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Flipped Classroom Integrated with Ethnoscience: Innovative Learning Tools in Science Learning

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Abstrak

Alat pembelajaran bagi seorang guru merupakan suatu kewajiban yang harus dimiliki, karena menjadi pedoman bagi seorang guru dalam melaksanakan proses belajar mengajar. Perangkat pembelajaran merupakan tahap awal dalam proses pembelajaran, sehingga kualitas perangkat yang digunakan harus membuat siswa lebih aktif dalam proses pembelajaran. Tujuan penelitian ini adalah mengembangkan perangkat pembelajaran kurikulum merdeka flipped classroom yang terintegrasi dengan materi etnosains menerapkan prinsip dan konsep kalor. Penelitian ini menggunakan model 4D, namun peneliti melakukan penelitian hanya pada tahap pengembangan. Subyek penelitian ini adalah 2 orang dosen Fisika dan guru. Metode pengumpulan data yang digunakan dalam penelitian ini berupa wawancara dan lembar validasi ahli yaitu pedagogi, materi dan media. Teknik analisis data dalam penelitian ini terdiri dari data kualitatif, data kuantitatif dan data angket validasi. Hasilnya menghasilkan perangkat pembelajaran flipped classage yang terintegrasi dengan etnosains pada materi penerapan prinsip dan konsep kalor fisika SMA. Berdasarkan data validasi dosen sebagai ahli dan guru sebagai pengguna, dapat disimpulkan bahwa produk perangkat pembelajaran validasi memperoleh hasil pada seluruh aspek dengan kategori sangat baik.

***Kata kunci*:** *Perangkat Pembelajaran,* Flipped Classroom, *Etnosains*

Abstract

Learning tools for a teacher are an obligation that must be owned, because they become a guide for a teacher in carrying out the teaching and learning process. Learning devices are the initial stage in the learning process, so the quality of the devices used must make students more active in the learning process. The aim of this study is to develop learning devices of flipped classroom independent curriculum integrated with ethnoscience materials applying the principles and concepts of heat. This study uses a 4D model, but researchers conduct research only at the develop stage. The subjects of this study were 2 Physics lecturers and teachers. The data collection method used in this research is in the form of interviews and expert validation sheets, namely pedagogy, materials and media. Data analysis techniques in this study consisted of qualitative data, quantitative data and validation questionnaire data. The result produce flipped classroom learning device integrated with ethnoscience in the material applying the principles and concepts of high school physics heat. Based on the validation data of lecturers as experts and teachers as users, it can be concluded that the validation learning device products get results in all aspects in very good categories.

Keywords: Learning Tools, Flipped Classroom, Ethnoscience

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1. INTRODUCTION

Education is a process for acquiring and instilling skills carried out by students. Education itself has a goal to develop the potential contained in students, so they can think critically and creatively (Arnaiz-Sánchez et al., 2023; Astalini, Dwi Agus Kurniawan, 2019). Education is a process in order to influence students to be able to adapt as well as possible to their environment, so that it will cause changes in themselves. School is one of the places where the educational process takes place through teaching and learning activities between teachers and students (Oktaviana et al., 2016; Putri, 2021). Teaching and learning activities in schools are based on the curriculum set by the Ministry of Education and Culture. The curriculum is lesson plans, teaching materials, learning experiences that have been programmed in advance and is a reference for every educator in implementing the teaching and learning process. The curriculum is structured according to the level of education in

Indonesia by paying attention to increasing faith and piety, Pancasila values, potential, intelligence and interests of students, the diversity of regional and environmental potentials, and the demands of technological developments (Manalu et al., 2022; Nurhayati, 2022). The presence of the Minister of Education and Culture of the Republic of Indonesia Nadiem Makarim sparked an idea for a change in curriculum, namely the independent curriculum. An independent curriculum is the authority of the education unit to carry out the learning process in accordance with the characteristics of the education unit and students so as to provide free and comfortable learning opportunities for students (Fitriyah & Rizki Putri Wardani, 2022; Setiawan et al., 2022). Whereas according to previous study the independent curriculum is one of the curriculum concepts that demands independence for students (Arjihan et al., 2022). Independence in the sense that each student is given the freedom to access knowledge obtained from formal and non-formal education (Iñiguez-Berrozpe & Boeren, 2020; Vhalery et al., 2022). Education is currently developing very rapidly by utilizing technology-based learning systems.

Flipped classroom is the implementation of a learning model where the teacher can divide the time of learning activities outside the classroom, at school and delivery online after school assignments (Kurniawati et al., 2019; Maziyah et al., 2022). In this flipped classroom model, teachers can access material via the internet, such as Google Classroom media. Google Classroom media, which can be accessed via a laptop or Android, is quite easy to learn and is an application that is light enough to reach students even with various internet network limitations from home (Ade-Ojo et al., 2022; Banat & Martiani, 2020). In the flipped classroom model the teacher can present material with video problems, where the teacher can relate the material to ethnoscience, because there are still many students who do not know what ethnoscience is in the learning process, especially learning physics (Fearnley & Amora, 2020; Utami Dian Pertiwi et al., 2019).

Ethnoscience or indigenous science is the study of knowledge systems developed from local cultural beliefs related to natural phenomena. One form of original knowledge that can be linked to the concept of science is local wisdom. Local wisdom is a human policy in developing local excellence that relies on a philosophy of values, ethics, ways and behavior that are traditionally institutionalized (Asih & Ujianti, 2021; Putri et al., 2021). In everyday life students always interact with regional culture in the surrounding environment. This can be a supporting factor in increasing the potential of students' understanding of the material they are studying. In addition to maintaining the preservation of regional culture, ethnoscience learning is considered to be able to improve the quality of education and the character of students. According to previous study ethnoscience-based physics teaching materials can improve student learning outcomes, both cognitive learning outcomes and affective learning outcomes (Hikmawati et al., 2021). This makes a teacher required to be able to prepare learning to be better by designing learning tools to be used in the learning process. Learning devices for a teacher are an obligation that must be owned because learning devices become a guide for a teacher in carrying out the teaching and learning process. Learning device is a device used in the learning process (Afnan et al., 2022; Luh et al., 2019). The preparation of the device is the initial stage in learning, therefore, the quality of the device used also determines the quality of learning.

In the era of Information and Communication Technology (ICT) as it is now, students who will be faced are students who were born and developed in the digital era. The influence of ICT is very large on students, so teachers must have a high understanding of technology in the learning process. ICT-based learning cannot be separated from the demands of 21st century learning. One of the demands of 21st century learning is the integration of technology as a learning medium to develop learning skills (Hamid & Hadi, 2020; Huwaidi et al., 2021). 21st century learning brings a change in the learning paradigm which is marked by changes

in curriculum, media, and technology. At this time there are still teachers who do not understand developments in technology, as a result students do not understand the use of technology in the classroom (Lie et al., 2020; Siregar, 2020). Learning in the classroom has lost its appeal in the 21st century. Blended learning combines activities in the classroom and technology-based learning both offline (outside the network) or online (in the network). In accordance with 21st century learning which invites teachers and students to utilize technology in their learning. Blended learning is widely used by teachers to facilitate the learning process during the Covid-19 pandemic. Even though blended learning is learning that is applied as an alternative to distance learning by combining learning in the classroom.

Based on initial observations made by researchers in the form of interviews with physics teachers at SMA Negeri 7 Jambi City, that the procedure for making independent curriculum learning tools for physics learning had not been established. Teachers do not know much about how to make learning tools used in the independent curriculum. Enthusiastic students are less active at the beginning of learning in class. The use of technology in physics learning is rarely used in face-to-face meetings and is only used during the Covid-19 pandemic. The urgency of this research is very important because this is the first research conducted at SMA Negeri 7 Jambi City, then using a flipped classroom learning system and the material presented is related to Jambi ethnoscience. So that this research facilitates the learning system and increases students' knowledge in utilizing technology for learning.

In previous study conducted learning that was integrated with ethnoscience, the results of the research showed that the learning model developed was valid and feasible to use and had a positive impact on students (Damayanti et al., 2017). Supported by other study conducted a study on learning using the flipped classroom model, the results of this study showed that the learning process was in the very good category, student learning outcomes were in the sufficient category, there were differences in learning outcomes between male and female students , and student responses are in the very high category (Kurniawati et al., 2019). Based on some of the previous studies that have been described, the researcher found several aspects of students' learning activities. The development that needs to be done is the development of high school level physics learning tools. The aim of this study is to develop learning devices of flipped classroom independent curriculum integrated with ethnoscience materials applying the principles and concepts of heat.

2. METHODS

In this study, the development model used was the research and development method (R & D). Research and development methods (R & D) is a research method used to produce certain products and test the effectiveness of these products. The development model used in this study is the 4-D development model (Amali et al., 2019; Thiagarajan, 1976). The 4-D model has stages namely Define, Design, Develop, and Disseminate (Dian Christi et al., 2020). However, in this study it was carried out until the third stage, namely the develop stage.

The define stage consists of 5 steps, namely initial-end analysis, student analysis, task analysis, concept analysis, and formulation/specification of learning objectives. Preliminary analysis was carried out to find out the basic problems in learning device design. The design stage consists of 4 steps, namely the preparation of benchmark reference tests, media selection, format selection, and initial design. While the develop stage is the device validation stage where there are 2 lecturers and 2 teachers validators for learning devices. The develop stage is a stage that aims to produce development products for flipped classroom learning tools integrated with ethnoscience.

This research was conducted at SMA Negeri 7 Jambi City, Jambi Province. This research was conducted in May 2023. The subjects of this research were 2 pedagogical, material and media experts and 2 teachers who taught physics. The data collection instruments used in this study were interview sheets, pedagogical expert validation sheets, material expert validation sheets, media expert validation sheets and teacher validation sheets. Data analysis techniques in this study were quantitative data which were analyzed descriptively. The data collection in this study was using a Likert scale validation questionnaire (scale 1 to 5) with the lowest score being 1 and the highest score being 5. With a Likert scale, the measured variables are translated into variable indicators. Then these indicators are used as a benchmark for compiling question items or statements.

3. RESULTS AND DISCUSSION

Results

The resulting development product is in the form of a learning device flipped classroom integrated with ethnoscience in the material applying the principles and concepts of heat. This development is carried out using a 4-D model consisting of stages define, design, develop, and disseminate. However, this development is only carried out in stages define, design, and develop. The three stages can be explained in the following presentation.

Define Stage

Define is done to determine the instructional requirements obtained by doing some analysis. The analysis carried out is to find out the problems that exist in the field. There are 5 analyzes that must be carried out which include beginning-end analysis, student analysis, task analysis, concept analysis, and learning objectives analysis.

Preliminary analysis is an analysis carried out to find out the basic problems that exist in the field. Analysis of the activities carried out is by analyzing the needs of physics teachers and students. Based on the results of interviews with physics teachers at SMA Negeri 7 Jambi City, it was found that teachers did not know much about how to make learning tools used in the independent curriculum. The use of technology in physics learning is rarely used in classroom meetings and is only used during the Covid-19 pandemic. The learning models and methods used are good enough for students' understanding, but the availability of time to fulfill the syntax is still lacking. There are no learning tools specifically associated with Jambi ethnoscience objects. The next step is student analysis. This student analysis was carried out to determine the characteristics possessed by students, especially learning physics at the beginning of learning. The steps taken were to conduct interviews with physics teachers. Based on the results of interviews with physics teachers, it was found that each student has different characteristics. At the beginning of learning in the classroom not all students were actively involved in expressing knowledge, there are some who respond and some do not respond at all. This happens because students are only waiting for an explanation from the teacher, without having to study before carrying out the learning process.

After analyzing the students, the next step is task analysis. This task analysis is carried out to determine the content of teaching materials in an outline. Based on preliminary studies conducted by researchers in exploring Jambi's ethnoscience field from various sources such as modules and journals. In order to obtain a number of data regarding the stages in the learning process to be able to develop learning tools flipped classroom integrated Jambi ethnoscience. After doing the task analysis, the next step that needs to be done is concept analysis. Concept analysis is carried out to find out the physics concepts that must be mastered by students. The last analysis that needs to be done is the analysis of learning objectives. This analysis was carried out to develop learning objectives that were formulated from the results of task analysis and concept analysis.

Design Stage

Design is carried out to design the initial form of the developed learning device. The steps that need to be taken at this stage are the preparation of benchmark reference tests, media selection, format selection, and the initial design of learning devices. The preparation of a benchmark reference test is a step that connects between stages define and stages design. This test is also prepared based on the results of student analysis and analysis of learning objectives. The next step that needs to be done is the selection of media. The selection of this media is carried out to determine learning media that are in accordance with the needs of physics teachers and students. Based on the results of the initial-end analysis and student analysis, it is necessary to choose the right media to overcome the problems that exist in schools. The media that can be used is in the form of learning devices flipped classroom integrated with ethnoscience. This learning tool aims to enrich students' learning methods so that they are more active during learning as well as readers' insights, especially for teachers and students. In addition, not all material in physics learning can be associated with Jambi ethnoscience objects. Therefore, it is necessary to have learning tools that can examine more specifically physics concepts related to Jambi ethnoscientific objects, especially in the application of heat principles and concepts.

After selecting the media, the next step is to select the format for making learning devices flipped classroom integrated with ethnoscience in the material applying the principles and concepts of heat in high school designed with A4 paper size (21 cm x 29.7 cm) which is presented in the form portrait and landscape. The margins used are 4 cm (left) and 3 cm (right, top and bottom). The complete format of the learning device flipped classroom integrated with ethnoscience can be seen in Table 1.

Table 1. Types and Sizes of Learning Set

Design	Font Type	Font Size
Cover	Playfair Display black Agrandir	22 pt dan 24 pt, 18 pt, 20 pt, 27 pt, dan 39 pt
Foreword	Times New Roman	12 pt dan 18 pt
List of Contents	Times New Roman	12 pt dan 18 pt
Learning Access	Times New Roman	12 pt dan 18 pt
Learning Objectives	Times New Roman	12 pt
Teaching Module	Times New Roman	12 pt
Bibliography	Times New Roman	12 pt dan 18 pt
System *Google Classroom*	Times New Roman	12 pt dan 18 pt

In addition, there is also the content structure of the learning device flipped classroom integrated with ethnoscience in the material applying the principles and concepts of heat. The following content structure can be seen in Table 2.

Table 2. Learning Device Content Structure

No.	Structure
1	Front cover or cover
2	Preface
3	Table of Contents
4	Learning Access
5	Learning objectives flow
a	Learning Objectives
b	Flow of Learning Objectives

No.	Structure
6	Teaching module
a	General Information
b	Your competences
c	Appendix
7	Usage System *Google Classroom*
8	Bibliography

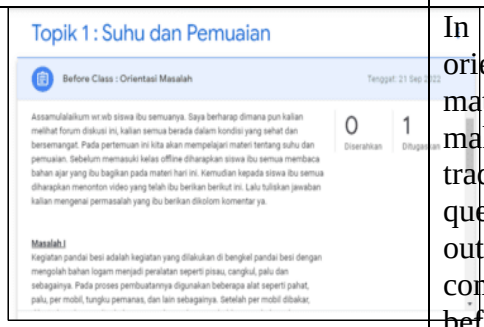
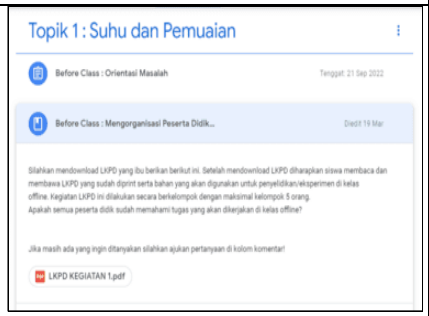
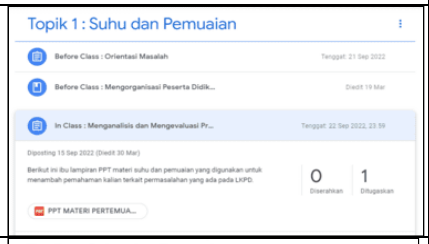
The last step that needs to be done is the initial design of learning devices. The learning design is in the form of learning tools that include: learning outcomes, learning objectives flow, teaching modules, and learning designs using google classroom. In the learning outcomes section consists of general physics learning outcomes in phase F, achievements based on phase F elements. In the learning objectives flow section, it consists of learning objectives and learning objectives flow as well as learning objectives schemes. In the teaching module section it consists of general information, core, and. In the section on learning objectives, learning activities, teacher and student reading materials, student worksheets, enrichment and remedial, and learning resources related to Jambi ethnoscience related to material applying the principles and concepts of heat. The format of the learning device flipped classroom integrated with ethnoscience on the material applying the principles and concepts of heat can be seen in Figure 1.

Figure 1. Learning Device Flipped Classroom Integrated with Ethnoscience

System google classroom as a support for learning devices flipped classroom created based on division syntax problem-based learning (PBL). Image of system form google classroom. This can be seen in Table 3.

Table 3. System Google Classroom

No.	Figure	Description
1.		On the initial display are 4 learning topics. Topic 1 for meeting 1 with the subject of temperature and expansion. Topic 2 for meeting 2 with the subject of the relationship between heat and the temperature of objects and their forms. Topic 3 for meeting 3 with black's basic topic.

No.	Figure	Description
		Topic 4 for meeting 4 with the subject of heat transfer by conduction, convection andradiation.
2.		In the first part, namely activities problem orientation, teacher share reading material related to material. Then share the video about machete making, betangas and lanterns, boiling Meniran leaf traditional medicine and batik. Next teacher asking questions problem with the object. Students carry out discussions regarding questions in the comments column. This activity takes place 3 days before the face-to-face class takes place.
3.		In the third part, namely activities organize students to learn, the teacher distributes student worksheets at each meeting and informs that the investigation is carried out in groups. Students read the student worksheets and print it for use in face-to-face classes. Students can ask questions in the comments column if something is still not understood. This activity takes place 3 days before the face-to-face classgoing on.
4.		In the fourth part viz activity analyze and evaluate the problem-solving process, the teacher distributes powerpoint (PPT) streng thening.
5.		In the fifth part, namely activities learning reflection, the teacher gives questions related to learning that has been carried out to students after learning takes place. This activity lasts 1 day when face-to-face learning has been carried out.

Development Stage

Development stage is carried out to produce learning device products flipped classroom integrated with ethnoscience in the material applying the principles and concepts of heat. The learning device products developed are validated by pedagogical expert validators, media experts, and material experts as well as teachers. The purpose of validation is to level the feasibility of learning device products before being tested to the field. This validation was carried out by 2 Jambi University lecturers who acted as expert validators and 2 physics teachers at SMA Negeri 7 Jambi City who acted as users of the developed learning tools. This validation process was repeated 3 times by the lecturer and 1 time by the teacher. The components assessed by the validator on pedagogical aspects are related to educational studies such as the curriculum and theory being taught. Components assessed by the validator on material aspects include material/content and presentation of material/content. And the components assessed by the validator on the media aspect include language and graphics. In the flow of learning objectives validation section, validation was only carried out on the pedagogical and media aspects, because the material presented was only the main material.

The validation stage carried out by the teacher validator as the user of the developed device. The teacher sees and validates the product that will be tested on spaciousness. At the validation stage of the flow of learning objectives by the teacher validator, the pedagogical aspect validation results were obtained by 91.6% in the very good category. At the teaching module validation stage, the pedagogical aspect validation results were obtained at 95.3% in the very good category. Furthermore, at the teaching module validation stage, the material aspect validation results were obtained at 92.5% in the very good category. Meanwhile, at the flow of learning objectives validation stage, the results of the media aspect validation were 98.3% in the very good category. At the teaching module validation stage, the media aspect validation results were obtained at 94.4% in the good category. At the validation stagegoogle classroom, the media aspect validation results obtained were 94.2% in the very good category. Based on the validation data, the results obtained for all aspects are in the very good category. The validation was carried out by the teacher only once because the results of the data obtained were very good and there were no suggestions or comments regarding the product. So based on lecturer validation data as experts and teachers as users it can be concluded that the learning device products developed are ready to be tested in the field.

Discussion

Base on the result, the preliminary analysis identifies the basic problems in the field, such as teachers' lack of knowledge about using learning tools in independent curriculums and the limited availability of technology in physics learning during the Covid-19 pandemic. In the design stage involves designing the initial form of the developed learning device, which includes preparation of benchmark reference tests, media selection, format selection, and the initial design of learning devices. Then teacher validator validates the product on spaciousness, with results in very good categories for all aspects. Based on lecturer validation data and user feedback, it can be concluded that the learning device products developed are ready for field testing.

The benefit of using learning devices is that it allows students to understand the concept of heat in depth. They can study the material at home before coming to class, so that class time can be used for deeper discussions and interactive activities (Suharianta et al., 2014; Utomo et al., 2021). Then the integration of Ethnoscience materials allows students to relate hot concepts to local culture and knowledge. This makes learning more relevant and interesting for students (Nurcahyani et al., 2021; Sudarmin et al., 2017). By practically applying heat principles and concepts, students can better understand the material. They can do experiments or activities that support these concepts, which can increase their understanding. Apart from that, the Flipped Classroom model allows students to study anytime and anywhere according to their needs (Rasvani & Wulandari, 2021; Suharianta et al., 2014). This can be especially helpful for students who have busy schedules or varying learning preferences.

In previous study conducting research on flipped classrooms with the title development of Flipped Classroom Devices in High School Physics Subjects (Nyeneng et al., 2018). From this research it was obtained regarding Flipped Classroom learning devices on the material of harmonic vibration and impulse and momentum, it can be concluded that the resulting learning devices are stated to be valid, practical, interesting, easy and useful to apply in learning physics in high school, but have a low level of effectiveness in improve student learning outcomes. Supported by other study that conducted a study on learning using the flipped classroom model (Syarifudin et al., 2021). From this study, the research results showed that the learning process was in the very good category, the learning outcomes of students were in the sufficient category.

With the learning device flipped classroom integrated with ethnoscience in the material applying the principles and concepts of heat, the teacher can use this product as a reference for making independent curriculum learning tools. Development of learning devices flipped classroom. This can also add insight and understanding of teachers in using various learning models, because there are still many teachers who do not know about learning models flipped classroom. In addition, there is a link between ethnoscience in the learning process at school, so that teachers and students are not only able to understand material limited to everyday life, but can explore the ethnoscience that exists in their area.

4. CONCLUSION

Based on the results and discussion that has been done, it can be concluded that the resulting product is a flipped classroom learning device integrated with ethnoscience in the material applying the principles and concepts of high school physics heat. Based on the validation data of lecturers as experts and teachers as users, it can be concluded that the validation learning device products get results in all aspects in very good categories. So that the developed product is ready to be tested in the field. With flipped classroom learning tools integrated with ethnoscience, it can add insight and understanding to teachers in using various learning models, and make teachers and students not only able to understand material limited to everyday life, but can explore ethnoscience in their area.

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