



How 21st century skills can be taught: Design and implementation of an undergraduate course for prospective teachers

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ABSTRACT

21st century skills constitute one of the most salient foci within contemporary educational discourse. However, the persistent absence of a detailed and systematic curriculum addressing the pedagogy of these skills remains a significant challenge for teacher education. Employing a mixed-methods study, this study aims to develop and implement a course curriculum that focuses on teaching 21st century skills to prospective teachers. Data were rigorously collected through document and content analyses, semi-structured interviews, and a pre- and post-administration of “The scale for identifying perceptions of having 21st century skills,” developed and validated to determine the significance of the difference. The study encompasses three distinct phases: needs analysis process, design and piloting of the course, and implementation of the developed course with prospective teachers. The study participants were 18 academicians affiliated with diverse faculties of education from various universities, and a total of 73 pre-service teachers (56 for piloting and 17 for real implementation). The needs analysis conclusively indicated a clear demand for such a course. Consequently, a modular-based undergraduate course was developed and implemented over 28 weeks (14 weeks for the pilot and 14 weeks for the real implementation), aiming to teach how to teach 21st century skills grounded in the principles of progressivism and constructivism. The course delivery was structured around micro-teaching activities. Findings indicate that the course had a positive impact on pre-service teachers’ awareness and perceived ability to teach 21st century skills, highlighting the value of a dedicated, practical curriculum in teacher education.

Keywords: 21st century skills, teacher education, curriculum development, course design

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INTRODUCTION

The primary function of education systems in 21st century has evolved to prepare all individuals – as future employees, employers, and citizens – to fulfill their needs and adapt to the contemporary world. The 21st century skills are posited as the key competencies that enable young people to navigate the complexities of modern life effectively. These skills, which include adaptation, non-routine problem-solving, systematic thinking, self-management and complex communication and social skills, are considered significant primarily for the education systems to promote (Martinez, 2022; Shadiev & Wang, 2022; Mishra & Rohit, 2017; Herde et al., 2016; Koh et al., 2015; Brinkley et al, 2012; NRC, 2011).

Driven by such factors as globalization, internationalization, and shifts in economies and labor markets, the increasing demand for 21st century skills at national and global levels have made them a prevalent theme in educational discourse (Joynes et al., 2019). Those factors caused another reality of demands for educational content and delivery as the needs of industrial societies evolved to knowledge-based societies and collaborative and interactive learning environments (Van Laar et al., 2020). Another factor that made those skills a core component for educational contexts is the increasing need of empowered learners to become knowledge creator, innovative

designer, digital thinker, creative communicator and global collaborator besides developing a social and democratic citizenship (González-Pérez & Ramírez-Montoya, 2022; ISTE, 2016). Having noticed the significance of them for their citizens, at least 102 countries started to include 21st century skills in various national documents such as vision/mission statements of institutions and added them into curricula of their schools since 2016 (Joynes et al., 2019; Care et al., 2018; Wrahatnolo & Munoto, 2018).

Table 1. 21st century skills frameworks

Name of the framework	Developers/supporters	Skills
P21 21 st century Learning Framework (P21, 2009)	P21- Partnership for 21 st century Learning	Learning and innovation: creativity and innovation, critical thinking and communication and cooperation skills; Information, media and technology: information literacy, media literacy and ICT; Life and career: flexibility and adaptability, initiative and self-direction, social and intercultural communication skills, productivity and accountability, and leadership and responsibility skills
EnGauge Framework from Metiri/NCREL (2003)	Metiri Group and NCREL	Digital-Age Literacy; Inventive thinking; Effective Communication; High Productivity
American Association of College and Universities (AACU) Framework (National Leadership Council for Liberal Education and America's Promise, 2007)	AACU	Knowledge of Human Cultures and the Physical and Natural World; Intellectual and Practical Skills; Personal and Social Responsibility; Integrative Learning
European Reference Framework of Key Competences for lifelong learning (2018)	EU	Communication in the mother tongue Communication in foreign languages Mathematical competence and basic competences in science and technology Digital competence Learning to learn Social and civic competences Sense of initiative and entrepreneurship Cultural awareness and expression
Definition and Selection of Competencies (DeSeCo)	OECD	Use tools interactively (e.g. language, technology) Interact in heterogeneous groups Act autonomously
Framework for 21 st century Skills and Competencies (Ananiadou and Claro, 2009)	OECD	Information; Information as source: searching, selecting, evaluating and organizing information; Information as product: the restructuring and modelling of information and the development of own ideas (knowledge); Communication; Effective communication; Collaboration and virtual interaction; Ethics and social impact; Social responsibility; Social impact
Assessment and Teaching of 21 st Century Skills (ATCS) (Griffin and Care, 2015)	Cisco, Intel, and Microsoft	Knowledge; Skills; Attitudes; Values; Ethics
NRC Framework for K-12 Science Education with deeper learning and 21 st century skills (2012)	NRC	Self-regulation; Executive functioning; Complex communication; Cultural sensitivity; Valuing diversity (p. 5-29).

Furthermore, these skills are often presented in frameworks proposed by various researchers and organizations (Bravo et al., 2021; Erol, 2021; Dede, 2010; National Research Council, 2008, 2012; Griffin & Care, 2015; Binkley, et al., 2012). The most popular 21st century

skill frameworks in literature can be listed as the ones developed by the Partnership for 21st Century Learning (P21), Metiri Group and NCREL, the American Association of Colleges and Universities (AACU), the European Commission, the OECD, and National Research Council (NRC) (Bravo et al., 2021; Erol, 2021; Dede, 2010; National Research Council, 2008, 2012). The “ATC21S-Assessment and Teaching of 21st century Skills Project” supported by Cisco, Intel and Microsoft is another framework for 21st century skills (Griffin & Care, 2015; Binkley, et al., 2012). The above-mentioned frameworks of 21st century skills in literature are given in Table 1.

As clearly seen in Table 1, communication skills, information skills, digital skills, social and civic skills, innovation and critical thinking skills, and values are among the most frequently stated skills. As for the skills mentioned in other studies, critical thinking, problem-solving, cooperation, collaboration, teamwork, communication, ICT literacy, social/cultural skills, citizenship participation, creativity and ethics and values related skills are listed among the most frequently referred skills in the frameworks in literature (Tight, 2021; Kennedy & Sundberg, 2020; Özçelik, 2019).

Despite the variety of frameworks, a group of researchers asserted the P21 framework as the most widely referred one as it suits better in educational contexts (Erol, 2021; Van Laar et al., 2020; Shafie et al., 2019; Anagün, et.al., 2016; Alismail & McGuire, 2015; Atalay, 2015; Soulé & Warrick, 2015). The significance of critical thinking, problem solving, communication and cooperation and ICT literacy for students besides school subjects led P21 develop the “P21 Framework for 21st century Learning” in 2009 as a comprehensive program. The updated version of rainbow chart demonstrating the P21 framework is shown in Figure 1 (P21, 2019).



Figure 1. Final Version of P21 21st Century Learning Framework (P21, 2019)

P21’s first group of 21st-century skills includes learning and innovation skills, such as creativity, critical thinking, communication, and cooperation. Information, media, and technology skills/digital literacy address information, media, and ICT literacy. The third group, life and career skills, includes flexibility, adaptability, initiative, self-direction, social and intercultural communication, productivity, accountability, and leadership. These skills are integrated into the teaching of reading, writing, and mathematics, as well as 21st-century themes like English, world languages, art, economics, science, geography, history, government, and civics. Besides, global awareness, financial, economic, commercial, entrepreneurial, civic, health and environmental literacies are prioritized as well (P21, 2019, 2015; Trilling & Fadel, 2009). Standards and assessments, curriculum and instruction, professional development and learning environments are addressed as critical elements for the effective acquisition of 21st century skills and are called support systems (P21, 2019, 2015; Griffin & Care, 2015; Trilling & Fadel, 2009).

Standards and assessments focus on content knowledge, interdisciplinary themes, high-quality standardized testing, everyday learning through feedback, and 21st-century skills competency. Curriculum and instruction teach 21st-century skills through interdisciplinary

themes, innovative learning methods, supportive technologies, and community-school integration. Professional development centers on teachers addressing new insights, project-oriented teaching, problem-solving, critical thinking, and identifying learner characteristics. Learning environments create suitable physical settings for acquiring 21st-century skills through real-world contexts, architectural design, and facilitating face-to-face and online learning (P21, 2009).

Despite the emphasis on significance of 21st century literature, an independent course curriculum focusing on teaching how to teach them remains as a need as the previous research seems to lack it apart from some project-based suggestions on how to include 21st century skills into the curriculum (Martinez, 2022; Pearlman, 2010; McTighe & Seif, 2010). Examining the studies on 21st century skills, most of the studies were found to focus on just one or a few aspects of the skills. Definition and review of the skills (Kain et al., 2024; Karaca-Atik et al., 2023; Pahmi et al., 2022), studies on perceptions towards 21st century skills (Erol, 2021; Anagün et al., 2016; Göksün & Kurt, 2017; Bozkurt & Coşkun, 2018; Gömleksiz et al., 2019), digital literacy (Karakoyun, 2014) and learning and innovation (Atalay, 2015) and creative skills (Dilekçi & Karatay, 2021) were the scopes of some studies. As for some other studies worth mentioning, Anwar and Umam (2023) focused on the implementation of 21st century independent learning curriculum in their study and found out that incorporating 21st century skills into curriculum supported students' learner autonomy, collaboration skills, and critical and creative thinking skills. In another study, St. Louis et al (2021) found out that utilizing 21st century skills in project-based learning settings would help learners develop communication, collaboration, problem solving and critical thinking skills.

Despite the paramount importance of 21st century skills for students, no comprehensive and independent undergraduate course curriculum development study was discovered either in Turkey or internationally that addresses the teaching of these skills. Consequently, following the methodologies of curriculum development that commence with needs analysis, a course specifically designed to instruct prospective teachers on how to effectively impart 21st century skills was developed considering the following research questions outlined in this study: (1) Is there any need for an undergraduate course aiming at teaching how to teach 21st century skills? (2) What are the requisites for the development of an undergraduate course on teaching how to teach 21st century skills? (3) What are the requisites for the implementation of the course to be developed? (4) What is the impact of the developed course on prospective teachers?

METHOD

The mixed method research design was employed as the primary research model. In cases where quantitative or qualitative research methods are not sufficient alone, the use of quantitative and qualitative methods together can positively affect the validity and reliability results of the data (Punch, 2014; Creswell, 2013; Yıldırım & Şimşek, 2013). In this study, the research was conducted in four stages. The first two of these stages consisted of the need's identification and analysis stages. In the third stage, desk-based design and pilot implementation of the course curriculum was carried out referring to the literature and the needs analysis. In the fourth stage, the final version of the course program was implemented. In this stage, "The Scale for Identifying Perceptions of Having 21st century skills" (Durmuş & Güven, 2023) developed within the scope of the study was applied to the pre-service teachers as pre-test and post-test to see the effect of the course on the pre-service teachers before and after the implementation. Research model of the study is shown in Figure 2.

This study involved 18 teacher educators from five state universities and 73 sophomore students studying at faculty of education at a state university in Türkiye. Academicians were identified through snowball sampling which is a nonprobability sampling technique that allows researchers reach the required information in a detailed way (Patton, 2014; Yıldırım & Şimşek, 2013). Prospective teachers were identified through convenience sampling that is also a nonprobability technique. The number of participants and their roles in the data collection procedure are presented in Table 2.

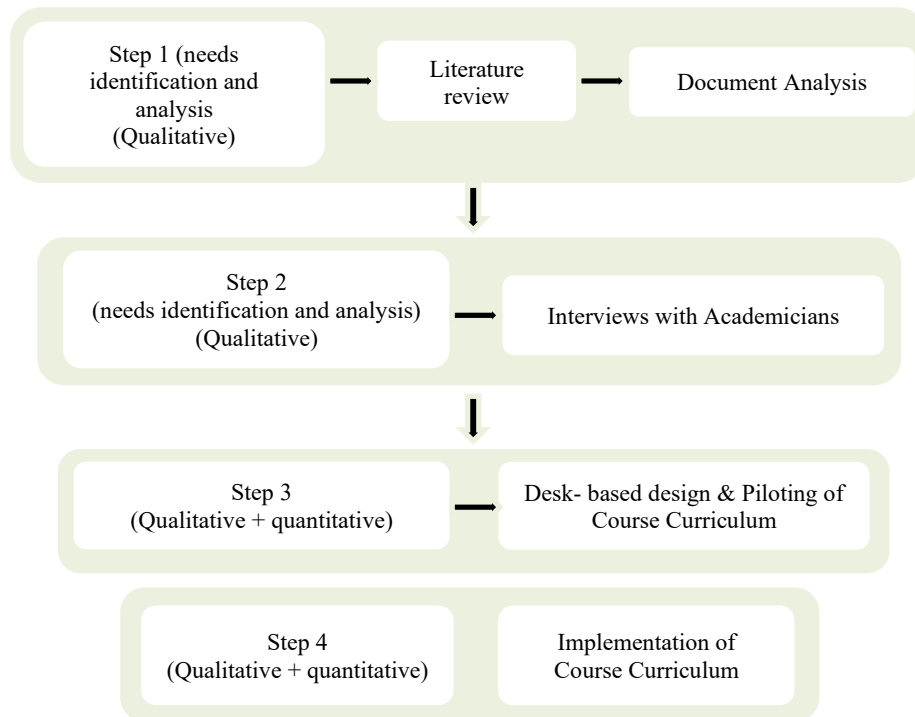


Figure 2. Research Model of the Study

Table 2. Participants of the study and their roles in the data collection process

Group	Participant	n	Type of participation
1.	Academicians	18	Participants of semi-structured interviews in needs analysis step
2.	Prospective teachers	56	Participants of the pilot implementation
3.	Prospective teachers	17	Participants in the actual implementation

Data were collected at a state university in Türkiye in the 2018-2019 and 2019-2020 academic years. Relevant national literature was reviewed to identify and analyze content addressing 21st-century skills in the General Competencies for Teaching Profession and Educational Sciences Basic Competencies in National Qualifications Framework for Turkish Higher Education. European Credit Transfer and Accumulation System (ECTS) web pages of Türkiye universities were visited to find courses directly related to 21st-century skills in education faculties. The contents of these courses were examined. International literature was reviewed to find courses directly related to teaching 21st-century skills for prospective teachers.

Semi structured interviews were developed and conducted with the academicians as another part of needs identification to get their views on their understanding of 21st century skills, existing situation of prospective teachers in terms of having 21st century skills and whether a course on teaching how to teach 21st century skills was needed from their perspectives. Names of participants were concealed using codes ACA+number for academicians and STU+number for students. The interviews were audio recorded and meanwhile some important points were noted down by the interviewer. The transcriptions were revisited by two experts filling in the transcription control form and the consistency between them was calculated by the formula suggested by Miles and Huberman (1994).

Considering the document analysis and scholarly perspectives, an instructional course focused on acquiring 21st-century skills was developed. The desk-based design was based on needs identification and previous research. A 12-week pilot implementation was tested in the fall semester of 2019-2020. An expert observed the pilot and kept diaries. The researcher also kept diaries for data revision. Semi-structured interviews were held with ten volunteering prospective teachers. The other participants were asked to express their opinions on the course's

implementation through a feedback form. Data from diaries, interviews, and feedback forms was used to revise and finalize the course for implementation.

Quantitative data of the study were collected through “The Scale for Identifying Perceptions of Having 21st century skills” (Durmuş & Güven, 2023) which was developed within the scope of this study as pretest and posttest during the actual implementation of the course. The scale, employing a three-factor structure, comprised 19 items. Cronbach’s Alpha reliability coefficients for the pretest and posttest were 0.90 and 0.91, respectively.

Besides, the course was implemented for 12 weeks in the spring semester of the 2019-2020 academic year. Due to the Covid-19 epidemic, the last six weeks were conducted online through the university’s learning management system, utilizing Zoom®, Teamline®, and Whatsapp® for live lessons, messaging, video chat, and group talks. Online lessons were recorded and shared on YouTube®. Semi-structured interviews were conducted with ten volunteering teacher candidates to evaluate the course after implementation. Researcher and observer diaries were maintained to gather feedback during the pilot implementation.

Qualitative data obtained from document review, semi-structured interviews and diaries were categorized into themes that were created in accordance with relevant literature and analyzed through descriptive analysis. Yıldırım and Şimşek (2013) defined descriptive analysis as the process of summarizing and interpreting data considering predetermined themes. Data gathered from the themes were analyzed in terms of frequency of the inclusion of 21st century skills in the teacher competencies of the MoNE, National Qualifications Framework for Higher Education (NQF-HETR), and in the course contents of the teacher education programs. Whether the statements found in the documents were related to the themes created were checked by two experts from the field of curriculum and some of the statements were rematched with the themes.

Semi-structured interviews were analyzed through the inductive approach by using the steps suggested by Thomas (2006). Accordingly, audio recordings were transcribed, analyzed in terms of themes, and related themes were gathered. To guarantee the reliability of the process, two experts in qualitative research independently verified the data by listening to the audio recordings and reviewing the transcripts. The reliability was analyzed by applying the “Consensus / (Consensus + Disagreement) formula proposed by Miles and Huberman (1994) and was found to meet Miles and Huberman criteria in terms of internal consistency and reliability.

Researcher and observer diaries kept during the pilot implementation were analyzed in terms of frequency regarding the themes created for them. Besides, data gathered from the pre-test and post-test findings were analyzed through Wilcoxon signed-ranks test, one of the nonparametric statistics suggested for the samples lower than 30 (Karadavut, 2020; Mascha & Vetter, 2018; Büyüköztürk, 2016), to find out the significance of difference.

This study was developed from the doctoral dissertation of the first author, titled “A course design and its implementation for teacher candidates aiming at teaching of 21st century skills” under the supervision of the second author. The research was carried out under the permission of the ethics committee of the university and was supported by the university as a scientific research project.

FINDINGS AND DISCUSSION

Findings

A need for an undergraduate course for teaching how to teach 21st century skills

First of all, the competency statements in the MoNE General Competencies for Teaching Profession, National Qualifications Framework for Higher Education in Türkiye (NQF-HETR) and in the courses considered to be related to 21st century skills were identified. Then, those statements were gathered in a table referring to skills in P21’s framework. The P21 21st century skills and their sub dimensions were utilized as themes in this section. Findings are shown in Table 3.

Table 3. Number of statements that include 21st century skills in teacher competencies, NQF-HETR and ECTS pages of universities

MoNE Teach. Comp. NQF- HETR Universities	Total Number of statements	21 st century skills											Total
		Learning and Innovation			Information Media and Technology Literacy			Life and Career					
		Creativity and Innovation	Critical Thinking and Problem Solving	Communication and Collaboration	Literacy Information	Media Literacy	ICT Literacy	Flexibility and Adaptability	Initiative and Self- direction	Social and Cross- cultural Skills	Productivity and Accountability	Leadership and Responsibility	
MoNE Teach. Comp. NQF-HETR	65	2	2	4	1	0	2	2	3	4	3	6	29
UNI1	34	2	4	3	3	1	1	2	2	1	2	3	24
UNI2	33	1	4	3	1	0	1	0	5	2	1	6	24
UNI3	35	0	2	2	1	1	1	0	1	2	0	1	11
UNI4	15	0	1	0	1	0	1	0	0	0	0	0	3
UNI5	5	1	1	0	1	0	1	0	1	0	0	1	6
UNI6	13	1	0	2	0	0	1	0	4	0	0	1	9
UNI7	20	1	1	3	0	0	1	0	0	2	1	1	10
UNI8	15	1	3	1	0	0	1	0	2	2	0	3	13
UNI9	6	0	1	1	0	0	0	0	1	0	0	2	5
UNI10	15	1	4	2	0	0	1	0	1	2	0	2	13
UNI11	16	2	3	0	0	0	0	0	2	0	0	0	7
UNI12	18	1	0	1	1	0	1	0	2	2	1	2	11
UNI13	39	3	3	3	6	0	1	0	0	1	2	5	24
UNI13	31	2	3	1	1	1	1	0	1	0	3	4	17
TOTAL		18	32	26	16	3	14	4	25	18	13	37	206
TOTAL	350		76			33				97			206

A total of 350 competency statements were identified, with 206 pertaining to 21st century skills. Life and career skills had the most statements (n=97), followed by leadership and responsibility (n=37) and life and career skills (n=76). Critical thinking and problem-solving skills had 32 statements, while media literacy had 3. These findings led to the development of a course to teach 21st century skills. Approximately 59% of statements were related to 21st century skills, supporting the rationale for a systematic curriculum to impart these skills.

Findings on semi-structured interviews conducted with academicians were analyzed in the order of the questions asked. First of all, academicians were asked to state their opinions on how much they knew about 21st century skills and to what extent they included 21st century skills in their courses. All of the participants (n=18) stated that they had read at least two or three academic articles on 21st century skills and were all aware of the significance of the skills. For example, ACA1 stated his opinion as, “21st century skills are indispensable in today’s education systems.” ACA5 stated his opinion as “they should be what we are responsible for thinking”. On the other hand, ACA11 stated her opinion with some reservations as, “I know 21st century skills are quite important but do we have those skills as teachers?” this question was another key point for the rationale behind the present study.

As for to what extent they included 21st century skills in their courses, 14 of the participants stated that they partially and spontaneously included 21st century skills in their courses although they were not specified in course objectives. Three academicians stated that they systematically included the skills both in course objectives and content. For example, ACA2 stated that he prioritized social skills in all of his lessons and focused on entrepreneurship, collaboration and communication almost every time. ACA8 stated her opinions as, “Actually it depends on the course. I don’t systematically focus on this or that skill but I try to have them take initiatives, become independent learners, think critically and collaborate others and the most

important become ethic citizens.” ACA6 stated her opinions as, “You know higher education programs do not cover those skills enough. It is our own initiative to include them in our courses. However, the teachers do not have enough knowledge on how to include them and which to include. I feel myself lucky as I know about the skills and I try to focus on creativity and critical thinking, problem solving skills, leadership skills, ethic values and certainly, the digital skills.” It can be concluded from those findings that although academicians were aware of the necessity of teaching 21st century skills to their students, a systematic content and approach to teach them would be more comprehensive and supportive.

In addition, Academicians also gave their opinion on whether prospective teachers were equipped with 21st century skills. Findings are presented in Table 4.

Table 4. Opinions of academicians on pre-service teachers' possession of 21st century skills

Pre-service teachers' possession of 21 st century skills from the perspectives of academicians	f
They don't have	8
Partially have	8
They have	1
Total	17

As evident in Table 4, a significant portion of academics indicated that pre-service teachers lacked or possessed only partial 21st century skills (n=8 for both groups). Notably, one participant asserted that they possessed sufficient such skills. One of the participants expressed his opinions as,

“I really can't understand them sometimes. You know, when you look from away, they seem like equipped with all those skills. They seem good with technology, they seem express themselves well but when you talk a couple of words, you see they turn out to be an illusion as being nothing. Can't utter a couple of words correctly, can't defend their rights, and the most terrible they are over and over self-confident” (ACA4).

This statement serves as the summary of the opinions of other academicians. Another academician emphasized students' partially having those skills as,

“The seem to have technology skills but just some basic skills. They are really terrible at taking initiative and problem solving. They are all still spoon-fed kids of their parents” (ACA9). The teacher who stated them to have 21st century skills expressed her opinions as, *“In fact they have those skills, they are equipped with creativity and problem-solving skills for example. However, they don't know how to use them correctly”* (ACA16)

Regarding the assessment of the necessity of a course designed to impart teaching methodologies pertinent to the 21st century, twelve participants indicated a perceived demand for such an educational program. Conversely, two academics expressed reservations and proposed the integration of relevant activities within an existing course curriculum. Three additional academics concurred that such a course was not deemed necessary. ACA5 stated his opinions as,

“If you can develop an applied and interdisciplinary course, it would be nice. We need such a course but if you are going to develop a course similar to the existing ones, namely, full of theory, it won't have an impact. It should be practical, otherwise no need.”

ACA3 stated her opinions as:

“There is definitely a need for such a course. I mean, this is an indisputable fact. However, it needs to be very fine-tuned. It is important that it is practice-oriented and brings different disciplines together in cooperation. For example, in our field, whether it is life science teaching, social studies teaching, mathematics, science teaching, it is important to ensure that children will acquire the skills required by the program in the teaching and learning process as well as the teaching of this course you will design.”

On the other hand, ACA14 stated his reservation on developing such a course as,

“I don’t think solution is a new course. We always make the same mistake. Opening a single course will not solve the problem alone. It will cause other teachers not to focus on skills as there is a course of them. It might cause a resistance on students towards the skills.”

Overall, results from document analysis and interviews revealed the paramount significance of 21st century skills. However, both analyzed documents and interviews indicated that these skills were not imparted systematically, and pre-service teachers lacked training in their effective teaching methods for 21st century skills. Consequently, it was concluded that a specialized course on teaching 21st century skills was necessary. Such a course would equip future teachers with a comprehensive understanding of their own skills and provide them with the necessary training to effectively teach 21st century skills to their students in the future. Therefore, the design and development of a practical course addressing interdisciplinary content was deemed essential to support teacher candidates in developing their own 21st century skills and acquiring the knowledge and skills to effectively teach them to their students.

The requisites of design and implementation of the developed course; “Teaching of 21st century skills”

Based on the findings of needs analysis, curriculum design approach was tailored primarily, and “Teaching of 21st century skills” a student-centered course based on modular design approach, following the principles of progressivist philosophy and constructivism was developed.

Modular approach allows teachers develop their contents suitable for various activities and interdisciplinary themes (Ambayon, 2019; Nardo, 2017). Taking the suggestions of participant academicians and experts in desk-based design, the course was decided to be structured withing the principles of modular approach. Accordingly, a student-centered course consisting of 4 modules each of which has its own objectives, content, learning-teaching process and evaluation was designed by following the stages similar to the ones of the SUPSKY curriculum design model developed by Selvi et al. (2016) and Schooling by Design (SbD) Model by McTighe and Seif (2010). SUPSKY curriculum design model has three main steps: planning, desk-based design, evaluation, and development, and pilot experiment. After these stages, the curriculum is ready for dissemination. As a bottom-up model, SbD shapes curriculum for teaching and learning of 21st century skills within the light of five questions: 1) Does our school or district mission include 21st century skills? 2) What principles of learning will guide our educational practices? 3) How will we design a coherent curriculum and assessment system to integrate 21st century outcomes? 4) How should we teach to achieve 21st century outcomes? 5) What policies, school structures, and resource allocations are needed to support the development of 21st century outcomes? (McTighe and Seif, 2010; p.150)

The course was designed in two-dimensional structure. The first dimension aimed to raise consciousness of pre-service teachers on 21st century skills. The second dimension was to train pre-service teachers on how to teach the skills. Both models have similarities in terms of developmental steps, however, SbD Model particularly focuses on how to develop 21st century skills of students. Therefore, the course was primarily structured based on the abovementioned questions of SbD Model. Developmental steps and overall structure of the course are shown in Figure 3.

The desk-based design of the course was sent to three experts who specialized in curriculum development. Based on their suggestions, the design of the course was finalized for pilot implementation. The course consisted of four modules with their own objectives and content regarding the type of 21st century skill they will focus on. Skills in P21 Framework were taken into consideration as this framework is among the mostly referred ones in literature.

The course was planned to have four overall objectives, and each module had its own objectives. The overall objectives of the course were formulated as “at the end of the course, prospective teachers will be able to (1) have at least basic knowledge about what 21st century skills are, (2) employ 21st century skills in their daily routines, (3) teach 21st century skills to their students, and (4) make reflections on their learning and teaching process.” The first module of this course aimed to provide pre-service teachers with the necessary theoretical background

and basic knowledge about 21st century skills and the 21st century frameworks in literature in a wholistic perspective. The second module focused on teaching learning and innovation skills. The third module aimed at the teaching of information, media and technology literacy skills, and the fourth module focused on teaching of Life and Career Skills.

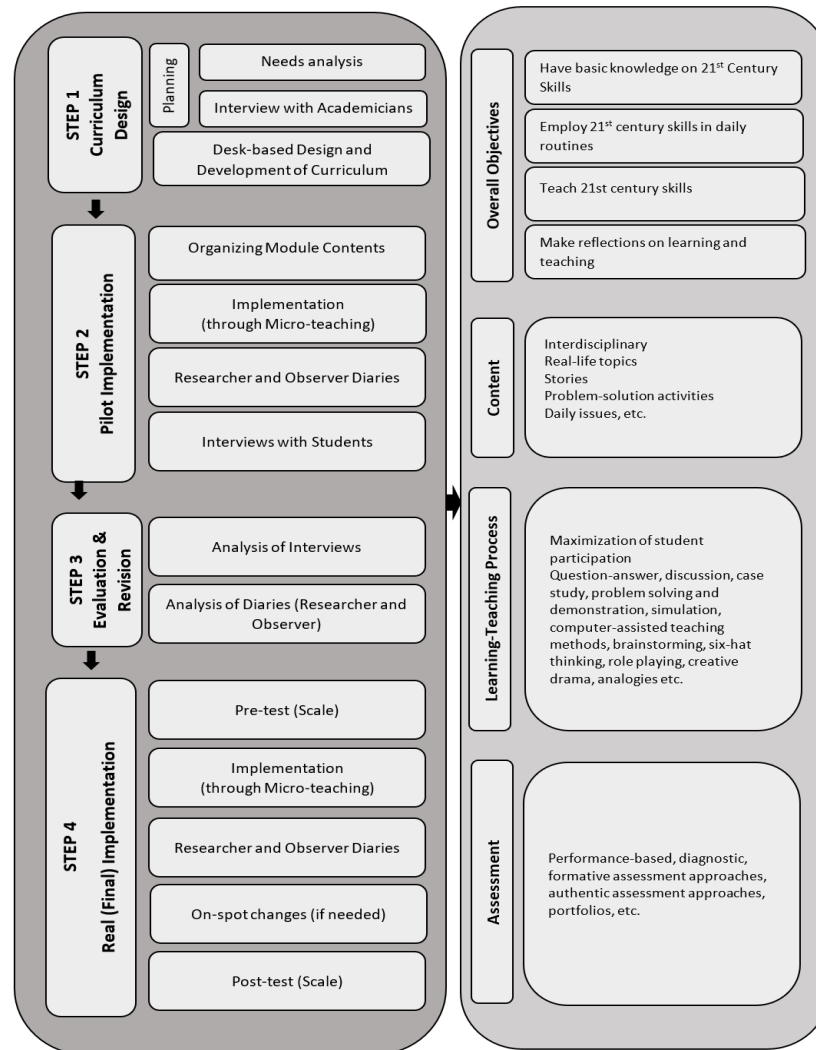


Figure 4. The Development Steps and Structure of the Developed Course

As stated by Nieveen and Plomp (2018), “the character of twenty-first century skills is such that learning can no longer be seen as the pure transfer of knowledge and skills, but it has to be viewed as a process in which students actively develop their knowledge and skills.” Thus, The course content was designed to actively build students’ skills through interdisciplinary, real-life topics like global issues and cultural diversity, shaped by participant input. During the learning-teaching process, lecturing, question-answer, discussion, case study, problem solving and demonstration, simulation, all of the computer-assisted teaching methods and brainstorming, six-hat thinking technique, role playing, creative drama and analogies were used as appropriate. In this process, the teacher (the researcher) tried to support the students as a guide and mentor in structuring the new knowledge they acquired. The classroom environment was tried to be made as flexible as possible, where students could express themselves easily and reveal their 21st century skills.

Drawing from the course implementation, several guiding principles emerged for effectively teaching 21st century skills. First, the course should be rooted in a constructivist philosophy, allowing students to apply what they learn in meaningful ways. It should also be learner-centered and encourage active participation. Flexibility in teaching strategies is essential,

enabling instructors to respond to classroom dynamics using a variety of methods. Importantly, instructors must not only be skilled but also serve as role models in demonstrating these competencies. To enhance learning, instruction should incorporate real-world examples, such as case studies, stories, and multimedia, and accommodate diverse learning styles. Even theoretical modules can be made engaging by integrating activities that align with students' interests, like online competitions or documentaries. For hands-on components like micro-teaching, it's important that activities are tailored to specific audiences and aligned with broader course objectives. A strong feedback loop is vital: instructors should provide written feedback on lesson plans before they are delivered and facilitate reflective discussions after each micro-teaching session, ideally supported by video recordings. Finally, teaching these skills is most effective when it connects to real-life topics and is supported by digital tools and platforms such as Socrative, Projeqt, or TED-Ed.

As an effective teaching technique that enables pre-service teachers to transfer their knowledge and skills into practice, micro-teaching was planned to be the main technique during the implementation process. It helps teacher candidates gain experience by trying various skills, improving their research skills, increasing their self-confidence, coping with stress, making reflections and increase deeper knowledge on art of teaching (Ledger & Fischetti, 2019; Reddy, 2019; Elias, 2018; Güven, 2015). Pre-service teachers were asked to plan and apply micro-teaching activities on the targeted 21st century skill in the second, third and fourth modules of the course.

In designing the assessment tools and processes for the course, emphasis was placed on enabling prospective teachers to reflect on their own performance and ensuring that the evaluation methods aligned with the course objectives. A variety of assessment techniques were incorporated to enrich the evaluation process. Student performance was assessed using a combination of process-based, performance-based, diagnostic, formative, and authentic approaches. To ensure transparency and a well-rounded evaluation of competencies, students were informed about all assessment components at the beginning of the course. The final grade was determined through a balanced mix of project work, performance tasks, and written exams, with a key emphasis on process-based assessment making up at least half of the total score. Each student was required to compile a performance portfolio, which included lesson plans, self-assessment forms completed after lessons, and reflection reports from micro-teaching sessions. Written exams were designed to be contextually rich, featuring authentic texts, anecdotes, or case studies, and the questions were crafted to encourage analysis that demonstrated mastery of 21st century skills. To maintain objectivity and clarity, every assessment item was accompanied by a rubric developed from a detailed table of specifications. Throughout the assessment process, the instructor played a supportive role, acting as a mentor and guide to help students grow and develop their competencies effectively.

The pilot implementation of the course spanned twelve weeks and was documented through twelve researcher diaries and nine observer diaries. The researcher diaries primarily highlighted areas such as student engagement, aspects needing improvement, micro-teaching practices, lecture delivery, presentation quality, and instructional methodology. Observer diaries were analyzed across three main themes: feedback, implementation, and content. Feedback-related notes included suggestions on how to better guide students, manage time effectively, and address theoretical components. Observations on implementation focused on skill development, micro-teaching activities, and promoting diversity in classroom practices. Content-related feedback emphasized the structure of presentations and the teaching methods employed. All issues and suggestions identified during this phase were promptly addressed and integrated into the final version of the course for its actual implementation.

Semi-structured interviews conducted with the prospective teachers at the end of the pilot implementation revealed that they did not have enough knowledge or awareness about 21st century skills prior to the course. One of the participant students stated his opinion as,

"I remember reading about them once in a social media post, but I didn't know this much detail about them prior to the course" (STU3).

Three prospective teachers interviewed stated they lacked knowledge of 21st-century skills before the course. Two participants (STU5 and STU7) found the course beneficial, learning and valuing the skills. All participants expressed awareness of the need to incorporate 21st-century skills in their future lessons. When asked for suggestions, they all praised the course as almost perfect. Five participants indicated they might not include 21st-century skills in their future lessons without the program. The pilot implementation unveiled the points to be improved. The program was revised and finalized for actual implementation. To illustrate, contents and time allocations for some activities were revised. The actual implementation was conducted with 17 primary school teacher candidates and lasted 12 weeks. However, last six weeks had to be covered online due to Covid-19 pandemic. To find out the impact of the designed course in terms of the perceptions of candidate teachers, the Scale for Identifying Perceptions of Having 21st century skills was applied as a pretest and posttest prior to and after the actual implementation of the course. Findings are shown in Table 4.

Table 4. Pre-test and post-test means and standard deviations of skill groups

21 st century skills	Pre-test		Post-test	
	$\bar{X}$	sd	$\bar{X}$	sd
Life and career skills	3.72	0.50	3.62	0.65
Information, media and technology skills	3.71	0.41	3.98	0.59
Learning and innovation skills	4.06	0.66	4.31	0.50

Note: N = 17

As seen in Table 4, pre-service teachers had perceptions of having skills well above the average range limits (2.61-3.40) both in pre and post-test. However, the post-test mean score of life and career skills was below the pre-test results. The highest mean value in both tests was found in learning and innovation skills (pre-test: 4.06, post-test: 4.31) and the lowest mean value was in life and career skills (pre-test: 3.72, post-test: 3.62). In order to determine the significance of the difference between the pre-test and post-test findings, Wilcoxon signed-ranks test was applied. The results of the Wilcoxon signed-rank test are presented in Table 5.

Table 5. Wilcoxon signed-rank test findings for the pre-test and post-test results

Post-test - Pre-test	N	Mean Rank	Rank Sum	z	p
Negative Ranks	7	7.14	50.00	-.933	.351
Positive ranks	9	9.56	86.00		
No difference	1				
Total	17				

Note: $p < 0,05$

Wilcoxon signed-rank test results showed no significant difference between pre- and post-test scores ($z = -0.933$, $p = 0.351$). The high pre-test scores of the pre-service teachers likely contributed to this. However, the post-test averages of 9 teachers were higher than the pre-test averages. This suggests the course positively impacted pre-service teachers' perceptions of 21st-century skills. Lower post-test scores can also be considered a positive effect, reflecting students' increased awareness and knowledge gained from the program.

Discussion

Findings of present study revealed that despite the significance of 21st century skills in various official documents and in relevant literature, an independent course purely focusing on how to teach them did not exist neither in Türkiye nor in other countries. Thus, designing a course on teaching how to teach 21st century skills was considered a need, and constituted the basic rationale for this study.

21st century skills are accepted to be significant teacher qualities that find their place in teacher competencies in studies on professional development of teachers (Alan & Güven, 2022; Petrunin, 2019), and teachers are recommended to develop themselves in 21st century skills and use the skills in educational activities (Voinea, 2019; Faulkner & Latham, 2016). Teachers who

will provide students with 21st century skills are expected to have those skills. As stated by Lamb, Maire and Doecke (2017), despite the existence of diverse learning frameworks and suggestions to integrate 21st century skills into their curricula, and the implementation of certain regulations in teacher training and professional development to foster these essential skills, the empirical evidence demonstrating a widespread and successful transformation of classroom practice and assessment remains inconclusive. The significance of 21st-century skills in teacher competencies specified by MoNE and the NQF-HETR has been emphasized, but no school system has been developed to teach these skills. Therefore, the study found the need for an instructional course to impart 21st-century skills. As a preliminary step, a course was developed to help prospective teachers acquire or enhance their existing skills, followed by instruction on effective teaching methods for imparting these skills.

Teachers teaching 21st-century skills should have knowledge and competence in these skills, as evidenced from interviews with academics and opinions of pre-service teachers. As stated by the Partnership for 21st century (2009), who designed the P21 framework, teachers themselves need to have basic competencies in these skills to integrate them into the curriculum and put them into practice through classroom implementations. Findings from the semi-structured interviews conducted with academicians and pre-service teachers revealed that pre-service teachers needed consciousness raising in 21st century skills. They were found to be weak particularly in taking enough initiative, being creative, in critical thinking and problem solving. These findings overlap with the findings of Lundeberg (2016) as he also stated that students were not at the desired level in many 21st century skills. From this perspective, the course required a theoretical background in 21st-century skills, so the first module focused on that. This aimed at giving pre-service teachers in-depth knowledge about the skills they'd teach. The study's findings supported this, as the literature criticized the insufficient theoretical background and pedagogical approaches in teaching 21st-century skills, especially in teacher education, suggesting an inductive approach (Chalkiadaki, 2018; Häkkinen et al., 2017). In addition, it is believed that an education carried out from this perspective, as emphasized by Moyer (2016), will enable students to learn skills in a more effective, practical and permanent way.

The course aimed to provide preservice teachers with skills suggested in P21 framework (P21, 2005; 2009) including innovation, critical thinking, creativity, problem solving, communication, collaboration, ICT literacy, flexibility, accountability, respect for different cultures, lifelong learning and leadership skills and to make them become able to address them in a flexible, user friendly and interdisciplinary course medium. The curriculum design models, SUPSKY (Selvi, et al., 2016) and The School by Design model (Mctighe & Seif, 2010), used in this study were found to be helpful for the acquisition of 21st century skills in terms of the approach they addressed as they both are step by step, detailed and flexible. Moreover, the objectives of the designed course aligned with the suggestions made by Siregar, Fauzati and Marmanto (2020) as they suggested that 21st century-teacher education should focus on teaching skills such as creativity, ICT literacy, communication and self-regulation more than the content.

21st century skills are strongly suggested to be taught in interdisciplinary learning environments (Brassler & Dettmers, 2017; Lamb et al., 2017; Holzer, et.al, 2018). They can match different subject areas. The designed course, based on interdisciplinary interaction, enables teachers to use content from various subject areas, leading to collaboration and corporate with other colleagues. Its modular and flexible structure provides pre-service teachers with different simulations in different modules to teach 21st-century skills and apply them in any course with the same objectives and outcomes. Preservice teachers transferred knowledge and outcomes from other courses into micro-teaching activities during the course implementation.

Ledger and Fischetti (2019) found micro-teaching to be an effective diagnostic tool to identify specific needs of pre-service teachers for making them ready for real-life conditions. Including micro-teaching in the designed course was one of the positive aspects of it. Positive opinions of almost all the preservice teachers on micro-teaching support this as well. It was observed in the study that micro-teaching helped candidate teachers increase their teaching skills practically and gain self-confidence particularly in terms of speaking or lecturing in front of others. Findings of the research overlap with the findings of the studies conducted by Nasution

et.al. (2023), and Karadağ and Akkaya (2013) as well. Both studies revealed that microteaching had a positive impact on pre-service teachers, enhancing their confidence, experience, and teaching methodology. This included lesson planning, effective teaching, communication, and classroom management skills. Elias (2018) found out that micro-teaching helped professional development of pre-service teachers in terms of designing, developing and promoting experiential learning projects. As for the present study, the teacher candidates prepared their own contexts referring to the 21st century skill they focused during the micro-teaching process. It is considered to contribute to their prospective professional development in terms of the points stated by Elias (2018).

The post-test scores showed a positive trend in all skill domains except life and career skills, though no statistically significant difference was found. Both test averages exceeded the average across all skill categories. However, pre-service teachers interviewed lacked comprehensive knowledge of the skills before the course. The non-significant results can be attributed to the high mean scores of both assessments. The high pretest scores may be due to pre-service teachers' misconceptions about 21st-century skills. Lower post-test scores in life and career skills may be due to their complexity. As teachers' knowledge expanded, their awareness increased, leading them to articulate their perspectives more effectively in the post-test. Findings of the study were like the studies conducted by Arnandho and Sutheejariyawattana (2022), Suprapti, Nugroho & Pembangunan (2021) and Cığerci (2020), in terms of the increase in 21st century skills of the teacher candidates after the implementation of various courses through online teacher education program on self-directed learning, on flipped learning, and digital story telling. Deriving from the findings from the literature and the present study, it can be said that the program fostered a positive change in teacher candidates.

The unexpected COVID-19 pandemic forced researchers to take new actions during the research process, and last six weeks of the study had to be conducted through distance education from synchronous and asynchronous platforms. In fact, the study revealed that this problematic period turned into an advantage in terms of witnessing the effective implementation of the course and the ICT skills. Flexible structure of the program helped the distance education process to be carried out smoothly. As stated by Coscullueala et.al. (2021), the more various learning opportunities and tools were addressed the more successful such programs would be. The effect of pandemic was also asked by the pre-service teachers in semi-structured interviews. They stated that they had the opportunity to reinforce their information, media and technology skills in terms of technological pedagogical skills in teaching of 21st century skills. This was like the findings and suggestions of Kimav and Kürüm-Yapıcıoğlu (2021) and Shafie, Majid and Ismail (2019) in terms of involving techno-pedagogical skills in development of 21st century skills. Ong and Annamalai (2023) stated some of the 21st century skills such as creativity, communication, critical thinking and collaboration as the missing part in techno-pedagogical curricula. The distance education focused on not only ICT skills of the teacher candidates but also other 21st century skills in a comprehensive approach having them apply the skills in their classes in a way that they would overcome a common misbelief of perceiving 21st century skills just as digital skills, and this aim can be said to be achieved.

CONCLUSION

In summary, based on the review of previous research and findings of the present study, the current investigation indicates a pressing need for an independent course dedicated to the instruction of 21st century skills for prospective teachers. This course would not only enhance their ability to effectively impart these skills to their future students but also foster their awareness of these skills and their practical application in both academic and non-academic settings. For all those reasons the course named, "Teaching of 21st century skills" was developed. The course was implemented with a limited group of students. Implementations with different groups and contents will contribute to the improvement of the course in further studies. Moreover, the course can be modified and applied to the teachers as an in-service training tool for helping them raise awareness in terms of teaching 21st century skills in further studies.

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