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Research Article

Needs Analysis of Differentiation Learning Design with a Sustainability-Oriented TPACK Approach on Climate Concept Phase D Natural Science Material

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Abstract.
Climate change is an increasingly real problem. One route that can be taken to overcome this problem is through education. Learning as the core of education needs to be designed in such a way that students receive sufficient provisions to be able to participate in overcoming climate change. This research aims to analyze the need for learning designs for climate change concepts. The method used in this research is a qualitative research method. The partcipants in this research were 30 science teachers in Pekalongan city. Data collection was carried out using interview techniques, documentation, and questionnaires. Data analysis techniques were done through data reduction, data presentation, and drawing conclusions. The data obtained shows that the depth of material in climate change learning is still lacking, learning is not yet differentiated, the use of information technology is still minimal, discussions are still focused on environmental aspects and have not been linked much to economic and environmental aspects. The findings in this research indicate the need for a climate change concept learning design with sufficient material scope and depth, accommodating the diversity of student characteristics, and introducing a sustainability perspective for sustainable development.

Keywords: needs analysis, learning design, climate change, natural science, Phase D.

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1. Introduction

Environmental problems are global problems [1,2]. Joint efforts continue to be made, including holding the G20 meeting in Bali in 2022 with one of the priority issues discussed being climate change [3]. The world is currently threatened by climate change [4]. Apart from global efforts, efforts to overcome environmental damage must be followed up locally, including through education. Appropriate learning design is needed to achieve these goals.

Environmental education leads students to have environmental literacy [5]. Environmental literacy plays a role in forming a person's character to care about the environment

How to cite this article: Ikasari Dewi*, Fenny Roshayanti, Endah Rita Sulistya Dewi, (2024), "Needs Analysis of Differentiation Learning Design with a Sustainability-Oriented TPACK Approach on Climate Concept Phase D Natural Science Material" in 6th *International Conference on Education and Social Science Research*, KnE Social Sciences, pages 694–701. DOI 10.18502/kss.v9i6.15323

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[6]. Meanwhile, junior high school students' environmental literacy still needs to be improved [7]. Increasing environmental literacy can be done through learning with appropriate designs. This suitability includes conformity with the Merdeka curriculum and student characteristics. The Merdeka curriculum applies differentiated learning so that students' differences in character can be accommodated [8]. Apart from individual characteristics, the characteristics of students in general who are Generation Z also need to be considered. One of the characteristics of Generation Z is that they are close to gadgets.

Learning design is concerned with understanding, improving, and applying learning methods [9]. The word design has a different meaning from development. According to Kurniawati [10], the word design means making a sketch/pattern/outline/preliminary plan, while development means making something grow regularly to make something bigger, better, more effective and so on.

This research aims to analyze the need for learning designs for climate change concepts. The four basic components in planning learning design according to Mirisson, et al [11] are student characteristics, objectives, learning strategies, and evaluation procedures. These four components serve as a guide in analyzing climate change learning design needs.

2. Method

The method used in this research is a qualitative research method. The subjects of this research were science teachers in Pekalongan City. The total sample was 30 people. The research was carried out in July 2023. Data collection was carried out using interview techniques, documentation, and questionnaires. Data analysis techniques are carried out through data reduction, data presentation, and drawing conclusions.

3. Result and Discussion

Climate change is one of the materials mandated to be studied in the phase D Merdeka curriculum with a formulation of learning outcomes, namely designing efforts to prevent and overcome pollution and climate change [12].

Learning this material is expected to be a means of increasing students' environmental literacy so that it has a positive impact on solving environmental problems both now and in the future. Students who have environmental literacy will have the ability to choose to behave responsibly towards the environment through knowledge, skills, and

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awareness of environmental problems so environmental literacy plays a role in forming a person's character to care about the environment [6]

Strong environmental literacy is needed for students in the future along with changes in ways of thinking related to the various interests they will experience in the future. These interests are not only related to the environment but are also related to economic and social aspects. The principle of balancing these three aspects needs to be instilled from an early age to maintain the continuity of human life (sustainability).

This research aims to analyze the need for differentiated learning design based on the concept of climate change with a sustainability orientation, and using the TPACK approach. The following are the findings of this research.

4. Student characteristics

Data from interviews, observations, and questionnaires shows that 100% of respondents stated that their students were close to devices in their daily lives. This is in line with the opinion which states that current junior high school students aged 12 to 15 years are Generation Z who have the characteristics of being close to technology [13].

Students' closeness to technology in their daily lives needs to be considered in designing learning related to the chosen media. The data obtained shows that the use of technology-based media is still minimal. As many as 30% of respondents used media in the form of power points which contained images and videos, 40% used images, 20% used videos and 10% did not use media. This data is contained in Diagram 1—use of Learning Media.
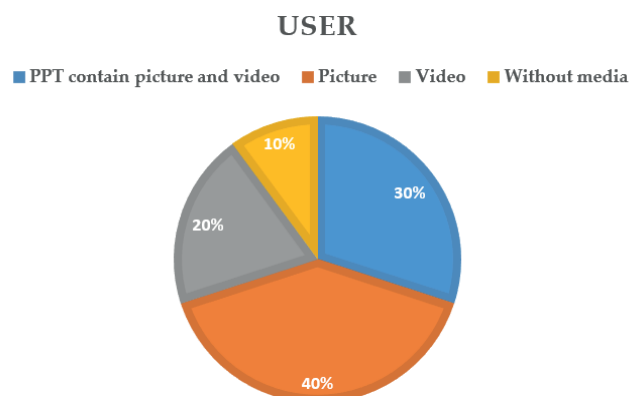

Figure 1: Use of Learning Media.

Learning about climate change requires educational media that is educational with an attractive presentation pattern and mobilizes action to overcome problems [14].

Some more interactive media include plotagon [14] and augmented reality [15]. There is also another interactive media, namely smart apps creator. According to research by Wardhani [16], with this media students are more interested in studying the material. This shows the need for learning design with the TPACK approach. Apart from character generally related to the nature of the times, namely the closeness of students to gadgets, each child has individual characteristics that are different from each other. This diversity of character is related, among other things, to interests and learning styles.

5. Learning objectives

The aim of this learning is that students are able to design efforts to prevent and overcome climate change. Before being able to design, of course, students need to first understand climate change material. Climate change material is related to global warming material [17]. However, studying global warming material alone is not enough for students to understand material about climate change. Based on the questionnaire, data was obtained as shown in Table 1. Scope of Climate Change Material.

TABLE 1: Scope of Climate Change Material.

Material	Studying Respondents
Global warming	93.30%
Greenhouse effect	80%
Understanding climate change	53.30%
Causes of climate change	60%
Impact of climate change	60%
Climate change mitigation	33%
Climate change adaptation	33%

Table 1. Scope of Climate Change Material shows that most teachers' discussion still focuses on global warming material and not all teachers teach climate change material in depth. The material studied also does not contain local wisdom. Teenagers must also have an understanding of local wisdom because adaptation and reinterpretation of local wisdom are a source of inspiration in overcoming climate change [18].

Climate change is not only about environmental problems but is also related to social and economic aspects. The data obtained shows that only 20% of teachers discuss the three aspects of sustainability in climate change learning.

6. Learning Strategies

Learning strategies are the methods that a teacher will choose and use to deliver learning material [19]. The data obtained shows that 40% of respondents use a direct learning model, namely by means of lectures and 60% of respondents use a student-centered learning model, including problem-based learning, project-based learning, and learning with the 5M approach. However, based on interviews, data was obtained that 100% of respondents had not carried out differentiated learning on climate change material. This data shows the need for differentiated learning design in climate change material. Tomlinson said that differentiated learning is an effort to adapt the learning process in the classroom to meet the individual learning needs of each student [20]. According to Tomlinson, differentiated learning accommodates the diversity of student characteristics [21]. Learning also needs to be designed to provide a quality, interactive, and contextual learning experience [22].

7. Evaluation Procedure

In Merdeka curriculum assessment activities, there are three types of assessment based on their objectives, namely assessment of learning, assessment for learning, and assessment as learning. Based on interviews, data was obtained that 100% of respondents had carried out an assessment of learning, namely the final CP summative test, but only 27% of respondents had carried out an assessment for learning (formative test). The technique used by 90% of respondents was paper-based multiple-choice tests and 10% used Google Forms. This shows the need for learning design with assessment techniques by utilizing existing applications. Some of these applications include Kahoot [23], quizzes [24], and Class Point [25] which can quickly provide information to teachers regarding student learning progress so that they are suitable for use in formative assessments.

8. Conclusion

This research shows that several things are needed in designing climate change learning, namely, there is a need to increase the scope of climate change material, learning needs to be carried out differently by utilizing information technology in media creation and assessment techniques and it is also necessary to integrate a sustainability perspective in learning.

Acknowledgements

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