (2020) found differences in the "confirmative" "flexible teaching," and "productive skills" subdimensions based on the seniority variable. Similarly, Özdemir's (2023) study with vocational teachers found no significant gender-based differences.

In examining teachers' school types, no significant differences were found between school types regarding directive and technopedagogical skills usage. However, a significant difference in administrative skills was identified between teachers working at Vocational and Technical Anatolian High Schools and Anatolian High Schools, favoring teachers at Anatolian High Schools, and between teachers at Vocational and Technical Anatolian High Schools and Imam Hatip High Schools, favoring those at Imam Hatip High Schools. Orhan-Göksün (2016) defines administrative skills as "teachers' abilities in classroom management, process management, and activity management." The higher usage of administrative skills by teachers in Anatolian and Religious Vocational High Schools could be attributed to these schools' academic and project-based structures, as well as teachers' focus on effective classroom management and role in activities, which suggests a teacher-centered approach. In terms of general usage levels of 21st-century teaching skills, a significant difference was found favoring teachers working in Anatolian, Religious Vocational, and Science High Schools. This difference can be attributed to the fact that these schools have an academic or project-based orientation, which likely encourages participating teachers to focus on student characteristics in their teaching and further develop themselves professionally.

As for the other sub-problem, the study examined whether high school teachers' use of 21st-century learning skills differed according to gender, seniority, and school type. No significant differences were found between the usage levels of cognitive and innovation skills among high

school teachers according to gender and seniority variables. However, significant differences were found in the usage of collaboration and flexibility skills and autonomous skills according to the school type variable. Teachers working in Science, Anatolian, and Religious Vocational High Schools showed higher usage levels of collaboration and flexibility skills. Orhan-Göksün (2016) defines collaboration and flexibility skills as "broadening learning environments to make them more collaborative and flexible." This result could be attributed to the academic and project-based structures of Science, Anatolian, and Religious Vocational High Schools, where teachers are more inclined to work collaboratively with colleagues and students. Regarding autonomy skills usage, a significant difference was found favoring teachers in Anatolian and Science High Schools. This difference is likely due to the teachers' need for continuous self-improvement, as these schools are academic-oriented institutions.

In the main problem of this study, the relationship between high school teachers' usage levels of 21st-century teaching and learning skills was examined. A strong positive correlation was found between teachers' 21st-century teaching skills and learning skills usage levels, with higher learning skills usage correlating with higher teaching skills usage. This result is consistent with findings from similar studies in literature. Akça (2023) found that geography teachers' usage levels of 21st-century teaching and learning skills were high and positively correlated. Similarly, Yıldız-Poyraz (2024) found a highly positive and statistically significant relationship between high school teachers' 21st-century learning skills and teaching skills usage levels. These findings align with similar studies conducted with classroom teachers by Kıyasoğlu (2019) and with teacher candidates by Orhan-Göksün (2016).

The results of this study suggest the following recommendations:

- Based on the finding that high school teachers use flexible teaching skills less than other skills, it is suggested that they receive support for incorporating out-of-school learning environments into instructional processes. It would be beneficial for secondary education institutions to support teachers in utilizing out-of-school learning environments through resources, curriculum flexibility, and other means.
- The study found that teachers use autonomous skills less frequently than other 21st-century learning skills, highlighting the importance of social-emotional learning processes. Therefore, it is essential to establish practices based on peer collaboration within institutions to foster these skills.
- Future research could examine 21st-century teaching and learning skills in different regions of Turkey.
- Qualitative research methods, such as case studies or phenomenological designs, could be employed to explore teachers' perceptions, definitions, and instructional designs concerning 21st-century skills.
- In line with the high levels of both 21st-century teaching and learning skills found in this study, classroom observations on how teachers impart these skills to students could be conducted, with best practices shared through workshops and meetings.

Acknowledgements

This research is based on the first author's master's thesis.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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