

E-Learning-Based Task Design for Developing Mathematics Instructional Tools Containing 4C Skills

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ABSTRACT

The challenge for teachers during this pandemic is to continue to provide quality learning for their students. All forms of learning that were initially carried out face-to-face must now turn to online learning. One form of learning that is considered effective to be given online is by giving powerful and meaningful tasks. This article aims to describe the task design to develop mathematics learning tools that contain creativity and innovation, critical thinking and problem solving, collaboration, and communication, or what is often referred to as 4C skills. The design of these tasks is delivered using google classroom as the Learning Management System, synchronously, and asynchronously. The tasks are developed by following the ADDIE (Analysis, Design, Develop, Implement, and Evaluate) model, which in this article reaches the Develop stage. The complete task designed consists of the activities of: 1) explaining the 21st Century Learning framework simply by showing the 4C's position in it; 2) analyzing math learning activities that provoke 4C skills; 3) developing 4C skills assessment rubric, and 4) designing math instructional tools that contain 4C. Furthermore, the task designed will be validated and tested on mathematics education students who have taken the course that supports the development of the instructional tool such as innovative learning, assessments, learning media, and others.

Keywords: *E-learning, task design, instructional tools, 4C skills.*

1. INTRODUCTION

In this era, everyone is required to be able to adapt to the rapid development of the era. Adapt means not easily stuttering with any newness that emerges and goes in harmony with the times itself. Teacher is a profession which is expected to be ready with every era development.

Currently, in the midst of the Covid-19 pandemic, all sectors are taking part in dealing with this outbreak. This pandemic has forced global physical closure of businesses, sport activities and schools by pushing all institutions to migrate to online platforms [1]. Each sector plays a role with its respective portion. In the education sector, distance learning is recommended by the Government. On March 24, 2020, the Minister of Education and Culture issued Circular No. 4 of 2020 which requires all forms of the learning process to be carried out by students / students from their respective homes. In this case, e-learning becomes very important during this pandemic. Though, some challenges are faced by all parties involved: students, lecturers, and the

institutions. Simamora stated that the students are challenged by connectivity, e-learning system support, and technological and self-regulation issues, the lecturers are being challenged by competency, operational, self-regulation, and isolation issues, while the institutions identify financial support and change management as challenging issues [2]. In fact, the Ministry of Education and Culture is preparing a learning scenario from a halfway house at the end of 2020 [3]. This has an impact on all institutions engaged in education to prepare online learning for the next semester. As part of society, we must also pay attention to the above recommendations while still paying attention to the needs of prospective teachers and not reducing their quality.

Hafsah states that 21st century teachers are required to pay more attention to the needs of students and prepare them to face various challenges in the future [4]. In 21st century learning, National Education Association requires that students today have the skills of Creativity and Innovation, Critical Thinking and Problem Solving, Collaboration, Communication, or more commonly referred to as "the Four Cs" or "4C" in order to compete

globally [5]. These four skills, within the framework of 21st century learning, are part of learning and innovation skills. The recommendation of students to have the four skills above causes a prospective mathematics teacher to need skills in compiling learning tools that contain 4C.

Regulation of the Minister of Education and Culture No. 65 of 2013 states that the instructional planning is arranged in the form of a syllabus and lesson plans which refer to the content standard. The Instructional Planning in question consists of the preparation of a lesson plan and the preparation of media and learning resources, learning assessment tools, and learning scenarios or what is often referred to as instructional tools.

Prospective mathematics teachers must be prepared to be flexible with the online learning process, as a contributor to the skills to be able to compile online mathematics instructional tools later. One form of online learning can be through giving assignments. Learning becomes more effective when the task given is complex, and requires students to actively discuss, involve decision making and foster creativity. Design assignments that are not carefully arranged and do not make students challenged causes students to not focus and students' energy to learn is lost [6]. Moreover, if presented online, the design of assignments given to students must be paid close attention.

There are at least four principles of online assignment, including: paying attention to task definitions and their characteristics, using appropriate tools or media to facilitate student interaction, paying attention to the relevance of assignments to student characteristics, learning objectives, and applicable curriculum, and planning teacher roles / actions on when the assignment is given [7]. E-learning and online learning have almost the same definition. However, e-learning is part of online learning [8]. E-learning is more specific when compared to online learning. Not only related to the technology used as online learning is defined, e-learning contains constructivism theory in which learners are able to build their own knowledge with designed activities.

Giving assignments using e-learning requires its own skills, namely the skills to utilize technology. The skills to utilize and process information, media, and technology (information, media and technology skills) are one of the skills demanded in 21st century learning apart from life and career skills and learning and innovation skills in which 4C skills are included [9]. From the above background, the research which aims to design e-learning-based assignments to develop mathematics learning tools containing 4Cs for student mathematics teacher candidates during the Covid-19 handling period was carried out.

2. RESEARCH METHOD

The type of research carried out is design research because in this study the aim is to design e-learning based tasks to develop mathematics learning tools that contain 4C during the Covid-19 pandemic. The development research model used is the ADDIE which consists of Analyze, Design, Development, Implementation, and Evaluation stages, as this model helps learning developers (lecturers, teachers, or researchers) to create learning designs that are efficient and effective [10].

In analysis stage, students' need, the document of curriculum, and instructional objective were analyzed. As a part of analysis stage, a questionnaire given to the 30 students to give a brief information about students' perception of online learning they are accustomed with, also to explore what kind of online learning form they prefer. From the questionnaire was also obtained the information about what Learning Management System (LMS) and platform they are familiar with. This information was used to choose the LMS and platform to deliver the task design. In design stage, literature review was conducted to gather the theory of delivering e-learning, instructional design, 21st century learning, and 4C skills. From these activities, a storyline was constructed, the tasks were designed and developed, and then validated by two experts.

The criteria for assessing the validity of the task designed in this study refer to the opinion of Sa'adun Akbar [11]. The criteria for assessing the validity of task designed in this study can be seen in Table 1 below.

Table 1. Validity Criteria

Interval	Validity level
3,41 – 4,00	Very Valid
2,81 – 3,40	Valid
2,01 - 2,80	Less Valid
1,00 – 2,00	Invalid

The average score obtained from two validators were classified by using the criteria in Table 1. After the tasks were all valid, those were uploaded into google classroom then.

3. RESULTS AND DISCUSSION

3.1 Analysis Stage

At this stage several analyzes were carried out, including: 1) student analysis; 2) instructional analysis; 3) preparation of learning objectives; and 4) analysis of learning objectives. Student analysis is needed to identify student needs, level of understanding, what are the prerequisites for the material to be delivered, to student characteristics. The most basic reason for the preparation of this task is because prospective teachers really need the skills to arrange learning tools that contain this 4C.

To be able to learn these skills, students must master or at least learn the preparation of learning tools, learning models, assessment, and learning media. In the curriculum structure of the Unesa Mathematics Education Study Program, the device development courses have not specifically linked material with 21st century skills. For this reason, this research was carried out by taking part outside of courses, namely by arranging tasks that enable students to design mathematics learning instructional tools containing 4C.

The conditions of the Covid-19 pandemic support the provision of these tasks to be carried out online. However, e-learning is part of online learning that e-learning is not only related to the technology used as online learning is defined, but e-learning contains constructivist theories in which learners are able to build their own knowledge with designed activities [6]. In line with the nuances of this research, through the design of

the assignments given, in the end students are able to independently compile learning tools. Therefore, e-learning is suitable for use as a form of learning that can accommodate students in learning the stages of preparing mathematics learning tools that contain 4C.

The data obtained from the questionnaire give a view about students' perception of online learning they are accustomed with, what kind of online learning form they prefer, and what Learning Management System (LMS) and platform they are familiar with. The result of the students' perception questionnaire is as seen in Table 2. Only the statement of "online learning can replace the traditional learning" that more than 25% of students are not agree with. These results also give a view about what kind of online learning they prefer. The LMS they are familiar with are only google classroom, while the platform they often used were Google Meet, Zoom, YouTube, and WhatsApp.

Table 2. Students' perception of online learning

No.	Questionnaire items	Percentage of Students Agree with
1.	I think online learning should give students flexibility in learning	100%
2.	The learning resources provided for online learning should be in vary and easy to access	100%
3.	Instructions for using the platform for learning must be explained first	93.33%
4.	The platform used must be easy to access and use	100%
5.	Online learning should represent face-to-face learning	96.67%
6.	I think online learning can replace traditional learning	73.33%
7.	The menus / features on the platform should be easy to understand and use	100%
8.	Online learning should improve my knowledge and understanding	100%
9.	Online learning that is implemented should be able to increase my independence in learning	100%
10.	Discussion forums, video presentations, and materials that have been in the past should often be reopened as materials for learning	100%
11.	Every student should remain active in online learning just as in face-to-face classes	100%
12.	Lecturers in online learning should still provide material explanations that are easy to understand	100%
13.	Lecturers in online learning should provide feedback on assigned assignments	93.33%

The next step is the preparation of learning objectives. The ability that is expected to be achieved by students through task design through e-learning is that students can develop mathematics instructional tools containing 4C skills. The instructional tools developed by the students may consist of lesson plan, media (PowerPoint slides, video, student worksheet or others), and the assessment.

3.2 Design Stage

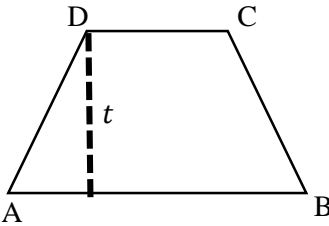
The design stage is the next step in the ADDIE model. At this design stage, it focuses more on the preparation of learning strategies which are manifested in guided discovery steps carried out on students so that students can achieve the predetermined objectives of task designed, namely students can develop mathematics learning tools that contain 4C skills. The learning objective stated in analysis stage is broken down into

these four main activities: 1) Explaining the 21st Century Learning framework simply by showing the 4C's position in it; 2) Analyzing math learning activities that provoke 4C skills; 3) Developing 4C skills assessment rubric; and 4) Designing math instructional tools that contain 4C. These four main activities then developed into task instructions that guided students to achieve the learning objective.

3.3 Development Stage

The next step is the Developmental Stage. The main activities designed then broken down into several assignment instruction as seen in Table 3. The development has considered the step that the students have to experienced to achieved the indicator of achievement in each main activity.

Table 3. The Activities Designed

Activities	Assignment instructions to students
<p>Explaining the 21st Century Learning framework simply by showing the 4C's position in it</p>	<p>Read material from the following handout and other sources</p> <ol style="list-style-type: none"> Express your opinion, what are the principles and characteristics of 21st Century Learning? Describe the transformed paradigm in 21st Century learning. What do 21st Century skills include? What are 4C skills in 21st century learning? Give a clear and concise explanation. Create a concept map explaining how the 4C skills will position the framework of 21st century learning. Identify 21st century skills to target through the given case studies. <p>Case: A mathematics teacher assigns his students to evaluate whether the following work of his friend is correct, if there are deficiencies / mistakes they are asked to show where their mistakes are and how they should be.</p> <p style="text-align: center;"> <i>Tentukan penyelesaian dari $\frac{1}{x+5} < 2$.</i> <i>Jawab: $\frac{1}{x+5} < 2$</i> $1 < 2x + 10$ $-9 < 2x$ $-\frac{9}{2} < x$ $x > -\frac{9}{2}$ <i>cek untuk $x = 0$, maka $\frac{1}{0+5} = \frac{1}{5} < 2$ Benar</i> </p>
<p>Analyzing math learning activities that provoke 4C skills</p>	<ol style="list-style-type: none"> Watch the following video. Identify the 4C skills that appear in the activity. Compile a list of questions that provoke students' critical thinking skills when teaching the quadratic function material (Junior High School) Construct one task that measures all four 4C skills at once.
<p>Developing 4C skills assessment rubric from given cases</p>	<p>A teacher invites students to rediscover the formula for the area of any trapezium by giving the following instructions.</p> <p>"An isosceles trapezoid ABCD is given as shown in the following picture.</p> <p>By dividing the trapezium above into shapes that you already know the area formula for, prove that the area of the trapezium is $\frac{1}{2} \times (AB + CD) \times t$ in at least 2 different ways. "</p> <div style="text-align: center;">  <p>The diagram shows an isosceles trapezoid with vertices labeled A (bottom-left), B (bottom-right), C (top-right), and D (top-left). A vertical dashed line segment from D to the base AB is labeled 't', representing the height of the trapezoid.</p> </div>

		(a) What 4C's stands out in the above problem? Give your arguments. (b) Arrange the scoring rubric according to the skills you claim in question (a) Complete the following questions, describe the outstanding 4C skills, and compile a scoring rubric.
Designing math instructional tools that contain 4C		Design a lesson plan complete with the media and / or student worksheet and assessment rubrics, for a topic in mathematics of Senior High School

Table 4. The result of validation phase

No.	Statement	Score from validator I	Score from validator II
1.	The task items are in accordance with the indicators formulated (attached).	3	4
2.	The task items encourage students to be able to understand the characteristics of 21st century learning	3	4
3.	The task items encourage students to be able to explain important skills in 21st century learning	3	4
4.	The task items encourage students to be able to explain the position of 4C skills in 21st century learning	2	4
5.	Task items encourage students to be able to identify 4C skills in given cases	3	4
6.	Task items encourage students to achieve the expected ability	3	4
7.	Task items use language in accordance with PUEBI (General Guidelines for Indonesian Spelling).	4	4
8.	The items according to the level of understanding of the student	4	3
Total score		25	31

The assignment as seen in Table 3 then validated by two experts. The result of the validation phase is as seen in Table 4. The average score from the two experts is 3.5 which is categorized as very valid [11]. In addition to providing a decision score on the assignment, the two

validators also provided comments and improvements to the validated design. The comments and suggestions are used as basis for improving the task. Comments and suggestions for improvement and the follow-up of the researcher are summarized in Table 5.

Table 5. Expert comments and suggestions for improvement and the follow up

Expert comments and suggestions for improvement	The follow up
Validator I There should be an assignment that asks students to arrange mathematical problems / assignments for students who can measure all 4c skills at once: creative thinking skills, critical thinking and problem solving, communication, and collaboration. (collaboration)	Added assignments that ask students to construct math problems / assignments for students who can measure all skills at once 4c
Task Item 1.2 is considered to have multiple interpretations, so it needs to be corrected for its editorial	Improve the editorial of assignment 1.2 according to the validator's suggestion

Task Editor 1.4 needs to be improved	Improve the editorial of assignment 1.4 as suggested by the validator
Validator II The information in task 1.1 needs to be clarified	Add important information to assignment 1.1 so that the purpose of the assignment is clearer
It is necessary to add the measured components in Task 1.4.	Adding the measured components according to the validator's suggestions on assignment 1.4

After refining the tasks as suggested by the validators, the tasks were then uploaded to the LMS as shown in Figures 1 and Figure 2.

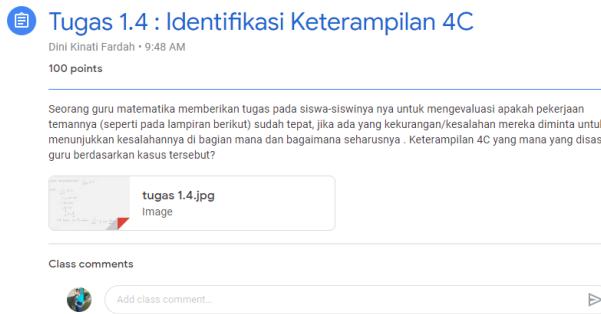


Figure 1. Example of task design I uploaded in Google Classroom



Figure 2. Example of task design II uploaded in Google Classroom

The task shown in figure 1 and figure 2 are the example of tasks that will be given to the students later then. The criteria of the students become the subject of the product implementation are the students have learned how to design lesson plan, assessment instrument, learning media and other topics supported instructional tools development.

5. CONCLUSION

Five stages of development with the ADDIE model, the results that have been achieved are: 1) the results of the analysis stage, namely in the form of task analysis and student needs analysis; 2) the results of design stage, namely in the form of a storyline for the development of mathematics learning tools containing 4Cs; 3) the results of development stage, namely the prototype of task designed. The complete task designed consist of the activities of: 1) Explaining the 21st Century Learning

framework simply by showing the 4C's position in it; 2) Analyzing math learning activities that provoke 4C skills; 3) Developing 4C skills assessment rubric; and 4) Designing math instructional tools that contain 4C. The four main activities that broken done into several task items were valid according to the experts.

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