An Action Research for Developing 21st-Century Learning Activities Design Skills of Elementary Teacher Candidates

Sevil ORHAN OZEN [1]

[1] sevil.orhan@usak.edu.tr, ORCID: https://orcid.org/0000-0003-1991-4964, Usak University, Usak, Turkey.

To Cite: Orhan-Özen, S. (2022). An action research for developing 21st-century learning activities design skills of elementary teacher candidates. *Malaysian Online Journal of Educational Technology, 10*(3), 166-188. http://dx.doi.org/10.52380/mojet.2022.10.3.353

ABSTRACT

The aim of this action research is to develop the skills of elementary teacher candidates in designing 21st-century learning activities. Action research, one of the qualitative research methods was applied in the study. Some criteria were determined and the applicability of the criteria were tested by the participants. Data were collected from two groups in two different education terms. The criteria sampling method was used for determining participants. The first group has 52, while the second group has 42 elementary education teacher candidates (ETCs). A rubric to design learning activities was created with ETCs in the first term and they applied them as a performance homework. In the second term, ETCs experienced by applying revised rubric to design 21st-century learning activities. They also fulfilled a self-assessment form to tell their experiences. Collected data were analyzed document analysis, descriptive analysis, and content analysis methods. Findings indicated that ETCs have developed professional and personal skills by designing 21st-century learning activities.

Keywords: 21st-century, learning activity, personalized learning, action research

Article History:
Received: 22 September 2021
Received in revised form: 29 December 2021
Accepted: 30 January 2022
Article type: Research Article

INTRODUCTION

The development and advancement of technology necessitate both the individuals who learn and those who teach to have some knowledge, skills, and competencies. However, they should also update their skills and competencies within the framework of new technological developments. The change in individual characteristics leads to the change and evolution of learning style, learning process, learning environment, and learning activities in many ways. Defining the characteristics of education stakeholders is important in guiding this change and transformation (Callison & Lamb, 2004). Students who are born in today's technology culture and raised in this cultural environment and teachers who will appeal to these students are called "21st-Century Students and Teachers"; whereas the skills and competencies that 21st-century students and teachers should acquire to become effective citizens in the information society are called "21st- Century Skills" (Annaniadou & Claro, 2009, p. 8).

21st-century skills can be grouped broadly under six headings: collaboration, communication, information, and communication technology literacy, socio-cultural skills and citizenship, creativity, critical thinking, problem-solving, and good-quality product development (Van Laar, Van Deursen, Van Dijk & De Haan, 2017; Voogt & Roblin, 2010). Within the scope of the 21st-century Learning Partnership (P21, 2019), a strategic education project supported by 33 institutions in 21 states of the United States, 21st-century student skills are grouped under three main headings: "learning and innovation skills'', "digital literacy skills'' and "career and life skills". In another study, 21st-century student characteristics include cognitive skills under the sub-themes of non routine problem solving, critical thinking, and systems thinking; interpersonal skills under the sub-themes of complex communication, social skills, teamwork, cultural sensitivity, and dealing with diversity; and intrapersonal skills under self-management, time management, self-development, self-regulation, adaptability, and executive functioning sub-themes (National Research Council, 2011).

The International Society of Educational Technologies (ISTE) summarizes the characteristics of 21st-century's digital age students in seven basic standards, each consisting of four sub-standards, as follows: competent student, digital citizen, knowledge builder, innovative designer, computational thinker, creative communicator, global collaborator (ISTE, 2019). The Ministry of National Education (MoNE) surveyed students, teachers, and administrators to determine 21st-century student profiles. According to the results of the research, students were generally found insufficient in many aspects such as awareness of responsibility, productivity, decision making, and problem-solving. In addition, teachers think that universal values and professional competencies, oral-written expression skills, critical thinking, research-inquiry skills are not sufficiently given to students and personal differences between students are not considered, which supports school administrators' views (MEB, 2011). However, according to a report published by the North American Council Online and Learning Center (NACOL, 2006), global awareness, self-directed learning, increased opportunities for students, increased information and communication technologies, increased problem-solving skills, individual responsibility and self-management skills are the skills that will gain importance in the 21st-century. Gelen (2017) stated that the themes of "technological development, educational environments, applied education, interactive distance education, directing, access to information/information source, globalization/international education, exams and assessment and evaluation, commercialization and economics, culture-society-sociability, education system, thinking to learn skills, values education, and language education will be determinant concepts of 21st-century education.

According to a study investigating basic student skills that are addressed in the curriculum of various countries, Turkey doesn't introduce students to critical thinking, creative thinking, communication, research, problem-solving, and decision-making and learning communication technology skills in the learning process or environments, it addresses them only through curriculums (Ananiadou & Claro, 2009). For an effective learning process, it is also important to know and understand the skills and characteristics expected from 21st-century students and teachers, which are the main stakeholders of today's education system, besides the curriculums (Orhan Göksun & Kurt, 2017). In this context, it is stated that learning processes lacking the integration of technology are inadequate in responding to the expectations and needs of the digital age (Karasar, 2004). In addition, Trilling and Fadel (2009) and Wagner (2010) stated that in 21st-century learning, besides the use of technological tools and resources, the learning environment should focus on individual skills such as innovation, knowledge acquisition, and creativity. When a school, system, standards, assessment, program, or learning environments are built on these bases, students will take a more active role in the learning process and graduates will be able to succeed in today's changing world (Gelen, 2017, p. 18). In this context, MoNE (2017) expects teachers to design appropriate learning environments and use technology effectively in these environments to develop high-level individual skills of learners for the 21st-century. Teachers are expected to lead and design their learning resources and environments to guide students in solving real-world problems and understanding key concepts, to assist students

in designing activities and projects that provide research skills, to use digital environments to follow-up, manage and evaluate different student projects, to support extracurricular student communication with digital environments, to design online learning activities within the framework of competencies such as using appropriate tools and environments properly (UNESCO, 2008).

In the book titled "World School-How should the school system be built in the 21st-century", written by Schleicher (2019), educational director of the Organization for Economic Co-operation and Development (OECD), misknown myths of education and the cases that differentiate high-performance school systems are discussed. Accordingly, it is understood that choosing students according to their abilities or grouping them according to their skills is not an appropriate method for raising standards. In contrast, the basic philosophy should be to believe that all students can learn and achieve at a high level. The level of learning can be increased by in-class skill groups or temporary groups according to the subject, instead of grouping students according to their academic achievement. In this context, it is seen that high-performing countries believe that all students can succeed by working and the learning process is equipped with convenience standards instead of the difficulties arising from individual differences. For these reasons, in the 21st-century learning process, the existing standards of all students should be known well, and facilitating environments providing new learnings in line with their potential should be designed. To this end, it is important to make the best use of teachers' time for diversifying students' learning needs through differentiated teaching practices and to see them as independent and responsible professionals (Schleicher, 2019).

As mentioned above, the skills expected of teachers are addressed in many studies for 21st-century students. For example, it is recommended to develop and support the technology-literacy skills of teachers (UNESCO, 2008). However, as much as the ability to integrate technology into the curriculum, there should be important to develop teachers' skills for designing activities that integrate 21st-century skills. The studies that guide teachers in designing the learning activities based on the integration of 21st-century skills into the curriculum are rare in the literature. Today teachers and teacher candidates should be ready to design 21st century learning activities. As soon as teacher candidates are appointed they are expected from them to incorporate 21st-century skills into learning activities in their classrooms. However, they do not generally receive courses in which 21-st century skills are integrated into the curriculum at the university. Therefore, teacher education programs should prepare them for 21st-century students and the learning environment. But there has been a problem in teacher education programs in developing teacher candidates' skills in designing 21st-century learning activities. To solve this problem, this action research is aimed to develop the skills of elementary teacher candidates (ETCs) in designing 21st-century learning activities. For the aim, ETCs have enrolled in the "Instructional Technologies" course where it was highly important for a teacher education program in a state university. The action research method was used to design the course plan. In the course, ETCs were engaged to design learning activities for their 21st-century students in the future based on the following questions.

- What are the criteria that can apply by ETCs for developing 21st-century learning activity design skills?
- How and to what extent can ETCs apply these criteria?
- What are the experiences of the ETCs in this process?

RESEARCH METHOD

Research Model

In this study, participatory action research designs that are one of qualitative research design approaches were used (McTaggart, 1994). Action research is a scientific research process that focuses

on ensuring the change and development of a group of individuals in the face of a certain problem and examines individuals' practices in a systematic data collection process. Based on this process, a new action, carried out in spiral steps, is prepared and implemented (Gürgür, 2017, p. 39). According to another definition, action research is an evidence-based cyclical process in which individuals come together to define a problem and offer solutions (Kemmis & McTaggart, 2000). In this process, it is also possible to test how successful the solutions are and if the result is not satisfactory, these solutions are retried (O'Brien, 2003). To summarize, action research generally involves the systematic data collection, and analysis process of an educational institution employee or practitioner (administrator, teacher, etc.) to understand and solve an existing problem directly or in company with a researcher (Yıldırım & Şimşek, 2016, p. 307). The problem to be solved with action research in this study is to develop the skills of ETCs in designing 21st-century learning activities.

The main priority of action research is to improve the practice rather than produce theoretical knowledge. The individuals who make the application provide the opportunity to learn from the first source and put the learned into practice by directly participating in the research process. Since action research aims to directly solve a problem that exists in the real world, it brings the empowerment of individuals, cooperation, and social change (Aksoy, 2003, p. 477). For these reasons, the researcher takes part in the process as the primary person experiencing the problem. The four stages of the action research process applied in the study are as follows; planning, implementing, evaluating, and experiencing (Figure 1). These stages have been explained in detail in the section on data collection.

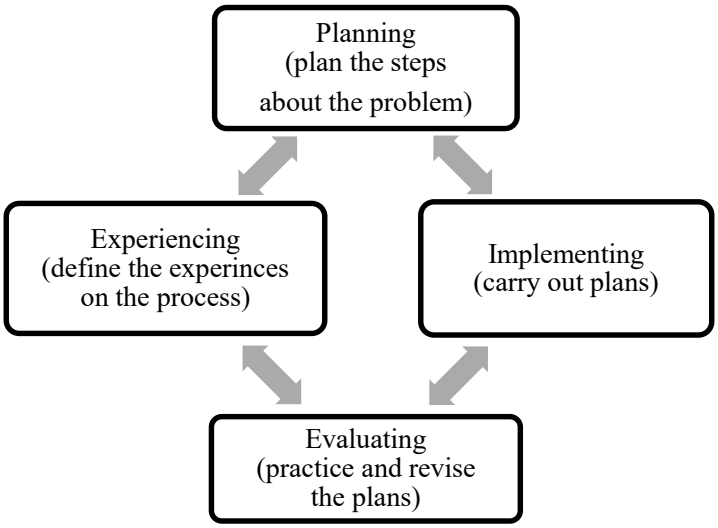

Figure 1. *Action Research Cycle in the Study* (Kemmis, McTaggart, & Nixon, 2014).

Participants

Elementary Teacher Candidates (ETCs): In the first group, 52 ETCs participated in "Instructional Technologies" at a state university, 5 of whom are foreign nationals, 39 of whom are female, and 13 of whom are male. The second group, 42 second-year ETCs participated who were in the same department the next year. Both groups were second-year ETCs taking the course of this content for the first time at the university.

Expert group: The researcher created discussion boards that include keywords about some questions after brainstorming with ETCs in the course. These questions have been given in the Table 1. The researcher then backed up each keyword with research and grouped them into a rubric that included requirements for building 21st-century learning activities. A total of four experts, two of whom were in the Department of Educational Sciences and two of them in the Department of Computer and Instructional Technologies, examined the rubric. All experts have a doctoral degree and work at a state

university. After their revisions, the researcher and ETCs used the rubric for the performance homeworks.

Role of the Researcher: The researcher acted as the instructor of the Instructional Technologies course in which the study was conducted. The researcher is a graduate of the Computer and Instructional Technologies department, undergraduate and graduate, and the Education Programs and Instruction department. In this context, the researcher is a learning designer who participates in various training such as online design thinking and online creativity, and also who gives lessons about technology integration to teachers and teacher candidates. For these reasons, it can be said that the researcher has sufficient knowledge and experience for the requirements of the relevant course. In this study, the researcher became a natural part of the process by sharing his direct views and experiences with the participants.

Data Collection

The data collection tools applied in the first group are the products, such as discussion board and performance homework, created by the ETCs and the 21st-century learning activity development rubric. A self-assessment form was used in the second group of the study. The data collection process was carried out in two stages within the “Instructional Technologies” course for two hours a week. A total implementation period of 7 weeks was followed in both stages. In the first four weeks, ETCs have discovered the features of the 21st-century learning activity. In the following three weeks, ETCs completed performance homework.

Planning

Planning, which is the first stage of action research, consists of five action plans carried out with the first group. The course was conducted by the researcher herself with the blended learning method. Table 1 shows the action plan process in the data collection.

Table 1. *Action Plan Process*

Action	Topic	Activity	Learning Product
Plan 1	Exploring student characteristics in the 21st-century	Teamwork	Drawing
		Brainstorming	Discussion board
Plan 2	Exploring teacher characteristics in the 21st-century	Teamwork	Drawing
		Brainstorming	Discussion board
Plan 3	Exploring the characteristics of learning activity in the 21st-century	Case study	Designing educational game
		Teamwork	Discussion board
Plan 4	Exploring the way to be followed to make the learning activity personal in the 21st-century	Research	Digital discussion board
		Brainstorming	Discussion board
Plan 5	Transforming 21st-century learning environment criteria and sharing with participants	Brainstorming	Criteria
		Expert Opinions	Rubric

As can be seen in Table 1, in the first action plan of the Instructional Technologies course, students are given the "What are the characteristics of the students in the 21st-century learning environment? " question has been asked. For that ETCs made a brainstorm in the groups and after they drew a picture. Each group presented the picture they drew in class. In this process, keywords for the answer to the relevant question were written on the discussion board, accompanied by the

researcher. In the second action plan, the same process was carried out for the question "What are the characteristics of the teacher in the 21st-century learning environment?".

In the third action plan, the researcher gave a case study containing as many problem situations to the groups. The groups selected a problem from the case study and developed solutions. Then the researcher showed the groups various objects such as hair bands, paper clips, pens, paper, cardboard. and asked them to choose among them. The groups designed an educational game for problem-solving by using these objects. Then each group presented their educational game in class. In this process, keywords on 21st-century learning activities were written on the discussion board, accompanied by the researcher. Figure 2 shows an example from group work.

Figure 2. *Group Work an Example From Educational Game Design*

In the fourth action plan, ETCs researched “Exploring the way to be followed to make the learning activity personal in the 21st century” before coming to class. The students uploaded their research to the digital discussion board created by the researcher. It was brainstormed on these posts, and keywords based on personalization were written on the discussion board in the classroom. In each of the four action plans, the researcher sent videos that gave perspective to the pre-class teachers to increase the quality of the discussions. In addition, the researcher supported the discussions in the lesson with the literature and enabled the students to discover the missing points. In the fifth action plan, the keywords written with ETCs were transformed into a rubric that included learning activity development criteria by the researcher. Expert opinions on the rubric were received to revise it by the researcher. So, the planning stage was completed and the implementing stage was started.

Implementing

It is the stage where the rubric created in the planning stage is applied. ETCs prepared a performance homework based on the rubric. For that, they chose a unit and outcome related to one of the Life Sciences, Science, Turkish or Mathematics courses in the MEB (2019) curriculum. After that, they develop some learning activities for their choice course and unit. In this process, the researcher and ETCs shared videos on how to use technologies that they can benefit from while developing learning activities on a digital discussion board. The aim here was to support the technology use skills of the participants during the implementation stage.

Evaluating

It is the stage of determining at which level of implementation of learning activity development criteria. In this process, the 21st-century learning activity development criteria were used by the researcher as an evaluation rubric. According to this, the rubric has three grades as "Good", "Must be Improved" and "Incomplete" and consists of 14 criteria in total. Also, the experiencing stage was determined for the application in the second group. At this point, the same criteria were addressed in the second group, but some implementation differences were made. These differences are explained during the improving stage.

Experiencing

The main purpose of this final stage of the action research is to test the sustainability of the 21st-century learning activity criteria in different participants and examine the experiences of ETCs. This stage was carried out by the same lesson and the researcher in the going term with the second group as a repetition of the first three stages. But some implementation differences were made. Because during the COVID-19 pandemic process, education was necessarily moved to distance education and the relevant course was held completely online. Although this may seem like a disadvantage, it provided an advantage in the research to support the technology use skills of the participants. In this context, the differences in the stage from the first application are as follows:

(i). The method of collaborative learning using breaking rooms was used in the online lesson.
(ii). At the end of the group studies conducted in each lesson, ETCs presented their discussion products in the technological environment. In this sense, they used technological tools more than the first group.
(iii). To increase the participation of ETCs, a method that is collecting seeds from the discussion board sharing was used. In this way, it was aimed for ETCs to be more sharing in the process.
(iv). ETCs completed a performance homework based on the criteria developed in both groups. The only difference is that the second group plays a role in improving the existing criteria, not creating them.
(v). While the participants in the first group completed the performance homework individually, they worked in teams of two in the second group. Thus, it was aimed to establish peer support.
(vi). One of the learning activities that completed the criteria at the highest level in the first group was presented as an example to the second group. In this example, how the existing criteria can be applied was evaluated with the researcher in the lesson.

End of the stage, the second group fulfilled the self-assessment form created by the researcher. In this form, there are a total of three questions, one of which is closed-ended and the other two are open-ended. In the first question, the participants are asked to rate the level of difficulty in the application of the activity development criteria given to them between 1 (Very Difficult) and 5 (Very Easy). The other two questions are about what kind of difficulties they faced and the contributions the 21st-century learning activity development process has for them. As a result of this, the criteria were rearranged to support the learning activity development performance of the 21st-century ETCs positively.

Data Analysis

Collected data were analyzed document analysis, descriptive analysis such as frequency, percentage, and average score calculation, and content analysis methods. Learning activities as given performance homework were coded in the form of M1, M2, in alphabetical order of ETCs' names. For the validity and reliability of the data, the researcher scored the performance homework using rubrics at different times. The opinion of an independent researcher was obtained for activities where a joint decision could not be made. To increase the credibility of the results are given examples from learning activities by ETCs. In the process, triangulation was made by using different data collection tools. And also, all the steps and methods of the study have been conveyed by the researcher.

FINDINGS

The findings of the study are presented based on sub-questions about the study's aim.

Findings on Criteria to Develop 21st-Century Learning Activity

These findings belong to the action research planning stages obtained from the first group. In

this process, theme and draft codes were obtained from the action plans carried out with ETCs. The 14 criteria obtained from these draft codes were created by the researcher and supported by the literature. Expert opinions were taken for draft codes and criteria and experts were also asked to add new criteria or codes if necessary. Appendix 1 shows criteria revised according to expert opinions and literature. According to Appendix 1, learning activities were prepared by ETCs, and activities prepared were evaluated by using the same criteria.

Findings on How and to What Extent Can ETCs Apply the Criteria

These findings belong to the action research implementing and evaluating stages obtained from the first group. Table 2 shows how many ETCs apply a criterion and how much.

Table 2. *Frequencies of How Many People Apply The Criterion and How Much*

21st Century Learning Activity Development Criteria	Frequencies		
	Incomplete	Must be Improved	Good
Asks questions before the learning activity to collect student recognition data about his/her interest, desire, or learning level.	4	13	35
Records student recognition data digitally for quick and easy analysis.	5	3	44
Uses student recognition data for guidelines and the stages such as diversifying activities or group work.	14	20	18
Students prepare reproductive, original products.	15	14	23
Allows students to learn from each other.	5	4	43
Encourages students to think critically by making comparisons between at least two learning elements.	8	12	32
Involves students in the problem-solving process.	13	17	22
Uses technologies suitable for the student level.	11	16	25
Uses descriptive instructions, such as task, discussion, or feedback cards, to make it easier for the student to discover information.	9	30	13
Allows students to progress individually or in groups independent of the teacher.	11	20	21
Allows students to change the content by making his/her own choices.	30	8	14
Allows students to control the learning process for different learning objectives through alternative activities.	36	3	13
Records the data to follow student development.	17	16	19
There are remarkable items suitable for student-level in content design.	13	23	16

According to Table 2, Criterion 1 (f_{good} = 35) collecting recognition data to develop activities according to student interest, desire, or level of learning and Criterion 2 (f_{good} = 44) digital recording of these data to develop activities according to student interest, desire or learning level are at the top of the criteria that are well implemented in learning activities. However, students met Criterion 3, which is the use of these collected and recorded recognition data in the learning activity, at an

incomplete or improvable level. The document analysis made through learning activities also confirms this situation. Because before the learning activity, students' learning level about the gain was measured using digital data collection tools such as Google Form, or their interests and requests were asked. However, these data were not associated with the learning activity stage. The exemplary learning activity, which successfully fulfilled these three criteria for recognition data, belongs to M22. M22 asked questions that measure preliminary knowledge through Google Form in the acquaintance activity of 3rd grade students about Life Science and used this data to group students in the learning activity.

Criterion 5 (f_{good} = 43) is another criterion that was well implemented in learning activities. Criterion 5 is allowing students to learn from each other to serve the collaborative aspect of the learning activity. Regarding the examples who met this criterion at a good level, they combined the students with low and high learning level and made use of each other for completing the activity (M10 realized it in Turkish, M15 in Life Science, M36 in Science, and M47 in Mathematics learning activities). In addition, a digital discussion board was used in M35 developed for 3rd grade Science students and M13 developed for 2nd-grade Mathematics students, where students were asked to check each other's work and correct mistakes, thus all students are expected to benefit from each other. Criterion 5 can be examined together with Criterion 4, which is preparing reproductive products. Criterion 7, which is being involved in the problem-solving process, both of which were usually implemented at the improvable or incomplete level. Accordingly, in the 21st-century learning activity, students work together to create reproductive products in a problem-solving process. M23 implemented these three criteria in a learning activity together, which is an activity for making dynamometers for 3rd-grade Mathematics students. In this activity, the teacher brings different types of dynamometer models and some design materials to the class. After the students examine the models in groups, they make selections from the materials brought by the teacher to design a dynamometer prototype. In this activity, students help each other with how to prepare the prototype in the process of solving a problem and create a product.

Another criterion that is well implemented in learning activities is Criterion 6 (f_{good}=32). Criterion 6 is encouraging students to think critically by making comparisons. This criterion can be examined together with Criterion 10 ($f_{improve}$=20), and Criterion 7 ($f_{improve}$=30), both of which were usually implemented at the improvable level. According to these three criteria, to encourage students to think critically in the learning activity, it is required to use explanatory instructions through the task or discussion cards that allow the discovery of the information. In this way, students who practice the activity can progress independently of the teacher by following the instructions in the process. M46, who implemented these three criteria at a good level for 4th grade students, addressed the gain of designing lighting tools that can be used in the future about Science. In this activity, students are assigned to design tasks encouraging them to think about similar and different aspects of various lighting tools. It has been used SCAMPER technique to design tasks for critical thinking. Explanatory instruction cards have been sent to the students through the digital discussion board so that these tasks can be completed within the group independent of the teacher and the discussion can proceed. So, the activity consists of three different digital discussion boards accessed through the QR code for each group. With explanatory instruction cards, it has been provided that the teacher plays only an observer and guide role in the process in the activity. Appendix 2 shows M46's performance homework.

Criterion 11 ($f_{incomplete}$ = 30) and Criterion 12 ($f_{incomplete}$= 36), which attempt to make the learning activity personal, are among the criteria that have been implemented incompletely in the learning activities. According to these two criteria, the learning activity is expected to provide the student the opportunity to control, change content or participate in alternative activities for different learning objectives. Although learning activities are generally lacking these issues, one of the examples that implemented these two criteria at the same time is M19, which addressed traffic signs and boards. M19 provides students with some traffic signs and boards at the learning stations. Students access the

interactive scenarios prepared in PowerPoint by reading the QR codes on these boards. The most significant characteristic of the interactive scenario is that the student makes choices in the problem situations about the relevant board presented as visuals and examines the findings of his/her own choices. Learning stations, on the other hand, offer alternatives that grant control to the students in determining the learning objective they need during the learning process. Accordingly, it can be said that M19 implemented both criteria 11 and 12. The reasons for rarely implementing these criteria may be students' low-level technological skills or the workload in creating alternative activities. Other criteria that are thought to be challenging in the implementation due to similar reasons are criterion 8, using technology suitable for student-level; criterion 13, digital record-keeping for following the development; and criterion 14, and using remarkable visuals in the design.

Findings on Experience of ETCs developed 21st-century learning activities

These findings belong to the action research experiencing stage. These findings were obtained from the self-assessment form filled out by ETCs in the second group. With this form, ETCs graded the criteria according to their level of difficulty to indicate how difficult they had while applying the learning activity criteria. The findings were given in Table 3.

Table 3. *ETCs' Perceptions On The Difficulty Level of The Applying Criteria to Develop a 21st-Century Learning Activity*

Criterion No	Frequencies				
	Very Hard	Hard	Moderate	Easy	Very Easy
Criterion 1	1	3	16	13	9
Criterion 2	4	9	12	10	7
Criterion 3	3	5	12	14	8
Criterion 4	1	2	13	15	11
Criterion 5	1	11	15	13	2
Criterion 6	4	9	13	12	4
Criterion 7	3	4	15	15	5
Criterion 8	4	5	15	12	6
Criterion 9	6	8	14	11	3
Criterion 10	2	5	16	14	5
Criterion 11	3	7	13	16	3
Criterion 12	2	7	10	20	2
Criterion 13	6	6	16	10	4
Criterion 14	13	6	13	10	13

When Table 3 is examined, ETCs in the second group found only the 14th criterion as "Medium" or "Difficult" among these criteria they applied in their performance homework. It can be said that they have some difficulty in creating the content based on the student level according to this criterion. Table 4 shows the findings of the open-ended questions in the self-assessment form obtained from content analysis.

Table 4. *Themes and Codes Obtained From Content Analysis On The Self-Assessment Form*

Themes	Codes	Frequencies
Difficulties	• Using technology • Creative thinking • Getting down to student level • Going out of the ordinary	• 17 • 6 • 6 • 3
Contributions: Personal skills	• Using technology effectively • Developing thinking skills • Gaining a different perspective • Working in a team	• 10 • 6 • 6 • 1
Contributions: Professional skills	• Gaining professional awareness • Integrating technology • Designing learning by having fun • Designing activities based on student characteristics • Learning ways to keep students active • Integrating creativity into the lesson	• 11 • 8 • 3 • 3 • 2 • 2

According to Table 4, the answers are given by ETCs to the question "What are the other difficulties you have in this process?" were collected under the headings of "using technology, creative thinking, getting down to the student level and going out of the ordinary". Their views are as follows:

I had difficulty preparing the activities step by step based on the student level. It was difficult to prepare an activity sheet for all students to understand [P19].

I think we lay the foundations of entering an unusual learning period. We will encounter a more complex learning style. The difficulties I experienced are also caused by learning from the rote learning system and continuing in the thinking system as I am not used to [P3].

According to these answers, it is understood that in the process of developing learning activity, ETCs tend to reflect their previous education on their teaching. Even if they had difficulty, ETCs made an effort to get out of this pattern by using technology, thinking creatively, and trying to get down to the student level.

The answers given by ETCs to the question "What are the contributions of the 21st-century learning activity designing process to you?" were collected under two headings: *personal skills* consisting of 4 codes and *professional skills* consisting of 6 codes. Their views of the contribution of personal skills are as follows:

I am seriously familiar with technology right now. I know where to use which applications and the biggest contribution to me were my ideas to prepare a lot of material that I could prepare for my students in the future [P30].

If I had done the event alone, maybe I would have had technical difficulties. Since we designed the activities as a group, we were able to complement each other's shortcomings and achieve a better event design [P7].

Their views of the contribution of professional skills are as follows:

When I started teaching, I understood better how to teach 21st-century students. While preparing the homeworks, I felt just like a teacher, as if I had students and I was designing a learning activity for them. Now I know better what kind of learning activity I should design when I start teaching. I will use the homework we have prepared in my teaching life [P5].

I learned different applications by taking advantage of technology. I realized that teaching would be more effective with the use of technological tools. I learned different information

thanks to different applications and materials. I had the opportunity to be in touch with technology while doing activities based on topics [P23].

DISCUSSION AND CONCLUSION

This study has been tried to solve a problem with action research. The problem was to develop the skills of ETCs in designing 21st-century learning activities in the teacher education programs. The solution to the problem was that designing 21st-century learning activities can be taught at various courses in teacher education programs. The ETCs made significant advancements and gained experiences in the course of "Instructional Technologies" based on this solution. In the course, ETCs have gained experiences by developing 21st-century learning activities about the characteristics as follows:

Reproductive learning for creativity: To encourage and reveal creativity in the learning process, the 21st-century learning activity should involve students in the process of reproduction. Especially, unusually combining usual objects, or creating unusual objects from usual parts can be facilitating techniques for planning this process. However, creativity is realized not before the design of the product, but during the design process, while participating in the activity, implementing, fragmenting, or integrating parts. These views can be supported by the Creative Learning Spiral by Resnick (2017) in his book "Lifelong Kindergarten". In the Creative Learning Spiral, the materials and activities are constantly changing within the framework of the same basic process, knowledge, product, or problem. In addition, Resnick (2017) emphasizes that imitating similar examples or following instructions is useful for developing creativity if it induces new ideas. Another way of revealing creativity is to think, reproduce or redesign an object differently (Özyaprak, 2016). ETCs tried these techniques to implement the criterion of designing reproductive products in a learning activity for creativity. But also another technique that ETCs use while planning the learning activity is the SCAMPER thinking technique, also known as creative thinking technique or guided brainstorming (Atasoy, Bozna, Sönmez, Akkurt, Büyükköse & Fırat, 2020; Çilci, 2019; İslim, 2011; Yağcı, 2012; Yiğitalp, 2014). In the SCAMPER technique, questions forcing us to think about an object or idea from different perspectives are asked. In the literature, there have been some studies that found the SCAMPER effects on learning positively (Altiparmak & Eryilmaz-Mustu, 2021; Jarrah & Fattah Al Tarawneh, 2021). Accordingly, each letter indicates different question patterns. These letters and question patterns can be outlined as Substitute (What can substitute my idea, material, method?), Combine (What materials, ideas, materials can be combined?), Adapt (What else is there like this?), Modify/Magnify (What changes can I make to make it better?), Put to another use (For what other purpose can I use it?), eliminate (What can I add or remove?), and Rearrange/Reverse (What other arrangements would be appropriate?) (Yağcı, 2012).

Problem-solving for critical thinking: 21st-century students are curious and problem-solving individuals (Wagner, 2010; ISTE, 2019). Afdareza, Yuanita and Maimunah (2020) stated that the implementation of problem-based learning was one of the alternatives to increase the critical thinking skills of students. Thus also, 21st-century learning activity should encourage critical thinking in the learning process. ETCs who tried to implement both criteria used some critical thinking techniques in the problem-solving process, such as analyzing, dissecting, classifying, distinguishing, matching, and taking the meaning implied in the reading (Ardhian, Ummah, Anafiah & Rachmadtullah, 2020). The most basic of these techniques is to make comparisons between at least two different objects that suggest similarities and differences. This technique, also known as analogy building, is the association of the objects, which seem to be independent of each other, presented to the student in the learning activity at some point by establishing a similarity. The important thing here is matching one of the objects with the student's prior knowledge and making an analogy with the unknown one through this knowledge (Şaşmaz Ören, Ormancı, Babacan, Koparan & Çiçek, 2011). But also, learning activities that use critical techniques and are developed by ETCs involve students in the problem-solving process through case studies, visuals, animations, riddles, rhymes, or puzzles in problem scenarios or educational games. Supporting these, Hacısalihoğlu Karadeniz (2018) suggested that teachers who

want to include problem-solving strategies in learning activities should use event-based genres such as stories, tales, and riddles. Karasu (2019), also concluded that the scenario-based learning approach increases students' interest and curiosity towards the course and decreases the general anxiety level.

Learning from each other in collaboration: Working as a team is an important characteristic expected from 21st-century students. Therefore 21st-century learning activities should allow students to learn from each other. The learning activities developed by ETCs generally include educational games using collaborative techniques such as learning stations (Pho, Nguyen, Nguyen & Nguyen, 2021), Jigsaw technique (Chang & Benson, 2020; Rahmawati, 2021; Salam, 2020). In this regard, it was reported in the literature that collaborative games will facilitate making sense of the knowledge, as well as constituting a model for developing a series of 21st-century skills including creativity, problem-solving, communication, etc. (Bermingham et al., 2013; Cooney & Darcy, 2020). Another method used by ETCs is learning by teaching which is named by Fiorella and Mayer (2013) as learning by explaining or transferring what is known to someone else. In this technique, the learning is realized by shifting them from the student position to the teacher position. In this context, generally, ETCs have grouped students in their learning activity according to high and low prior knowledge or having similar characteristics and interests. Thus while working as a team, transfer what they know to those who do not know, students check and regulate each other's work with peer assessment, discover something unthought within the group or strengthen each other's communication skills.

Self-Directed Learning: In the 21st century, the learning activity appeals to students who know themselves, who manage and make their own decisions (Gününç, Odabaşı & Kuzu, 2013; Dağhan, 2017), who set their learning objectives and reflect them to the learning process (Dağhan, 2017; ISTE, 2019). These students, also known as "autodidacts", tend to be teachers for themselves, discover knowledge independent of the teacher, and learn on their own. Autodidacts think in various ways, make library and internet searches, experimental studies in a certain area, filter and transform information from any source and anywhere (Tarhan, 2013). So, 21st-century learning activities should present autodidactic techniques like self-directed learning or independent learning (Ferri, 2021; Hutasuhut, Adruce & Jonathan, 2021). Self-directed learning requires the willing orientation of the student to different learning environments suitable for him/her. To this end, teachers can use research-based, collaborative learning environments enriched by the use of different learning sources, considering individual differences (Küçüker & Selvi, 2016). In the study, ETCs asked questions offering the student the preference to participate in different alternative learning activities such as writing stories, drawing pictures, playing educational games, or drama for self-directed learning. Also, ETCs developed audio, visual, or written instructions, explanations, instructions, and discussion or information cards for students to discover the knowledge independent of the teacher.

Making the learning activity personal: As mentioned above, self-directed learning which is a concept that exists in much 21st-century learning (ISTE, 2019; P21, 2019) is important to personalize learning experiences (Caffarella, 1993). So, 21st-century learning activities should consider students' interests, desires, experiences, and learning needs (MEB, 2011). According to AASL Standards (2017), teachers and ETCs should pursue "personal growth" for the 21st-century learner. The teacher's role is important to foster and support self-directed learning and personalization in 21st-century learning environments (Mishra, Fahnoe & Henriksen, 2013). To this end, ETCs have benefited from some recognition data such as a student's prior knowledge, learning objects he/she likes or wonders, teammates he/she wants to work with during the learning process, the learning activity he/she wants to participate in. At this point, the ETCs stated that they would benefit from student recognition data in designing activities according to student characteristics in their professional lives in the future. In this way, teachers can be able to get quick information about the student's past, present, and future learning process. Using this information, teachers can diversify the learning content and make the content specific to the student or group by developing different activities for different interests in learning activity design.

To summarize, ETCs have gained experience in developing 21st-century learning activity during

the teacher education program and these experiences contributed to their professional skills and awareness. In this sense, this study is important to prepare ETCs for the 21st-century learning environments for teacher education programs.

Limitations and Suggestions

Some suggestions for future studies, based on the limitations of the study can be listed as below:

In this study, the ETCs stated that while designing 21st-century learning activities, they had difficulty getting out of the education system they are used to. This situation reveals the necessity of changing the learning methods of ETCs. In this sense, it would be important to increase the proficiency of ETCs on this subject, to use problem scenarios that enable the discovery of today's world problems in the content of undergraduate courses, to support problem-solving skills.

While ETCs in the first group worked on individual homework, ETCs in the second group worked in pairs. In the base of that, One of the results obtained is about preservice teachers making up for their deficiencies while designing activities together. In support of this result, Mirzeoğlu (2015) stated that working in pairs enabled ETCs to gain both personal and professional gains. In future studies, the effect of double and single work on the performance of designing 21st-century learning activities can be examined experimentally.

In this context, ETCs should be educated and trained about using critical thinking techniques that guide the discussion and encourage creativity. For that, teaching education programs at the universities can be redesigned to involve ETCs in similar learning processes.

21st-century teachers are expected to realize the learning activity by using digital media for the follow-up of student development (UNESCO, 2008). ETCs have stated that their students gained professional awareness that it is important to use digital technologies for progress tracking. But also they have stated that they had difficulty in technology integration. In this respect, it should be ensured that teachers and teacher candidates are supported to gain digital skills and made aware of the use of digital media for personalization.

In-service training with similar content can be organized for teachers and lecturers to gain experience in designing learning activities in the 21st-century. The scope of the study can be expanded with a research design in which ETCs apply their learning activities in the real classroom.

REFERENCES

AASL (2017). *AASL [American Association of School Librarians] Standards Framework for learners.* Arrival from: https://standards.aasl.org/wp-content/uploads/2017/11/AASL-Standards-Framework-for-Learners-pamphlet.pdf

Afdareza, M. Y., Yuanita, P. & Maimunah, M. (2020). Development of learning device based on 21st century skill with implementation of problem based learning to increase critical thinking skill of students on polyhedron for grade 8th junior high school. *Journal of Educational Sciences,* 4(2), 273-284. http://dx.doi.org/10.31258/jes.4.2.p.273-284

Aksoy, N. (2003). Eylem araştırması: Eğitimsel uygulamaları iyileştirme ve değiştirmede kullanılacak bir yöntem. *Kuram ve Uygulamada Eğitim Yönetimi*, 36. s: 474-489. https://dergipark.org.tr/en/download/article-file/108417

Altiparmak, T. & Eryilmaz-Mustu, Ö. (2021). The Effects of SCAMPER technique activities in the 8th grade simple machines unit on students' academic achievement, motivation and attitude towards science lessons. *International Journal of Educational Methodology, 7*(1), 155-170. http://dx.doi.org/10.12973/ijem.7.1.155

Ananiadou, K. & Claro, M. (2009). *21st-century skills and competencies for new millennium learners in OECD countries*. OECD Education Working Papers: OECD. http://www.oecd-ilibrary.org/education/21st-century-skills-and-competences-for-new-millennium-learners-in-oecd-countries_218525261154

Anisimova, T. I., Sabirova, F. M. & Shatunova, O. V. (2020). Formation of Design and Research Competencies in Future Teachers in the Framework of STEAM Education. *International Journal of Emerging Technologies in Learning (iJET),* 15(02), 204-217. DOI: 10.3991/ijet.v15i02.11537

Ardhian, T., Ummah, I., Anafiah, S. & Rachmadtullah, R. (2020). Reading and critical thinking techniques on understanding reading skills for early grade students in elementary school. *International Journal of Instruction, 13*(2), 107-118. https://doi.org/10.29333/iji.2020.1328a

Atasoy, E., Bozna, H., Sönmez, A., Akkurt, A. A., Büyükköse, G. T. & Fırat, M. (2020). Active learning analytics in mobile: Visions from PhD students. *Asian Association of Open Universities Journal (AAOUJ)*, 15 (2). 145-166. https://www.emerald.com/insight/2414-6994.htm

Caffarella, R. (1993). Self-directed learning. *New Directions for Adult and Continuing Education,* 57, 25-35. https://doi.org/10.1002/ace.36719935705

Callison, D. & Lamb, A. (2004). Keywords in instruction. Audience analysis. *School Library Media Activities Monthly,* 21(1), 34-39. http://hdl.handle.net/1805/8779

Chang, W. L. & Benson, V. (2020). Jigsaw teaching method for collaboration on cloud platforms. *Innovations in Education and Teaching International,* 1-13. https://doi.org/10.1080/14703297.2020.1792332

Corlu, M. S., Capraro, R. M. & Capraro, M. M. (2014). Introducing STEM education: Implications for educating our teachers in the age of innovation. *Eğitim ve Bilim,* 39(171), 74-85. http://hdl.handle.net/11693/13203

Cooney, A. & Darcy, E. (2020). 'It was fun': Exploring the pedagogical value of collaborative educational games. *Journal of University Teaching & Learning Practice, 17*(3). https://ro.uow.edu.au/jutlp/vol17/iss3/4

Çilci, N. (2019). *SCAMPER (Yönlendirilmiş Beyin Fırtınası) tekniğinin 5 ve 6. sınıf öğrencilerinin yaratıcı yazıları üzerindeki etkisi* [Master Thesis]. Ordu University, Ordu.

Dağhan, G., Nuhoğlu Kibar, P., Menzi Çetin, N., Telli, E. & Akkoyunlu, B. (2017). Bilişim teknolojileri öğretmen adaylarinin bakiş açisindan 21. Yüzyil öğrenen ve öğretmen özellikleri. *Eğitim Teknolojisi Kuram ve Uygulama,* 7 (2). 215-235. https://doi.org/10.17943/etku.305062

Ferri, A. (2021). *The perceptions of academic librarians on their role in lifelong learning, self-directed learning and heutagogy* [Master Thesis]. University of Massachusetts, Boston.

Gelen, İ. (2017). P21-Program ve öğretimde 21. Yüzyıl beceri çerçeveleri (ABD Uygulamaları). *Disiplinlerarası Eğitim Araştırmaları Dergisi,* 1(2). 15-29. https://dergipark.org.tr/tr/pub/jier/issue/33877/348852#article_cite

Günüç, S., Odabaşı, H. & Kuzu, A. (2013). 21. yüzyıl öğrenci özelliklerinin öğretmen adayları tarafından tanımlanması: Bir Twitter uygulaması. *Eğitimde Kuram ve Uygulama, 9*(4). 436-455. http://acikerisim.lib.comu.edu.tr:8080/xmlui/handle/COMU/1145

Hacısalihoğlu Karadeniz, M. (2018). "Kraliçeyi Kurtarmak" adlı hikâye kitabında yer alan bilmecelerin problem çözme stratejileri bağlamında incelenmesi. *IV. International Academic Research Congress (INES-2017),* Alanya/ Antalya.

Hutasuhut, I., Adruce, S. A. Z. & Jonathan, V. (2021). How a learning organization cultivates self-directed learning. *Journal of Workplace Learning. 33*(5). 334-347. https://doi.org/10.1108/JWL-05-2020-0074

ISTE (2019). ISTE standards for students. https://www.iste.org/standards/for-students. Retrieval date: 02.02.2020

İslim, Ö. F. (2011). SCAMPER (Yönlendirilmiş beyin fırtınası tekniği). *5th International Computer & Instructional Technologies Symposium,* Fırat University. Elazığ- Turkey.

Karasar, S. (2004). Egitimde yeni iletisim teknolojileri-internet ve sanal yüksek egitim. *TOJET: The Turkish Online Journal of Educational Technology,* 3(4). http://tojet.net/articles/v3i4/3416.pdf

Karasu, A. (2019). *Senaryo temelli öğrenme-öğretme yaklaşımı'nın 7. sınıf öğrencilerin ingilizce dersine yönelik tutumu ile ingilizce öğrenmeye yönelik görüş ve kaygılarına etkisi* [Master Thesis]. Balıkesir University, Balıkesir.

Kemmis, S., McTaggart, R. & Nixon, R. (2014). *The action research planner: Doing critical participatory action research.* Singapore: Springer Science & Business Media. http://dx.doi.org/10.1007/978-981-4560-67-2

Koenig, J. A. (2011). *Assessing 21st Century skills: Summary of a workshop.* Washington, DC: National Research Council.

Küçüker, G. F. & Selvi, K. (2016). İlkokul öğrencilerinin kendi kendine öğrenme becerilerinin geliştirilmesine yönelik öğretici destekli bir model (İÖDKKÖM) önerisi. *Eğitim ve Bilim*, 41(185). 167-198. http://dx.doi.org/10.15390/EB.2016.4933

Lemov, D. (2010). *Teach like a champion: 49 techniques that put students on the path to college (K-12).* John Wiley & Sons. https://juliusbucar.files.wordpress.com/2017/04/teach-like-a-champion-49-techniques-that-put-students-on-the-path-to-college.pdf

Margot, K. C. & Kettler, T. (2019). Teachers' perception of STEM integration and education: A systematic literature review. *International Journal of STEM Education,* 6(1), 2. https://doi.org/10.1186/s40594-018-0151-2

MEB. (2011). *21. Yüzyıl öğrenci profili.* Ankara: Millî Eğitim Basımevi.

MEB. (2017). *Öğretmenlik mesleği genel yeterlikleri.* Öğretmen Yetiştirme ve Geliştirme Genel Müdürlüğü. Ankara: Millî Eğitim Basımevi.

MEB. (2018). 2023 Eğitim Vizyonu. Retrieved from: http://2023vizyonu.meb.gov.tr/

Mirzeoğlu, A. D. (2015). Sınırlandırılmamış materyallerle yapılan yansıtıcı bir oyun çalıştayına ilişkin sınıf öğretmeni adaylarının deneyimleri ve kazanımları. *Eğitim ve Bilim.* l (40). 180, http://dx.doi.org/10.15390/EB.2015.4233

Mishra, P., Fahnoe, C. & Henriksen, D. (2013). Creativity, self-directed learning and the architecture of technology rich environments. *TechTrends,* 57(1), 10. https://doi.org/10.1007/s11528-012-0623-z

NACOL (2006). *Virtual Schools and 21st Century Skills. The North American Council for Online Learning and the Partnership for 21st Century Skills.* http://files.eric.ed.gov/fulltext/ED514436.pdf Retrieval date: 02.02.2020.

O'Brien, R. (2001). Um exame da abordagem metodológica da pesquisa ação [An overview of the methodological approach of action research]. In Roberto Richardson (Ed.), Teoria e Prática da Pesquisa Ação [Theory and Practice of Action Research]. João Pessoa, Brasil: Universidade Federal da Paraíba. (English version). http://www.web.ca/~robrien/papers/arfinal.html

Orhan Göksün, D. & Kurt, A.A. (2017). Öğretmen adaylarinin 21. yy. Öğrenen becerileri kullanimlari ve 21. yy. Öğreten becerileri kullanımları arasındaki ilişki. *Eğitim ve Bilim,* 1(42), 190. DOI: http://dx.doi.org/10.15390/EB.2017.7089

Özyaprak, M. (2016). Yaratıcı düşünme eğitimi: SCAMPER örneği. *Üstün Zekalılar Eğitimi ve Yaratıcılık*

Dergisi, 3(1), 67-81. https://dergipark.org.tr/tr/pub/jgedc/issue/38681/449375

Pho, D. H., Nguyen, H. T., Nguyen, H. M. & Nguyen, T. T. N. (2021). The use of learning station method according to competency development for elementary students in Vietnam. *Cogent Education, 8*(1), 1-27. https://doi.org/10.1080/2331186X.2020.1870799

P21. (2019). Framework for 21st Century learning definitions: The Partnership for 21st Century Learning a Network of Battelle for Kids. http://static.battelleforkids.org/documents/p21/P21_Framework_DefinitionsBFK.pdf

Rahmawati, D. (2021). Improving Students' Vocabulary Mastery through Jigsaw Techniques in 21st Century. *Journal of Educational Study, 1*(2), 1-8. https://doi.org/10.36663/joes.v1i2.153

Rahmawati, Y., Ridwan, A. & Hadinugrahaningsih, T. (2019). Developing critical and creative thinking skills through STEAM integration in chemistry learning. In *Journal of Physics: Conference Series. 1156* (1), p. 012033. IOP Publishing.

Resnick, M. (2017). *Yaşam boyu anaokulu (Lifelong kindergarten)* (G. Sart, G., B. Çetin ve C. Aşkın, Çev.). İstanbul: Aba Yay.

Rifandi, R. & Rahmi, Y. L. (2019, October). STEM education to fulfill the 21st-century demand: a literature review. In *Journal of Physics: Conference Series, 1317* (1), p. 012208. IOP Publishing.

Salam, H. B. (2020). Jigsaw cooperative learning strategy based lesson study on Indonesian college study in National Information Polytechnic. *Journal of Science and Education (JSE), 1*(1), 15-19. https://jse.rezkimedia.org/index.php/jse

Schleicher, A. (2019). *Dünya Okulu: 21. Yüzyılın okul sistemi nasıl kurgulanmalı* (Ş. Karadeniz, çev.). İstanbul: BAU Yay. https://bau.edu.tr/icerik/14890-dunya-okulu

Swann, C. (2002). Action research and the practice of design. *Massachusetts Institute of Technology Design Issues,* 18(1), 49-61. https://eds.s.ebscohost.com/eds/pdfviewer/pdfviewer?vid=0&sid=3b71d9dd-1b49-4a39-84a9-a99332a733d6%40redis

Şaşmaz Ören, F. Ş., Ormancı, Ü., Babacan, T., Koparan, S. & Çiçek, T. (2011). Analoji ve araştırmaya dayalı öğrenme yaklaşımı temelli rehber materyal geliştirme çalışması: 'Madde ve Değişim' öğrenme alanı. *Kuramsal Eğitim Bilim Dergisi*, 4(2), 30-64. http://hdl.handle.net/11630/5388

Tarhan, U. (2013). Otodidakt (Autodidact). Martı Dergisi Dijital Gelecekte. http://www.ufuktarhan.com/resimler/file/UFUK-TARHAN-M-GEN-MARTI-GERGISI-MART-SAYISI-OTODIDAKT-KUPUR-BUYUK.jpg. Retrieval date:02.02.2020

Trilling, B. & Fadel, C. (2009). 21st-century skills: Learning for life in our times: learning for life in our times. John Wiley & Sons. https://epdf.pub/21st-century-skills-learning-for-life-in-our-times.html

UNESCO. (2008). Teaching and learning for a sustainable future. https://unesdoc.unesco.org/ark:/48223/pf0000125235 Retrieval date: 02.02.2020.

Van Laar, E., Van Deursen, A.J.A.M., Van Dijk, J.A.G.M. & De Haan, J., (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers & Human Behaviour,* 72, 577–588. https://doi.org/10.1016/j.chb.2017.03.010

Voogt, J. & Roblin, P. N. (2010). *21st Century skills discussion paper. Report prepared for Kennisnet.* University of Twente, The Netherlands. http://hdl.voced.edu.au/10707/254371

Wagner, T. (2010). *The global achievement gap: Why even our best schools don't teach the new survival skills our children need and technology-rich what we can do about it (ebook).* Basic Books (1st edition).

Yağcı, E. (2012). Yönlendirilmiş beyin fırtınası tekniği: SCAMPER konusunda veri görüşleri üzerine bir çalışma. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi,* 43. 485-494. https://dergipark.org.tr/tr/pub/hunefd/issue/7795/102048

Yiğitalp, N. (2014). *Yönlendirilmiş Beyin Fırtınası (SCAMPER) tekniğine dayalı eğitimin beş yaş çocuklarının problem çözme becerilerine etkisinin incelenmesi* [Yüksek Lisans Tezi]. Hacettepe Üniversitesi, Ankara.

APPENDIX 1. *Criteria, Themes, Codes, And Supportive Literature Notes From The First Group, Expert Controls, And Literature Support By Week*

Criteria	Themes and Codes				Notes from the Literature
	Student in the 21st century	Teacher in the 21st century	Learning Activity in the 21st century	Making the Activity Personal	
1	• Aware of his/her interest and desire • Self-aware	• Gathering purposeful data to know the student	• Using recognition data	• Measuring the learning level • Learning student interest and desire • Knowing the digital experiences that they use or wonder	• Teacher knowing the student (MEB, 2017) • Self-knowing student (Gününç, Odabaşı & Kuzu, 2013)
2		• Recording and analyzing the data digitally	• Keeping digital records • Using digital media that records data	• Draw individual data about student's learning level, interest, and need	• Teacher collecting and analyzing digital data to know the student (MEB, 2017) • Students aware of the digital marks left (ISTE, 2019)
3	• Choosing the information that he/she needs • Eliminating unnecessary information • Not memorizing	• Considering student characteristics • Knowing the student	• Preparing activity according to student information records, creating a group • Voice recordings, visual or written explanations	• Guiding learning activity, content or group work with recognition data	• Student and teacher considering individual skills (Trilling & Fadel, 2009; Wagner, 2010) • Student (National Research Council, 2011) and teacher (MEB, 2011) considering personal differences • Teacher considering student characteristics (Dağhan et al., 2017)
4	• Creativity • Productivity • High imagination	• Promoting creativity • Providing examples that encourage the production • Consultant/guide	• Designing the whole from independent parts • Redesigning a part of the product with other objects	• Preparing products according to student interests and needs • A student selecting and combining the parts that he/she needs to develop the original product	• Productive students, students learning by doing and living (Dağhan et al., 2017). • Students producing original works and changing some components uniquely (ISTE, 2019) • Highly imaginative student (Wagner, 2010)

5	• Collaborative • In motion • Communication skill is high	• Benefiting from collaborative learning techniques • Managing the collaborative learning environment • Effective communication	• Learning techniques while teaching each other in groups • Learning stations • Collaborative learning techniques	• Grouping those who know and who don't know • Grouping by learning level • Grouping according to student interest and desire • Grouping according to digital skills	• Students communicating with others for academic and personal interest (ISTE, 2019) • Students using collaborative technologies (ISTE, 2019) • Students working as a team (National Research Council, 2011)
6	• Critical thinking • Questioning • Distinguishing the correct information	• Using critical thinking techniques	• Question, activity, or products that make comparisons about similarity and difference of the objects	• Choosing the right information and technology to develop his/her product or to solve his/her problem	• Students evaluating the accuracy of information, media, data, or resources (ISTE, 2019) • Students thinking of an object or problem from different perspectives (Dağhan, 2017; ISTE, 2019) • Questioning student and teacher (Gününç, Odabaşı & Kuzu, 2013)
7	• Solution-oriented • Enthusiastic to solve complex problems • Curious	• Providing problems to explore knowledge • Challenging	• Presenting a problem in a case study, scenario, story, or puzzle	• Using the real problems belonging to the student him/herself • Learning student problems in recognition data	• Students collecting data to discover real-world problems and to solve original problems (ISTE, 2019) • Solution oriented student (Gününç, Odabaşı & Kuzu, 2013)
8	• Using technology effectively • Digitally literate	• Integrating technology into education • Digitizing printed materials	• Combining printed and digital materials • QR codes, social media, and learning management systems	• Knowing the technologies that the student actively uses and using them in the activity • Learning the technology experiences of the student at the recognition data stage • Students choosing and using the appropriate one among the new technologies for his/her	• Using online materials (UNESCO, 2008) • Using technology for information discovery, information transfer, product design, problem-solving (ISTE, 2019) • Student blending digital and real life (Gününç, Odabaşı & Kuzu, 2013) • Learning experiences built with technology (Trilling & Fadel, 2009)

				unique product or problem.	
9	• Managing and evaluating his/her learning • Setting his/her objectives	• Enabling self-directed learning	• Discussion or task cards • Feedbacks indicating correct and incorrect learning	• Explanations, directions, voice responses suitable for student level • Explanations and directions about the student's product or problem	• The student seeking feedback for his/her application (ISTE, 2019) • Self-directed learning student (NACOL, 2006; Tarhan, 2013)
10	• Able to discover information independent of the teacher	• Planning learning activity, rather than instruction • Guiding • Learning environment designer	• Using guidance and explanations	• Guidance and explanations based on student progress • Guidance on remarkable content	• Self-progressing student (Mawas, Bradford, Andrews, 2019) • Independently learning student (Dağhan, 2017) • Teacher, designer of the learning environment (UNESCO, 2008)
11	• Making his/her own choices • Active in learning	• Allowing students to choose	• Interactive story, script, presentations that allow student interaction with options	• The control of the material with choices • Getting the same knowledge with different choices • Knowing student preferences such as character, scene, object	• Students customizing the learning process in a supporting way (ISTE, 2019) • Teacher, designer of interactive education (Gelen, 2017)

12	• Able to make decisions about his/her learning process • Knowing him/herself • Self-improving • Versatile reader	• Allowing the student to control his/her learning • Risk-taker	• Alternative learning activities for different learning objectives	• Knowing students' learning objectives • Addressing different learning objectives • Teamwork according to learning objectives	• Students setting personal learning objectives and reflecting them to the learning process (Dağhan, 2017; ISTE, 2019) • Student managing and developing him/herself (Dağhan, 2017; National Research Council, 2011) • The student knowing him/herself, able to make decisions and performing multiple tasks (Gününç, Odabaşı & Kuzu, 2013; Dağhan, 2017) • Increasing opportunities for students (NACOL, 2006)
13	• Following and evaluating his/her learning progress	• Recording and analyzing student development	• Using digital platforms to follow up on student progress	• Giving information to the student about his/her individual development	• Teacher following and evaluating student projects digitally (Gününç, Odabaşı & Kuzu, 2013; MEB, 2017; UNESCO, 2008) • Self-supervised (Koenig, 2011) student, taking individual responsibility (NACOL, 2006; Dağhan, 2017)
14	• Having fun • Visual learner	• Keeping student active • Attracting attention	• Visuals, animation techniques, and videos	• Using audio and written visuals, animations, and videos suitable for learning level	• Teachers using questions, various games, visuals, and stimuli that attract student's attention (Lemov, 2010)

APPENDIX 2. *M46's Performance Homework*

21. Yüzyıl'da Öğrenme Etkinliği: Fen Bilimleri Dersi

Öğretim Teknolojileri

Öğrenci: M46

Öğrenciyi Tanıma

Öğrenciyi tanıma formunda amaç bilenle bilmeyeni ayırt edip ona göre öğrenme etkinliğini düzenlemek. Öğrenciye seçenekler sunup öğrenme etkinliğinde nasıl öğrenmek istediğini seçmesini sağlamak.

Öğrenciyi tanıma etkinliğinde google formdan öğrencilere çoktan seçmeli görselli sorular sunulmuştur. Birkaç tane de kısa yanıtlı sorular ve son olarak öğrenme etkinliğini seçmesi için bir soru vardır.

Öğrenciyi tanıma formu (Bağlantılar Ek:1)

Öğrenme Etkinliği

Öğrenme etkinliğinde amaç 21.yüzyıl becerilerine uygun öğretmenden bağımsız olarak öğrencilere seçenekler sunma, eleştirel düşünebilme, problem çözme, yaratıcılık gibi seçeneklerle ilerleme imkanı sundum.

Powerpoint interaktif seçenekler sunuyor. Powerpoint sunusu geleneksel bir sunu değil. Gruplar öğrenciyi tanıma verilerinden belirlenmiştir. Öğrenciler verilere göre gruplara ayrıldılar.Powerpoint ile interaktif bir senaryo oluşturdum.Öğrenciler powerpointte yaptığı seçimlerle öğrenme etkinliğine müdahale edip powerpointteki sonucu değiştirebiliyor.

Öğrenme Etkinliği (Bağlantılar Ek:2)

Öğrenme etkinliğindeki ışık kaynaklarına örnek

Öğrenme etkinliğindeki çiçeğimizi koparmayalım oyunu

Öğrenme etkinliğindeki eşleştirme oyunu

Öğrenme Ortamı ve Araç Gereçler

Öğrenciler öğrenme ortamı için powerpoint ortamını kullanacaklardır. Powerpoint aracılığıyla learning apps uygulamasından da yararlanacaklardır.

Değerlendirme

21.yy becerilerine yönelik problem çözme, yaratıcı düşünme,işbirlikli çalışma,eleştirel düşünme becerilerini değerlendirme testi aracılığıyla oluşturmaya çalıştım.

Uygulama aşamasında birinci öğrenci ilk görevi yapıp diğerinin sorusunun bileşenlerini de seçip yanındaki arkadaşıyla kağıtları değişecek bu şekilde işbirliğinin sağlanmasını ve üretici ürüne yönelik olmasını hedefledim. - Değerlendirme testi (Bağlantılar Ek:3)

Işık Avcısı rozetini alan öğrencilere akran geri bildirimi yapması için bir görev mesajı yazdım. Bu şekilde öğrenciyi öğrenme sürecine tekrar dahil ettim.

Puanlama ve Geri Bildirim

Puanlama yerine rozet kullanılmıştır.

Amaç: Rekabet ortamını kaldırıp işbirlikli ortam kurmak ve öğrenciyi motive etmek, öğrenme hevesini arttırmak. Puanlama Anahtarı (Bağlantılar Ek:4)

Amaç: Geri bildirim rozetleriyle becerileri kategorize edip öğrenciyi farklı görevlerle öğrenme sürecine geri döndürmek.

Geri bildirim Rozetleri (Bağlantılar Ek:5)

Bağlantılar: https://tinyurl.com/yxscc6u2