An action research: Experiences and practices of designing 21st-century assessment activities of elementary teacher candidates

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Article Info	Abstract
Keywords: Assessment 21st-century Feedback badges Collaborative Skill-based scoring Research Article	The aim of this action research is to improve the experiences and practices of elementary teacher candidates in designing 21st-century assessment activities. This study was conducted with two groups in Instructional Design Course in two different education terms. The first term has 52, while the second term has 42 elementary teacher candidates (ETCs). A rubric to design assessment activities was created with ETCs in the first term and they applied them to revise. Then the ETCs in the second term experienced by applying revised rubric during performance homework and fulfilled the self-assessment form including both rating scale and open-ended questions were used to tell their experiences. The responses to the rating scale were analyzed through descriptive analysis, while open-ended responses of ETCs were analyzed through content analysis. The findings indicate that ETCs have experience based on creating problem-solving, critical thinking, and productive product-based questions, using collaborative structure, using digital tools, creating feedback badges based on skill-based scoring. Also, ETCs reported they have improved professional and personal skills by designing 21st-century assessment activities. This study contributes to preparing ETCs for 21st-century learning.

1. Introduction

In the 21st-century, the assessment includes cognitive, intrapersonal, interpersonal, and technical skills that go beyond the skills of reading, writing, interpretation, and synthesis (Ananiadou&Claro, 2009; Shute & Becker, 2010; Yalçın, 2018). In different words, assessment ways in the 21st-century require adapting 21st-century skills into curricula, considering instructional approaches to teaching such skills, and developing instructional materials to encompass 21st-century skills (Geisinger, 2016). These skills, which were defined from different perspectives in various researches (Binkley, etc., 2012; National Research Council, 2011; Voogt&Roblin, 2010) and gathered around three headings are: i) learning and innovation skills, ii) information, media and technology skills; and iii) life and career skills (P21, 2019). In another report published by the National Education Association (2015), these skills that must be acquired in order to seize career opportunities in the 21st-century are expressed under four headings: critical thinking and problem solving, communication, collaboration, and creativity (4C).

There are many studies in the literature focusing on measuring the 21st-century skills of education stakeholders. Yalçın (2018) stated that the tools used to measure 21st-century skills include rating scales, situational judgment tests, performance evaluations, simulations, portfolios, and tools including different

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types of items (such as multiple-choice, computer-aided, and open-ended forms). According to P21 (2006) report, in the assessment of the 21st-century learning process, standardized tests can measure only a few key skills. But Lai and Viering (2012) reported assessing each of these skills in a variety of ways such as standardized assessments (Ennis & Millman, 2005; Facione, 1990; OECD, 2014; OECD, 2017; Zhuang et al., 2008), self-report surveys (Zhuang et al., 2008), global rating scales (Cevik & Senturk, 2019; Treffinger & Isaksen, 2005), and observational measures (Whitebread et al., 2009). But mentioned these skills in the planning of curriculums and learning activities, should also be reflected in assessment methods in addition to learning methods (Voogt & Roblin, 2012). According to the P21 (2006) report, assessment of 21st-century skills should be completed in an integrated manner with basic education subjects such as English, Mathematics, Science, Foreign Languages, Citizenship, Economy, Art, History, and Geography. So, assessment ways in the 21st-century require adapting these skills into curricula, considering instructional approaches to teaching, and developing instructional materials to encompass these skills (Geisinger, 2016). So, there is a need for assessment tools in the 21st-century, especially the ones integrated with the environment or context in which learning takes place (Shute & Becker, 2010). Otherwise, the objective of adopting 21st-century skills in basic education will not be realized.

As a result, there is a need for assessment tools in the 21st-century, especially the ones integrated with the environment or context in which learning takes place (Shute & Becker, 2010). In other words, methods that force students to use 21st-century skills while testing and evaluating their learning in assessment environments are needed. Thus the nature of assessment is expected and required to change in order to support 21st-century learning. For all of that, both teachers and teacher candidates play a significant role in designing the assessment methods that possess the features of the 21st-century. They should be prepared for designing assessment methods and tools that they could use some skills such as critical thinking, problem-solving, creativity, and collaboration while measuring how much their students achieved a learning goal.

New technologies are making it easier and new models of assessment that measures both content and skills are emerging. For example, River City presents middle school students with a problem and asks them to develop a hypothesis and procedure, test it and then describe their findings and write a report. River City is a "virtual world" that simultaneously teaches and assesses them. These models have the potential to move us forward for assessment that is more aligned with what students need to know (Silva, 2009). In this context, assessment material or tool of the 21st-century is more than a measurement process. The assessment process to be discussed systematically collects information; analyzes and interprets the collected information, and reflects this information on the learning objectives by guiding the student's future learning. In addition to improving the learning outcomes of students, educators can also use assessment data for various purposes such as helping to improve program and education services and showing evidence (Shute & Becker, 2010). At these points, effective in-class assessments could be used in addition to high-level standard tools. Formative assessment is also known as assessment for learning may be advantageous at this point (Shute & Zapata-Rivera, 2010). Also, feedback together with formative assessment provides an important opportunity for supporting student learning (Spector, et al., 2016).

Teachers or teacher candidates should be prepared for designing assessment methods and tools that they could use some skills such as critical thinking, problem-solving, creativity, and collaboration while measuring how much their students achieved a learning goal. Thus there is a need for assessment tools in the 21st-century, especially the ones integrated with the environment or context in which learning takes place (Shute & Becker, 2010). In other words, methods that force students to use 21st-century skills while testing and evaluating their learning in assessment environments are needed.

When appointed, teacher candidates, in particular, are expected to incorporate 21st-century skills into learning activities in their classrooms. So, teacher preparation programs should guide the development of learning and assessment activities using different technologies. It should prepare them for 21st-century learning and assessment environment. These programs should change their perceptions about teacher

candidates' capabilities in academic contexts, and they should provide to have their experiences using technology, and their access to resources such as digital devices and software (Lawrance, Saran, Johnson & Lafontant, 2020). However, teacher candidates are not even aware of these when they are at university. Because if they do not receive courses in which 21st-century skills are integrated at the university, teacher preparation programs cannot prepare them for 21st-century learning and assessment.

In this context, there have encountered problems in terms of developing ETCs' skills in designing assessment activities suitable for the 21st-century in teacher preparation programs. Starting with these problems, this study which uses the action research method has been aimed to improve the experiences and practices of elementary teacher candidates (ETCs) in designing assessment activities for the 21st-century. For the study aim, ETCs have enrolled in the "Instructional Technologies" course that was engaged them to design assessment activities for their 21st-century students and where it was highly important for a teacher preparation program in a state university.

2. Methodology

2.1. Research Model

This study is used the action research model that is one of the qualitative researches (McTaggart, 1994). Action research generally involves the systematic data collection, and analysis process of an educational institution employee, researcher 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 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, s. 477). The problem to be solved with action research in this study is to improve the experiences and practices of ETCs in designing assessment activities for the twenty-first century. So, the present study was used a classroom action research which is a kind of action research that is applied in a course and aims to improve practice (Bondy, 2001; Eti & Sıgırtmaç, 2021; Morales 2016). The action research cycle was used the four stages based on Kemmis, McTaggart and Nixon (2014) in the study which includes planning, implementing, evaluating, and experiencing (Figure 1).
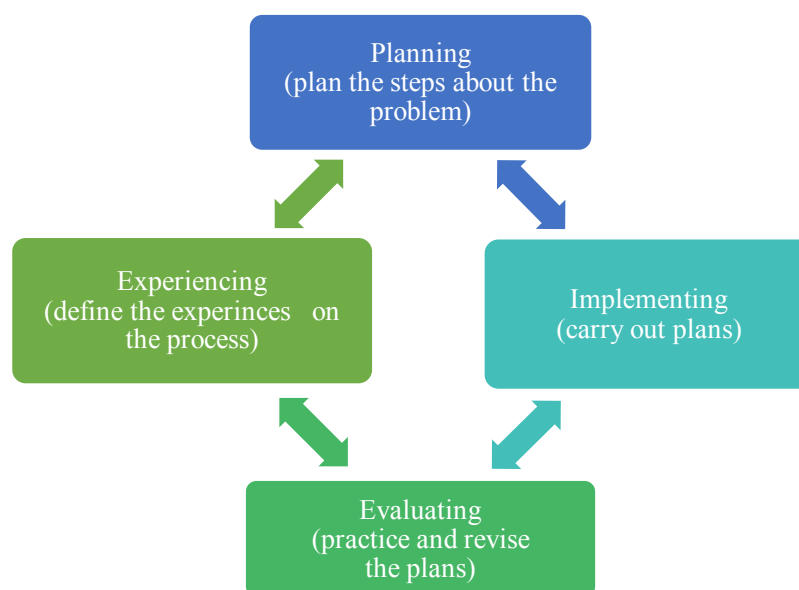
Fig. 1. Action Research Cycle in the study (Kemmis, McTaggart &Nixon, 2014).

2.2. Study Group

2.2.1. *Elementary Teacher candidates (ETCs):* In the first term is a total of 52 ETCs, 5 of whom are foreign nationals, 39 of which are female, and 13 of which are male, enrolled in *Instructional Technologies* course in a state university. In the second term is 42 ETCs who took part in the same course and from the same department. These ETCs, who attend the course, received another short training on what is 21st-century skills before the research as a prerequisite for the relevant course. Thus, ETCs are ready to learn how to create 21st-century assessment activities. After that, they participated in the Instructional Technologies course for the research. The flow of this course is explained in the title of the action plan of the Instructional Technologies Course.

2.2.2. *Expert group:* The researchers prepared discussion boards with the ETCs and supported each keyword with the literature on the course. Supported keywords have been arranged as a rubric to design 21st-century assessment activities. An Assoc. Dr. from the Educational Sciences department of a state university and three Dr. Lecturers from the Computer and Instructional Technologies department were consulted for the rubric and the codes that they address. Experts checked the rubric for suitability, understandability, and developability.

2.2.3. *Role of the Researchers:* In this study, the first author was the instructor who is applying the action plan of the "Instructional Technologies" course to improve ETCs experiences and practices about designing 21st-century assessment activities. She became a natural part of the data collection process by improving the experiences and practices that ETCs face regarding designing 21st assessment activities. The instructor has a master's graduate of the Computer and Instructional Technologies department, a Ph.D. graduate of the Education Programs and Instruction department. She is a learning designer who takes part in various training such as online design thinking and online creativity, as well as an instructor who teaches technology integration courses 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 course. The second author acted to design course materials, analyze collected data, and report.

2.3. Action Plan of Instructional Technologies Course

Planning, implementing, and evaluating applied with ETCs in the first term while experiencing applied with ETCs in the second term. Then they defined some criteria to design 21st-century assessment activities and completed performance homework. A total implementation period of 4 weeks was followed in both stages.

2.3.1. Planning

It is the first stage of action research carried out with ETCs in the first term. In the planning, ETCs applied some learning activities such as discussion board, drawing, and similar examples to discover the features of the 21st-century assessment in the course. Table 1 shows the course plan by week.

Table 1.

Course Plan by week.

Action	Topic	Methods	Learning Activities
Week 1	How should an assessment process addressing 21st-century skills be? What are the characteristics of the materials needed in the assessment process and what are they?	Teamwork	Drawing
		Brainstorming	Discussion board
Week 2	How to write the assessment questions addressing critical thinking and problem-solving skills of 21st-century assessment activity?	Teamwork	Reviewing examples
		Brainstorming	Similar examples

Week 3	How to write the assessment questions addressing collaborative and productive product features of 21st-century assessment activity?	Case study	Reviewing examples
		Teamwork	Similar examples
Week 4	How should be the scoring system of the 21st-century assessment material? How to use assessment data to turn the learning process into a cycle?	Research	Reviewing examples
		Brainstorming	Discussion board

As can be seen in Table 1, in the first-week teacher candidates worked in groups and focused on the following questions: "How should an assessment process addressing 21st-century skills be?" "Which materials are needed in this process and what are their characteristics? The groups shared their solutions for these questions by drawing pictures, deriving common codes via brainstorming, and writing them on the discussion board. In the second week, the focus was on the skills of using digital tools in the process of critical thinking, problem-solving, and assessment within the framework of the "How to write questions in an assessment material addressing 21st-century skills?" question. Examples that can guide teacher candidates on how to write assessment questions or items for these skills were provided. For this purpose, a variety of critical thinking activities that use visual clues and visuals, such as pattern or code decoding, classification, sequences, establishing relationships or analogies to find different/similar/common aspects, writing anagrams, following instructions, and guessing or inferring, were analyzed. ETCs tried to write questions similar to these examples in groups. The focus of the third week was on teamwork and a case study within the framework of the "How to write assessment questions addressing collaborative and productive product features in the 21st-century assessment material?" question. ETCs examined some examples and tried to create similar examples. In the fourth week, ETCs discussed the features of the scoring and feedback by brainstorming around "How should be the scoring system of the 21st-century assessment material?" and "How to use assessment data to turn the learning process into a cycle?" questions based on examples. All course examples were prepared by the researcher. At the end of the group discussions, common codes were written on the discussion board.

Throughout the course, the researcher supported the features discovered by ETCs with the literature, added them to the discussion board, and allowed students to explore the missing parts. At the end of the course, a rubric to design 21st-century assessment activity was prepared by the researcher using keywords on the discussion boards. The researcher supported this rubric with the literature. Experts checked the rubric for suitability, understandability, and developability. The rubric is planned to develop two basic materials, which will be used in the 21st-century assessment, the "assessment sheet" and the "scoring chart" (Table 2). Questions on the assessment sheet should be developed in a skill-based way, in integration with the scoring. 6 keywords and 7 criteria written on the discussion boards, supported by the literature and expert opinions determined the main features of the assessment sheet, whereas 4 keywords and 5 criteria define the features of the scoring chart. In this way, a rubric consisting of 12 criteria was obtained for ETCs to design assessment activities. After that, the implementing stage was started.

2.3.2. Implementing

It is the stage that ETCs in the first term have designed assessment activities based on the rubric prepared as performance homework for two weeks. As the rubric, they designed two materials as an assessment sheet and a scoring chart. For that, they chose a unit and outcome related to one of the Life Sciences, Science, Turkish or Mathematics lessons in the MEB (2019) curriculum. In this process, the researchers and ETCs shared videos on how to use technologies that they can use while developing assessment activities on a digital discussion board. The aim was to support the technology use skills of the participants during the implementation phase.

2.3.3. Evaluating

It is the stage that designed assessment activities as performance homework by ETCs were evaluated through the rubric. The aim of this stage was to assess the difficulty of the rubric in the application and revise it. In this way, the revised rubric consists of a total of 12 criteria under two main themes, namely "Assessment Sheet" and "Scoring Chart" according to the type of material and each criterion has three options, "Good", "Must be improved" and "Incomplete".

2.3.4. Experiencing

It is the stage that final of the action research was conducted with ETCs in the second term enrolled in the same course in the second term at the university. Collecting data in this stage formed the findings of the study. ETCs in the second term applied the same course method with some planning differences as follows:

(i). The method of collaborative learning using breaking rooms was used in the online lesson. Because during the COVID-19 pandemic process, education was necessarily moved to distance education.

(ii). At the end of the group studies conducted, the ETCs presented their discussion products in the technological environment. In this sense, they used technological tools more than the first group. Thus online education may seem like a disadvantage, it provided an advantage in the research to support the technology use skills of the participants.

(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 them to be more sharing in the process.

(iv). ETCs completed performance homework based on the rubric revised in the first term. They were not involved in the development of the rubric, but ETCs in the first term were.

(v). While the ETCs in the first term completed the performance homework individually, they worked in teams of two in the second term. Thus, it was aimed to establish peer support.

End of the completed performance homework, ETCs fulfilled the self-assessment form to tell their experiences. The form created by the researchers includes both a rating Scale and two open-ended questions. Scale on the form is to rate of difficulty in the application of the rubric between 1 (Very Difficult) and 5 (Very Easy). One of the open questions is about they faced what kind of problems. The other is about they had what kind of contributions to design the 21st-century assessment activity.

2.4. Data Collection and Analysis

It has obtained data from the self-assessment form and rubric on performance homework in the study. In the self-assessment form, open-ended responses of ETCs were analyzed through content analysis. Obtained from the rating scale and the rubric was analyzed descriptive analysis such as frequency and percentage.

2.5. Validity and Reliability

For the validity and reliability of the study, triangulation was done by using different data collection tools. The performance homework, created by ETCs in the first term, was coded as M1, M2, etc. Two researchers scored this performance homework using the rubric at different times. The opinion of an independent researcher was taken for activities when there is no consensus. To increase the credibility of the results, examples are given from assessment activities by ETCs during reporting of the study. And also, all the steps of the study have been conveyed step by step.

2.6. Findings and Discussions

In this section, findings were explained in two titles by benefiting from related literature.

2.6.1. *Findings obtained from the rubric*

These findings were obtained from the rubric developed with ETCs in the first term to design 21st-century assessment activity. ETCs in the first term did performance homework based on this rubric. The researchers scored them as "must be improved or good" using the rubric. Table 2 shows the criteria in the rubric and the findings obtained from it.

Table 2.

Criteria and Findings Obtained from the Rubric

Materials	Discussion Keywords	Criteria	Frequencies		
			Incomplete	Must be Improved	Good
Assessment Sheet	● Problem-solving ● Critical thinking ● Productive product/ Creativity ● Completing with the group for collaborative work ● Individual scoring	1. Questions require solutions to problem situations that are scenario-based or that have more than one answer.	0	5	43
		2. Either the comparisons or one of the critical thinking techniques are used in the questions.	2	5	41
		3. The solution of the problem requires considering the problem with multiple answers from different perspectives, establishing a meronymy among unusual objects, or designing a new product such as poetry, story, and drawing.	9	0	39
		4. Each student defines a new task, question, or the options of the question for the other.	5	9	34
		5. An assessment sheet includes blanks to be filled or answered by more than one student.	9	10	29
		6. No student interferes with the other's marks or answers.	16	9	23
		7. There are guiding notes explaining the blanks to be filled or answered by the student for each task.	6	19	23
Scoring Chart	● Based on skill and performance instead of grade ● Turning the learning process into a cycle ● Provides feedback for sending assessment data back to the learning process ● Digital data recording	8. Each of the criteria that contains a skill or learning objective matches with the questions on the assessment sheet.	0	7	41
		9. Criteria categorize students according to the skills they acquired or missed, rather than grading.	0	38	10
		10. The feedback badge(s) to be assigned to the student according to the categorized skill can be clearly distinguished in the scoring chart.	0	21	27
		11. Badge names support skill-oriented learning such as solution-oriented, hard-working, rather than the adjectives that will increase competition among students such as novice and expert.	0	12	36
		12. The scoring chart provides both individual and summary reports for the analysis of the assessment data.	2	0	46

According to Table 2, criterion 1 (f_{good}: 43) and criterion 2 (f_{good}: 41) that were used in the assessment sheet were performed well by ETCs. Evren (2012) stated that problem-solving, critical thinking, and creative thinking skills, which constitute macro-level thinking skills, occur by using them interactively with micro-level thinking skills. Some of the micro-level thinking skills, which are classified in various ways, are: establishing a cause-effect relationship, establishing analogies that require associating unknown parts with the known ones, making associations find similar/common aspects, seeing the part and the whole, predicting the result/making an inference, sequence, comparing, distinguishing, pattern coding, decryption and identifying the qualities (Kayagil, 2010; Lipman, 1988). Regarding these criteria, which are related to the type of assessment task, ETCs created tasks that are presented in a specific scenario such as riddle, rhyme, story, or problem-based questions with more than one answer, or questions that use critical thinking.

On the other hand, criterion 6 (f_{incomp}: 16) and criterion 7 ($f_{mustbeimp}$: 19) addressing the collaboration features of the assessment sheet were implemented at an incomplete or improvable level. In case of criteria 6 and 7 cannot be implemented, the assessment sheet, which should be filled in as a team for the sake of collaboration, fails to allow individual scoring. Figure 2 and Figure 3 show some examples of the assessment sheet created by ETCs. They scored maximum from the rubric.
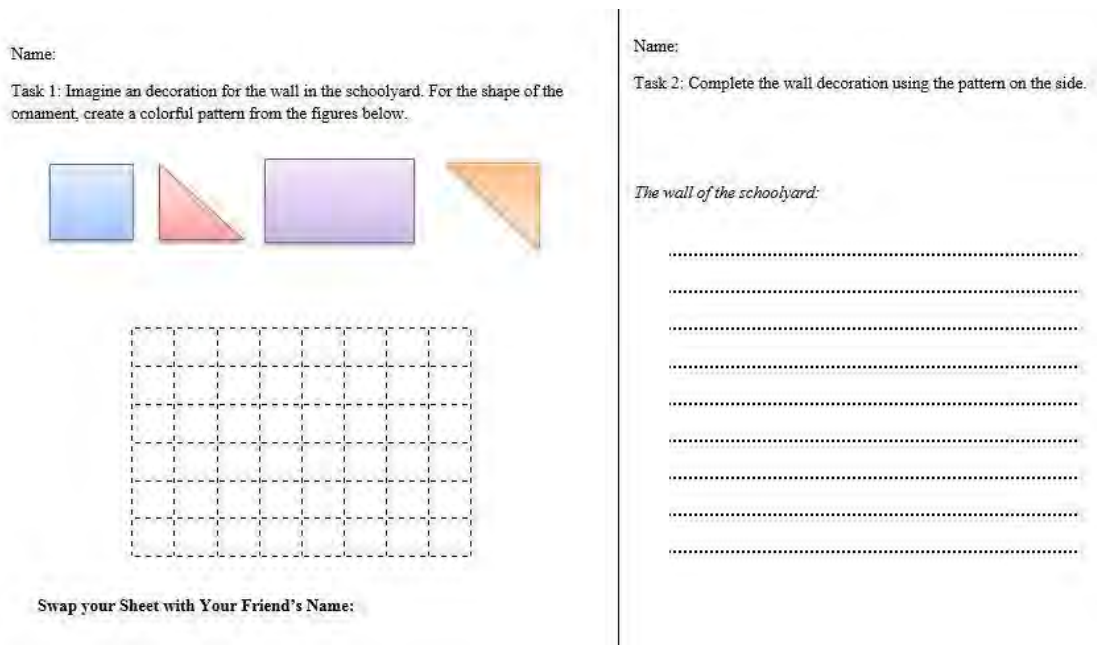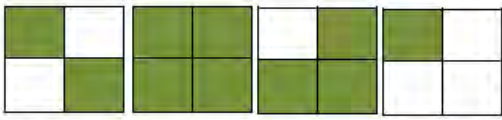

Fig. 2. Example of the Assessment Sheet from ETC14

As seen in the example in Figure 2, ETC14 includes the tasks that require meronymy and generating a unique product. For the collaboration feature to work, there should be independent marking areas on the assessment sheet for two different students. A student who completes the first task switches the material to complete the second task on the assessment sheet he/she received from his/her friend. The marking areas are independent of each other and task 2 is shaped according to the response of the student who completed task 1. In this way, two students fill each other's assessment sheets as a group, at the same time they can be scored individually as well. Another example of an assessment sheet is shown in Figure 3. As Figure 3, ETC1, which attempts to evaluate the skills of 3rd-grade mathematics students about fractions, established a meronymy relationship for the solution of a problem presented in the story (Figure 3). In addition, after a story writing activity similar to the first, the student changes with another student the sheet to complete the second task. For the collaborative sheet, there are explanations about the independent marking areas and directives in the next step.
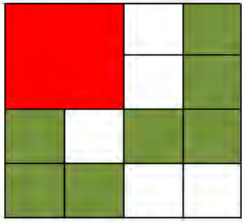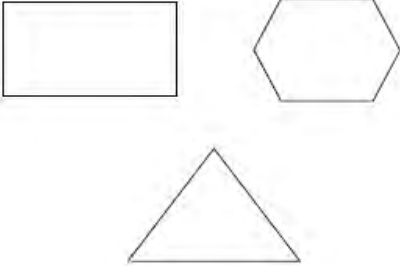
Fig. 3. An Example of the Assessment Sheets from ETC1

ETCs were not performed very well in Criterion 9 ($f_{mustbeimp}$: 38) and Criterion 10 ($f_{mustbeimp}$: 21) used in the scoring table. These two criteria were about categorizing the students according to their learning skills and giving them feedback for the new learning tasks. Tarhan (2015) stated that in the 21st-century, digital badges that define difference or similarity, knowledge, degree of expertise, or talent could be used in education instead of a diploma. Digital badges may be defined as digital visuals representing the skills and knowledge gained by the student (Hebebci & Usta, 2018). Because diplomas today do not contain detailed information about the learning process and the skills acquired by the student, while digital badges can help to evaluate the students more effectively in the learning environment and reflect the skills required in the field of employment (Yıldırım, Yıldırım, Çelik & Kara, 2014). Thus it can be said that they need more guidance about completing assessment tasks with groups but individual scoring on the assessment sheet and also they need more knowledge about creating feedback based on the badge. Figure 4 shows an example of feedback badges from ETC1. These two badges categorize students based on their scoreboard results and send them some feedback on a new learning task. The designed learning task allows peer learning by matching students.

Fig. 4. An Example of Feedback Badges from ETC1

2.6.2. *Findings obtained from the self-assessment form*

These findings were obtained from the self-assessment form filled out by ETCS in the second term. ETCs rated the difficulty level of the applying criteria to design a 21st-century assessment activity. The findings were given in Table 3.

Table 3.

Obtained findings from the rating scale in the self-assessment form

Criterion No	Frequencies				
	Very Hard	Hard	Moderate	Easy	Very Easy
1	1	1	9	22	7
2	0	11	17	13	1
3	2	12	11	15	2
4	3	4	18	13	3
5	1	7	11	12	10
6	3	4	16	12	5
7	0	6	14	12	10
8	2	8	14	11	7
9	3	4	10	18	7
10	2	5	16	12	5
11	2	7	12	13	8
12	1	7	14	14	5

As Table 3, ETCs found the criteria in the rubric as "Moderate level" generally during application. But also, it could be said that they thought criteria 2 and 3 was hard to apply. These criteria are about creating assessment tasks on critical and creative thinking. Table 4 shows the findings of the open-ended questions in the self-assessment form obtained from content analysis.

Table 4.

Obtained findings from responses of ETCs to open questions in the self-assessment form

Themes	Codes	Frequencies
Difficulties	● Using technologies ● Creating assessment tasks ● Creating feedback badges ● No difficulties	● 10 ● 11 ● 9 ● 8
Contributions	● Professional skills and awareness ● A different perspective on assessment ● Technical skills	● 26 ● 9 ● 8

According to Table 4, the answers to the open question 1 (What are the difficulties of designing 21st-century assessment activity for you?) were collected under the headings of "using technologies, creating

assessment tasks and creating feedback badges". On the other hand, 8 participants of ETCs stated they had no difficulties. ETCs' some views on difficulties are as follows:

I had some challenges in adapting the feedback methods we use in feedback messages to the student's learning lack [ETC32].

In the assessment activity, we had some difficulty in terms of how we could assign tasks to the students. Apart from that, we also thought a lot about how to make students think critically and look inquisitively [ETC38].

In this regard, Özden (2006), who emphasized the critical thinking skill for problem-solving, stated that at this point students should be taught that a problem always has an alternative solution. ETCs in the first term created some tasks very well but they used a few critical techniques such as grouping and establishing relationships. Also, ETCs in the second term stated that had difficulty on creating assessment tasks and feedback badges. Digital badges have several advantages such as motivation, active participation, and interest in the course, but they also bring some disadvantages due to the competition and infrastructure problems among students. But also, with that arrangements is to be made at these points would spread the use of digital badges (Hebebci & Usta, 2018). For these reasons, that can be said that ETCs need more guidance on creating assessment tasks and feedback badges based on using technology.

The answers to open question 2 (What are the contributions of designing 21st-century assessment activity to you?) were collected under the codes of "professional skills and awareness, technical skills and different perspective on assessment". Some of ETCs' views on *professional skills and awareness* are as follows:

Now I can do the assessment activity that a classroom teacher can do. I learned what is needed. Assessment should be made according to students' skills in the 21st-century. They should be categorized by their skills, not their scores. The student should feel that each of them has a skill. The homework we did in practice also contributed to me [ETC5].

I think that the tasks given to students by preparing digital badges are quite creative. It was a lesson and evaluation process that I will always use in my own professional life [ETC6].

Some of ETCs' views on *technical skills* are as follows:

I realized that I knew nothing about technology and any about applying it to education [ETC8].

Some of ETCs' views on *different perspective on assessment* are as follows:

It allowed me to explore different aspects of traditional assessment techniques. I have seen that it is possible to make evaluations in much more effective and different ways. I saw that I could make students realize their shortcomings and be improved by motivating them. [ETC32].

I learned how an evaluation activity should take place in the 21st-century and how it will happen step by step. This allowed me to be a little more creative and productive [ETC39].

After all, though ETCs faced challenges when designing assessment activities in the 21st-century, they stated that these experiences contributed to them in a professional sense.

3. Conclusion and Suggestions

In the study, ETCs experienced designing assessment activities for the 21st-century based on some characteristics. These characteristics which were created by researchers' contributions have been compared to other assessment tools measuring 21st-century skills about what kind of differences and similarities. All of that has explained as follows:

(i).   *Tasks based on problem-solving, critical thinking, and productive product:* The assessment tasks developed according to these criteria, are scenario-based problems that require considering the problems having more than one answer from different perspectives or requiring the design of unique products such as poetry, story writing, and drawing. These tasks are similar to

California Critical Thinking Skills Test (Facione, 1990), the Cornell Critical Thinking Tests (Ennis & Millman, 2005) and PISA 2012 Creative Problem Solving Test (OECD, 2014). Because these standardized assessment tests utilize multiple-choice items or open-ended prompts in tackling real-life problems designed to assess component critical thinking skills such as deductive reasoning, inductive reasoning, drawing conclusions, evaluating arguments, and so forth. On the other hand, some tasks made by ETCs have differences from these tests in requiring the design of unique products such as poetry, story writing, and drawing. In these case, the problems are considered as a means to boost collaboration and creativity (Gündoğdu & Merç, 2022).

(i).   *Collaborative tasks:* Collaborative approach is as a key drive towards the acquisition of 21st century skills (Ndibalema, 2020). For that, in the study, an assessment sheet have developed towards the students who learn in collaboration in the 21st-century. But the important thing was that the assessment sheet had to be in a collaborative structure. This structure is similar to PISA 2015 Collaborative Problem Solving (CPS) test (OECD, 2017), but also it has a few differences. For the collaborative structure designed by ETCs, tasks in the assessment sheet are filled by more than one student, in other words, the marks or answers of two different students are present in the same assessment sheet. So these structures are similar to PISA 2015 Collaborative Problem Solving (CPS) test (OECD, 2017), but also it has a few differences. Collaborative structure designed by ETCs, tasks in the assessment sheet are filled by more than one student, in other words, the marks or answers of two different students are present in the same assessment sheet. So, they work individually on the sheet, not as a team. But also, they create or choose some tasks for the team workers. For example, a student picks some words from a story about the issue in the first task. These words should be about the issue. After changing the assessment sheet with the team workers, the second task is to write using these words chosen by the team worker another story similar to the first task. But CPS test, differently requires individuals to work on a problem by communicating with each other or performing certain actions. Also the both assessment ways are like each other in discovering perspectives of team members and identifying and describing tasks to be completed. On the other, they both are allowing and targeting individual scoring. To allow individual scoring on this study, each student's answers or markings must be independent of each other. For this reason, students are provided with clear instructions about what to solve and where to write on the assessment sheet by ETCs.

(i).   *Skill-based scoring and feedback badges:* Learning outcomes in the scoring system of the 21st-century assessment are defined by skills rather than grades. So, at the end of the assessment, feedback badges are used to categorize students based on learning skills. Feedback badges have a symbolic logo and name that will increase motivation and willingness to learn. These badges are assigned to the students through a digitally designed scoring table. They include to students new tasks that they will do as peers or individually. Also in this way, they are used for going back the assessment data to the learning process. In this way, teachers can create student profiles for an environment that encourages learning by recording the knowledge and skills that the student has acquired or missed during the learning process. These new tasks on feedback badges provide on recognizing the students' own strengths and weaknesses in relation to the task (meta-memory) and recognizing the other students' strengths and weaknesses (transactive-memory). Thus, it is similar to monitoring and reflecting phases in the CPS test, but it is used in a different way (OECD, 2017).

Summarily, we tried to solve a problem with action research in this study. The problem was improving ETCs' skills in designing assessment activities suitable for the 21st-century in teacher preparation programs. The solution to the problem was that designing 21st-century assessment activities can be taught at various courses in teacher preparation programs. As a result of this solution, the ETCs made significant improvements in the experiences and practices of designing 21st-century assessment activities in the teacher preparation program. Also this study indicated that ETCs were not familiar with common technologies and faced challenges when designing assessment activities in the 21st-century. Thus ETCs need more guidance and resources about the characteristics mentioned above. On the other hand, these experiences contributed to them their professional skills and awareness. In this sense, this study is important to prepare ETCs for the 21st-century. Some suggestions for future studies, based on the results of the study can be listed as below:

(i). The scope of the study can be expanded with a research design in which ETCs apply their assessment activities in the real classroom.

(ii). Teaching preparation programs at the universities can be redesigned to involve ETCs in similar assessment processes.

(iii). In-service training with similar content can be organized for teachers and lecturers to gain experience in designing assessment activities in the 21st-century.

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