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Thematic Learning Design Using the Internet of Things (IoT) at the Elementary School During the Covid-19 Pandemic

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Abstract *– One of the impacts of the Covid-19 pandemic in the world of education is a change in the learning process from face-to-face learning to online learning. To compensate for these changes, it is necessary to integrate technology in learning. The goal of this study is to design thematic learning at the elementary school level by integrating the Internet of Things (IoT) related to climate change parameters. The method in this study uses research and development of IoT-based measuring instruments using the Lolin V3 MCU node, with sensors for temperature, air pressure, humidity, altitude, and light intensity. The research respondents were 20 students. Data collection was carried out using a questionnaire containing four aspects, namely, usability, ease of use, aspects of learning ease, and satisfaction. The results showed that the reliability value > 0.6 and the level of student acceptance of the product was 3.4 with effective criteria. Based on the findings, this instructional design has potential opportunities to increase student engagement even though it is limited in networking. So it can be concluded that IoT-based learning media can be applied as a thematic learning model at the elementary school level during the Covid-19 pandemic.*

Keywords: *climate change problems; covid-19; internet of things; thematic learning*

I. INTRODUCTION

The challenges of education in Indonesia have always been a serious concern of education experts (Faisal et al., 2020; Wahono et al., 2021). At least there are several problems faced by educators in Indonesia, namely teacher quality, teacher welfare, teacher politicization (Faisal et al., 2020; Fatima et al., 2015), and what is happening now is the Covid 19 outbreak, which requires restrictions on the teaching and learning process (Setiyoaji et al., 2021; Wahyuningsih et al., 2021). This problem will greatly affect the performance and quality of 21st-century learning that requires an educator to have more quality. Not only competing in the world of Indonesian education but also in the world of education in fellow ASEAN countries and even outside ASEAN countries. Due to restrictions on the

learning process, new breakthroughs are needed, such as the use of the internet in learning (Agusty & Anggaryani, 2021).

The existence of the internet is one of the causes of the birth of the Internet of Things (IoT) which are interconnected and provide information through internet services, which can then be further processed to take several decisions (Gul et al., 2017). In the current pandemic era, the digitalization process is needed in preparing innovative learning processes so that it becomes a new challenge along with technological advances that demand the learning process from home (Nguyen & Chung, 2020). The use of technology in the learning process can be seen as the use of technology that is making student projects. Students are more enthusiastic when doing projects that involve technology because it makes work faster and more efficient (Hanif et al., 2019; Heafner, 2004). However, there are still many teachers who do not understand the importance of technology that can be integrated into learning (Bancong et al., 2019; Fatima et al., 2015). One obstacle is the limitations of human resources and inadequate teachers in using the technological devices provided. One obstacle is the lack of use of IoT technology in learning. IoT can link environmental phenomena into virtual catches, which enables the advancement of services in the information society (Abdel-basset et al., 2018). The application of the national curriculum in primary schools using thematic-based learning approaches is a new opportunity to increase the use of IoT technology (Abbasy & Quesada, 2017; Khanna & Kaur, 2019). Because IoT has been considered the third wave of the information industry, the key lies in developing effective designs for using IoT as thematic-based special learning in elementary schools (Sulisworo et al., 2019).

The use of IoT requires quite complex digital literacy to avoid errors in its use (Deursen & Mossberger, 2018; Tan et al., 2018). So taking into account the spirit of reform of the National. The education curriculum in Indonesia has experienced a shift in the management of student-centered learning environments, especially with thematic learning in elementary schools. Thematic knowledge includes increasing various competencies such as critical thinking, creativity, communication, and collaboration that have developed in several countries in the 21st century. IoT activities are dominated by hands-on activities (Kolias et al., 2016; Carver, 2016), fun learning, and being able to provide an interest in students (Eguchi, 2014). IoT acts as a new actor in the educational environment that can facilitate visual and virtual interaction as an academic environment (Marquez et al., 2016), while manipulating objects to increase understanding of the problem under study.

Based on the previous description, it was identified that the problem faced by schools today is the lack of use of technology in

learning. Therefore, this study aims to create a thematic learning design during the Covid-19 pandemic that integrates IoT in elementary schools on the issue of climate change.

II. METHODS

This study was designed using research and development (Gul et al., 2020; Sulisworo et al., 2019). This study was conducted at an elementary school in Sikka Regency, East Nusa Tenggara, with a total of 20 respondents in five grade. Data was collected using a product acceptance response questionnaire by students with four criteria (strongly agree, agree, disagree, and disagree) (Prihatiningtyas & Sholihah, 2020). Processing of data using descriptive statistics. This section explains the methods for preparing and conducting research as well as the basis of experimental research, students and investigative facilities, characteristics, criteria, indicators, and assessment parameters used as research parameters

The research procedure consists of four stages: Focus Group Discussion (FGD), developing IoT tools, integration, and implementation, as shown in Figure 1. The FGD was conducted to obtain several learning design requirements such as learning objectives according to national curriculum standards, thematic-based IoT use strategies, and implementation in the Covid-19 pandemic conditions. At this stage, it involves several experts with scientific families that are in accordance with the learning design to be developed, such as curriculum experts, lecturers, stakeholders, graduate users, which is carried out once. The outputs of this phase are thematic-based lesson plans, learning achievement evaluation instruments, and the development of IoT tools.

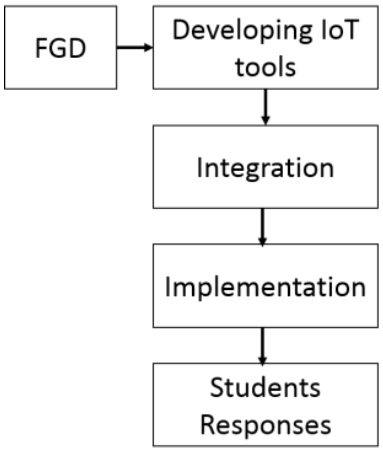

Figure 1. IoT research diagram

At the IoT development stage, the theme chosen according to the standard grade V elementary school curriculum is global climate change, while the parameters used in IoT are temperature sensors, air pressure, altitude, light intensity, and humidity. The sensor will be connected to IoT using the Lolin MCU V3 node and displayed on the Blynk application dashboard according to a theme that can be accessed using wifi. Users can monitor parameters in the Blynk dashboard application. This application can be downloaded for free on smartphones. The way the sensor works will be to acquire data and pass it on to students in different places via the internet (Bagheri & Movahed, 2017; Banica et al., 2017). Thus, students from their

respective homes get other environmental information without having to be in that place. With different environmental data, students will be encouraged to think deductively in understanding the environment. Previously, IoT will be tested on a laboratory scale, with configurations according to research that has been carried out by (Sulisworo et al., 2019).

Learning strategies are managed based on sub-themes using a project-based learning approach. This activity is determined based on FGD activities by several teams of curriculum experts to produce collaborative learning designs and then be piloted in a limited way for three online meetings. The final result expected from this stage is a learning design that is ready to be applied during the Covid 19 pandemic.

The implementation of the learning design was given to 20 fifth grade students online using Zoom Meeting with material on climate change. At this stage, the teacher will explain the operation of the media to avoid obstacles during the data acquisition process using IoT according to the topic chosen from home. Furthermore, a questionnaire will be given at the end of the meeting with reference to aspects of use, see (Lund, 2001). The results of the questionnaire will be analyzed to explain the level of validity of the data on the learning design.

III. RESULTS AND DISCUSSION

1. Focus Group Discussion

The main change in the 2013 National Curriculum is a student-centered orientation. These changes are contained in the learning implementation plan on core competencies and basic competencies. At the elementary school level, there are 4 to 6 themes for one semester. In integration, each theme will be interconnected with several other subjects, which are divided into several sub-themes, which will then be transformed into periodic learning activities. In this study, the selected themes and sub-themes are in accordance with table 1. In addition, students will also gain related knowledge such as social studies, language, culture, and citizenship. Such as climate change on this topic is associated with hot matter and its transfer

Table 1. The thematic structure of heat and displacement

Theme	Theme 6 Heat and displacement
Subtheme	Subtheme 1 Temperature and heat
Purpose	Improve logical thinking, think the high leveland strengthening skills
Strategy	Design strategy This activity will provide opportunities for students to ask questions and explore relevant information
Activity	• Observe and describe • Ask and analyze • Product presentation • Reflection

2. IoT Based Learning Tools

IoT-Based Learning Tools are presented in Figure 2.

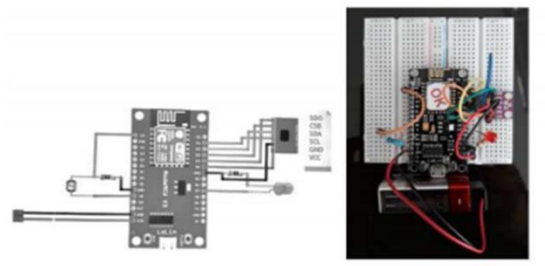

Figure 2. Schematic of the circuit and product of IoT

The use of microcontroller technology is used, such as sensors that can be accessed using Wifi, namely the Lolin MCU V3 node device. Data acquisition is carried out according to the configuration of programming language commands that connect sensors, processors and monitoring applications from climate parameters that are used as objects of observation (Daş & Ababaker, 2021). The complete device configuration is presented in Figure 2. For monitoring from students' homes, the Blynk application is used as a visualization dashboard. The application is based on open source, which can be downloaded for free on the Google Play Store. The monitoring dashboard is presented in Figure 3.

Figure 3. The dashboard on a smartphone with the Blynk application

3. Learning Strategies

At this stage, the experts conducted a work assessment in the second FGD by paying attention to the substance of how the learning media (IoT) works, implementing themes according to the media developed, learning achievements, and implementing learning strategies during the Covid-19 pandemic. So from these factors, experts will decide on a suitable learning mechanism that can be applied during the pandemic. More details are shown in Table 2.

Table 2. Collaborative activities

Procedure	Activity
Observe and describe	The teacher directs students from home about the impacts of climate change, and identifies them
Ask and analyze	Students who are assigned to measure climate parameters using IoT while other students monitor the same parameters from their respective homes via smartphones. The results obtained will be compared for several different conditions (geographical location) during the data acquisition process. From these comparisons students are encouraged to explain the effect on the results obtained, why it is different.
Product presentation	Students write down the problems encountered from the results of the data obtained
Reflection	Students are able to conclude the causes of climate change and its mitigation

Furthermore, the design was validated using an assessment approach by a team of experts to be tested on a small scale group of 20 students in class V. Project-based learning allows students to work collaboratively and encourages student involvement in understanding a phenomenon by using appropriate technology (Craft & Capraro, 2017).

4. Implementation of Learning

The initial stage of the teacher explains the learning objectives and activities that must be carried out to students, by providing worksheet that is in accordance with IoT media. Students who have assignments from home will bring IoT to be placed in several different places. The ON/OFF feature in the Blynk application is synchronized with IoT, making it easier for other students to be able to record data related to parameters. Then the data is transferred to the LKPD sheet. From the observational data that has been collected then presented and other students provide responses. The next step is to conclude the results of the analysis to solve simple problems related to higher order thinking skills (Liana et al., 2020; Pervez et al., 2018).

At the end of the learning process, students are given a questionnaire regarding the level of acceptance of the developed media, this refers to the suitability of the strategy and device design. Aspects assessed include usability, ease of use, ease of learning, and satisfaction. In terms of usability, learning with IoT media has very good benefits, especially in explaining climate phenomena in real terms without having to be in the same place. In addition, the use of IoT media is remote monitoring which is very useful during the Covid-19 pandemic. Regarding the ease of use aspect, students did not find it difficult to operate the Blynk application even though the application was relatively new to them. The aspect of ease of learning is that the worksheets provided are very in line with climate parameters, so students can easily copy information from their cellphone screens.

The teacher's role in the learning process using IoT is only as a facilitator and does not dominate. So that students in discussion activities can express their opinions and feel comfortable in the learning process (Gomez et al., 2013). In terms of satisfaction, IoT media is very interesting to use. Student involvement dominates and creates a pleasant learning environment. Based on the results of the questionnaire, in general this application is effective and has high potential if used in thematic-based learning. Figure 4 shows the results of student responses after using IoT

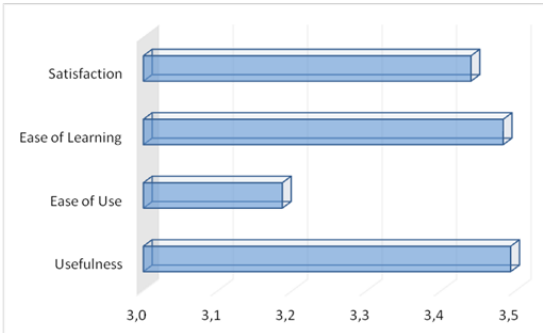

Figure 4. Student responses after using IoT

Figure 4. The results of the validity of the questionnaire data show valid results with a reliability value of 0.69 > r table. The results of the questionnaire showed that students got an average score of 3.4 out of a maximum score of 4 with categories of benefit 3.5, ease of use 3.2, ease of learning 3.5, and satisfaction 3.4. For information that students are more active and fun with IoT learning, especially during the pandemic.

IV. CONCLUSION AND SUGGESTION

The conclusion of this study is that the implementation of IoT in theme-based learning during the Covid-19 pandemic of climate change has a good impact on students. IoT-based learning can be used to encourage students to be more active in expressing their learning interests in achieving better competencies. IoT-based learning can also encourage students to think more critically about the problems being studied.

The limitation of this research lies in the number of student samples and the limited location. Therefore, it is recommended for further research to explore data with a large number of samples and a wide location. In addition, another assessment aspect that needs to be researched is the integration of thematic learning with IoT for other topics.

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