Need Analysis for Physics E-Module Based on Creative Problem Solving Integrated 21st Century Skills

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Abstract. Online learning is an alternative in the 21st century. Teachers are expected to adapt to these changes by developing teaching materials that are interactive, interesting, and accessed at any time. Besides, the development of teaching materials needs to pay attention to the skills needed by students today. This research is the initial part of development research. This study aims to determine the need of teaching materials that are appropriate for the 21st century. Through student analysis, curriculum analysis, and material analysis for physical learning, information is obtained. It is necessary to develop digital teaching materials in integrated e-modules with Creative Problem-Solving models to achieve 21st-century skills.

1. Introduction

The 21st century has brought changes to all aspects of life. The development of technology and science in the 21st century has brought about changes in many parts of our life [1]. These changes also occur in the education sector. Changes in the world of education include applying information technology in learning and competencies that students must master [2]. The development of technology has greatly influenced the world of education, face-to-face learning has turned into online learning, printed teaching materials have become digital teaching materials [3]. Teachers are expected to adapt in preparing digital teaching materials [4]. Digital learning meets the following criteria: there is teacher and student interaction, unlimited learning resources, contains online media so that it can be easily accessed and downloaded by students [5].

21st-century learning includes: learning encourages students to seek, learning is directed to formulate problems, learning is directed to train analytical thinking, decision making, and learning emphasizes the importance of cooperation and collaboration in solving problems [6]. Learning in the 21st century allows students to learn using unlimited learning resources; students can learn from anywhere, anytime. Teachers are expected to facilitate students to learn according to 21st-century instructions.

Learning in the 21st-century is also related to the competencies that students must master. 21st century learning emphasizes achieving 21st century skills [6]. The skills of the 21st century need to be possessed by all subsequent generations to be able to compete with world conditions in the future [7]. 21st-century skills consist of: informative and communicative, thinking and problem-solving skills and self-development [7]. Learning is expected to direct and facilitate students in achieving the expected competencies. One of the steps that the teacher can take is to use a learning model. Learning using problem-solving can help students achieve high-level learning goals (High Order Thinking Skills [8]).
The learning model that can develop 21st-century skills is Creative Problem Solving (CPS) \cite{9}. CPS emphasizes problem-solving skills through systematic stages \cite{10}. CPS Model is a learning model which could help students solve problems systematically \cite{11}. The application of CPS is one way to improve students' critical thinking skills \cite{12}. The CPS model allows students to learn to work in teams according to their respective problem-solving characteristics \cite{13}. Education experts have long developed CPS. The latest CPS model is the CPS model developed by the Creative Education Foundation, which explains CPS's syntax as clarify, ideate, development, and implement \cite{14}. In each syntax, it helps students be creative, solve problems, be critical in the discussion, communicate in conveying ideas, and practice collaboration \cite{15}. CPS can improve students' 21st-century skills.

Teachers as facilitators are expected to prepare to learn following the demands of the 21st century, both in the form or steps for achieving competence \cite{15}. Teachers in the 21st century are teachers who can adapt to technological developments \cite{16}. One of the things that teachers can do is to develop digital teaching materials. E-module is a tool for teaching materials suitable for use in 21st-century learning \cite{17}. E-modules are teaching materials that allow students to study independently, which can be accessed anywhere and anytime \cite{18}. E-modules are expected to help students in independent learning and accelerate the achievement of student competencies.

2. Methods
This research method is research and development. This study uses the Reeve model, which consists of 4 steps according to the image below:

![Figure 1. Reeve Models Steps](image)

This paper describes the first step in this part of the research, namely problem analysis. Problem analysis consists of curriculum analysis (analysis of learning objectives and analysis of material) and student analysis. Curriculum analysis using analysis sheets (curriculum document analysis). Student analysis was carried out by distributing questionnaires to 54 students, with a list of online learning questions, currently available teaching materials, and interest in 21st-century skills. The data analysis used was descriptive analysis for the characterization of students' characters. While for the next research steps will be presented in the next publication.

3. Results and Discussion
Curriculum analysis aims to analyze the main competencies for physics learning for second grade of senior high school. The curriculum document analyzed is Regulation of the Minister of Education and Culture No. 27 of 2018 concerning Core Competencies and Basic Competencies in Learning in Senior High School. Learning competences consist of: spiritual attitudes, social attitudes, knowledge, and skills. Knowledge competencies include students being able to analyze facts, principles, procedures, and metacognitive curiosity about science, social, culture, and technology. Skills competencies include the ability to process, reason, and present concretely and abstractly related to the studied material.
Core competencies are broken down into several basic competencies. Basic competencies consist of knowledge and skills. Competence knowledge consists of 1) applying the concepts of rotational dynamics and rigid body equilibrium in everyday life, 2) analyzing the elasticity of a material, 3) applying static fluid laws, 4) applying dynamic fluid laws in technology, 5) analyzing the effects of heat in everyday life, 6) explain the kinetic theory of gases. Based on the explanation above, it is found that the expected competence for learning physics class 2 in senior high school is to apply the concept and analyze something. The ability to apply concepts/principles is an ability that requires students' creativity in solving problems that exist in everyday life. Besides, the competency that students are expected to achieve after learning physics is analyzing a concept. Analyzing is closely related to being critical and creative and observant of looking for relationships between concepts.

Furthermore, the authors analyzed the learning objectives in one of the learning materials, namely static fluid and dynamic fluid. The learning objectives consist of: 1) explaining the concept of pressure, 2) analyzing Pascal's law, 3) analyzing Archimedes' law, 4) analyzing the quantities that affect capillarity and viscosity, 5) explaining the ideal fluid concept, 6) understanding the principle of continuity, 7) applying the concept of continuity in everyday life, 8) analyzing Bernoulli's law, 9) applying the Bernoulli principle to several technological products. Based on the description of the learning objectives above, information is obtained that the learning objectives formulated are dominated by applying and analyzing. Therefore, implementing the CPS model in learning is a must because CPS can help students think critically and creatively to solve problems they find. The learning objectives also formulate the ability to be able to apply concepts in everyday life. Applying the concept requires creativity, critical, collaborative, and communicative. Kreativitas relates to the choice of varied solutions, critical related to conducting literacy research before taking action, collaborative related to the ability to work with others in finding solutions, and communicative related to the skills to communicate the solutions found to others. These skills are related to 21st-century skills. Therefore, the integration of 21st century skills in learning is a must to prepare a generation of nations ready to compete in the future.

Skills competencies emphasize several abilities: 1) doing works related to rotational dynamics, 2) conducting and presenting experimental results related to elasticity, 3) designing and conducting experiments on static fluids, 4) testing dynamic fluid related projects, 5) designing and presenting heat-related experiments, 6) presenting works related to the kinetic theory of gases. Based on the above skill competencies, information is obtained that students are expected to produce work. Creating work requires creativity in preparing works that are novel and unique. Students must also be critical of the existing solution options. Then students must also be able to cooperate with friends in producing good work. Besides, an ability that is no less important is the ability to communicate the work that is found to others. Another competency that is expected is that students can design, conduct, and communicate an experiment. Based on this, the CPS model is fundamental to be applied in learning. Students are expected to be able to submit opinions or ideas, be able to do new works. The CPS model steps lead students to create new solutions and can convey ideas correctly. The application of 21st-century competencies needs to be done to support the achievement of competencies in doing works (creative), conducting experiments (critical, collaborative, and communicative).

Student analysis was carried out by filling out a questionnaire by 54 students. The results of the student analysis were: 1) 34 students agreed to learn at school, 2) 43 students agreed that the teacher was motivation when learning, 3) 47 students agreed that the subject, 4 influenced the enthusiasm for learning) according to 38 students, the teaching materials that were currently available not yet helping to learn independently optimally, 5) 30 people stated that teaching materials could be accessed anywhere and anytime, 6) 30 students stated that learning did not begin with challenging questions, 7) according to 26 students the language in teaching materials was difficult to understand, 8) according to 37 students display the teaching materials used is less attractive, 9) 33 students are not familiar with 21st-century skills, 10) 19 students believe that 21st-century skills need to be mastered and learned. Based on the above problems, it is obtained information that students are not familiar with distance learning, so teacher creativity is needed to create fun distance learning, one of which can be done by
developing teaching materials in the form of interesting e-modules [17]. E-module is a teaching material with the most complete, interactive components and allows students to learn independently [17]. Teachers are expected to be able to prepare interesting teaching materials and help students achieve competence effectively. Furthermore, students are not fully acquainted with 21st-century skills, but they are very interested in learning about 21st-century skills. Teachers need to integrate 21st-century skills to prepare future generations who master 21st-century skills and prepare to compete globally [7].

4. Conclusion
It is necessary to develop teaching materials in e-modules based on an integrated creative problem solving (CPS) model with 21st-century skills. This needs to be done to prepare a future generation that masters 21-century skills completely

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