



## **Development of Problem Based Learning Based E-modules in the form of Flipbooks on Environmentally Friendly Technology Materials As an Independent Learning Material for Students Especially Online Learning**

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**Abstract.** Problem solving skills are important to have in the 21st century. In the online learning period, students are required to be able to learn independently from home. However, in fact the motivation of students' learning has decreased. To facilitate students' self-learning during online learning, improving learning motivation and problem solving skills, teachers need to provide interesting learning materials. Therefore, this research aims to develop self-learning materials in the form of problem based learning e-module flipbooks on Environmentally Friendly Technology materials. This research is research and development with Lee & Owens development model namely analysis, design, development and evaluation. The data collected in the form of qualitative data in the form of comments and suggestions validators and quantitative data in the form of validation scores of material experts, media and readability. The data collection instruments used are material expert validation test sheets, media experts, teachers and readability tests. Data analysis techniques are descriptive analysis. The results showed that the e-module flipbook developed has a succession of feasibility percentages from the validation tests of material experts, media experts and teachers, namely 84.03, 84.62 and 95.00%. Meanwhile, the percentage of readability tests to students was 87.81%. Teachers and students showed a response that the developed flipbook was interesting and suitable for self-learning during the pandemic. It can be concluded that, the e-module flipbook developed falls into the category of very valid (worth using) and excellent. It is expected to test the effectiveness of flipbooks to learning and develop flipbooks for other materials.

**Keywords:** E-module, flipbook, environmentally friendly technology, problem based learning, problem solving

## **Introduction**

Natural Sciences is one of the subjects taught from elementary to secondary school (Khoirunnisa, et al., 2020). Science learning aims to understand environmental phenomena and wealth that needs to be preserved in the view of physics, chemistry and biology (Suendarti, 2020). Therefore, by learning science, students should be able to improve their ability to construct, understand and apply the concepts that have been learned, so that trained learners find concepts more holistically, authentically, meaningfully and applicatively in terms of problem solving by themselves.

The world has entered the era of the 21st century. The 21st century is marked by the development of technology, information and communication (Chalkiadaki, 2018). The world of education in this era occurs paradigm where education is more focused on improving students' ability to find out, formulate, think analytically and cooperation in solving a problem (Affriyenni, et al., 2020). Learners are required not only to memorize facts without understanding their meaning (Wijaya, et al., 2016). The way that can be done to realize 21st century education in terms of problem solving is to design learning programs, either from models, methods or media used with the aim of problem solving (Ardiansyah, et al., 2020).

The learning model that can improve students' problem solving skills is the problem based learning (PBL) model or commonly referred to as problem-based learning model (Widiawati, et al., 2018). The learning process with PBL model is centered on students. So, students play an active role in learning, while teachers act as facilitators (Munawaroh & Setyani, 2020). Some studies have proven that PBL can improve problem solving capabilities in environmental pollution materials (Dole, et al., 2017) and can improve learning outcomes in substance pressure materials (Wijaya, et al., 2019).

The world including Indonesia is experiencing the covid-19 pandemic (Setiati & Azwar, 2020). The COVID-19 pandemic is causing changes to the learning system that was originally implemented face-to-face into online distance learning (Rizqon, 2020). Online learning has the disadvantage of teachers not being able to supervise students directly, less effective material delivery and limited material delivery time (Yunitasari & Hanifah, 2020). Online learning requires students to be able to learn independently.

Based on observations and interviews to teachers at SMPN 4 Malang, the learning at SMPN 4 Malang was conducted online. The motivation of learning students in grade IX SMPN 4 Malang is also lacking. During this time, the learning materials used for online learning are in the form of science package books, videos and articles on the internet. In addition, the interview results also show that students' problem solving skills are still not optimal. Therefore, it takes an interesting student self-learning resource facility to train students' problem solving and increase students' learning motivation in the online learning period. E-module in the form of flipbook can be one solution to provide students self-learning materials in the online learning period.

This flipbook e-module can be opened by students on a student's laptop/computer with a book-like look in virtual form (Safitri, et al., 2021). In addition, images, videos and music can also be displayed in this flipbook e-module, thus adding to the attractiveness of the teaching materials (Kodi, et al., 2019). E-module research in the form of flipbooks shows that flipbook e-modules can improve students' learning outcomes and activeness in terms of visual, oral, listening, writing and emotional (Yulaika, et al., 2020). The advantage of this flipbook is a 3-dimensional digital-shaped module whose pages can be opened each sheet as if reading a book on the screen (Kodi, et al., 2019).

In circulatory system materials, the use of flipbook e-modules as learning materials can help improve students' motivation and learning outcomes (Situmorang, et al., 2020). Evaluation activities contained in the flipbook that has been developed today is still a sheet containing questions and places to answer. In fact, in the period of distance learning, teachers need to monitor students in learning. Therefore, in the e-module flipbook can be developed by adding a Google Form link feature that connects with the teacher's email in each task the student is working on.

Based on the things outlined above, this study aims to develop teaching materials in the form of PBL flipbook modules on environmentally friendly technology materials that are eligible to be used as student self-learning materials during the covid-19 pandemic. Problem-based science learning is suitable to be applied to environmentally friendly technology materials because students can learn from problems and solve problems using unfriendly technology that they experience themselves (Santoso, 2011).

## Methods

This type of research is included in the research and development with the development model of Lee & Owens. The stages performed in the study are:

1. Analysis

At this stage, the needs analysis is conducted by giving a questionnaire to the teachers and students of SMPN 4 Malang to find out the situation in the field.

2. Design

At this stage, the flipbook development schedule is done, designing flipbook specifications, flipbook storyboard, compiling material content, installing flipbook making software (Flip Pdf Corporate Edition).

3. Development

At this stage, google form link creation is done to save student report assignment template and student assignment collection, flipbook e-module preparation in Word, flipbook e-module conversion from Word to pdf, video addition on flipbook e-module, flipbook e-module conversion from pdf to exe, consultation, media improvement, material expert validation test, media expert, teacher and readability test.

4. Evaluation

At this stage, the evaluation is the determination of flipbook feasibility and practicality of flipbooks developed based on the results of validation and readability tests.

The type of data in this study is qualitative and quantitative data. Qualitative data in the form of interview data, comments and suggestions from validation test results to material experts, media experts, teachers and readability to students. Quantitative data in the form of validation test scores of material experts, media experts, teachers and readability tests. The data collection instruments used are the need analysis questionnaire sheet, the material expert validation test instrument sheet, the media expert and the readability test instrument sheet.

Quantitative data analysis techniques used are descriptive analysis with the initial process of converting score data to percentage. The percentage result is changed to the appropriate flipbook eligibility level in Table 1.

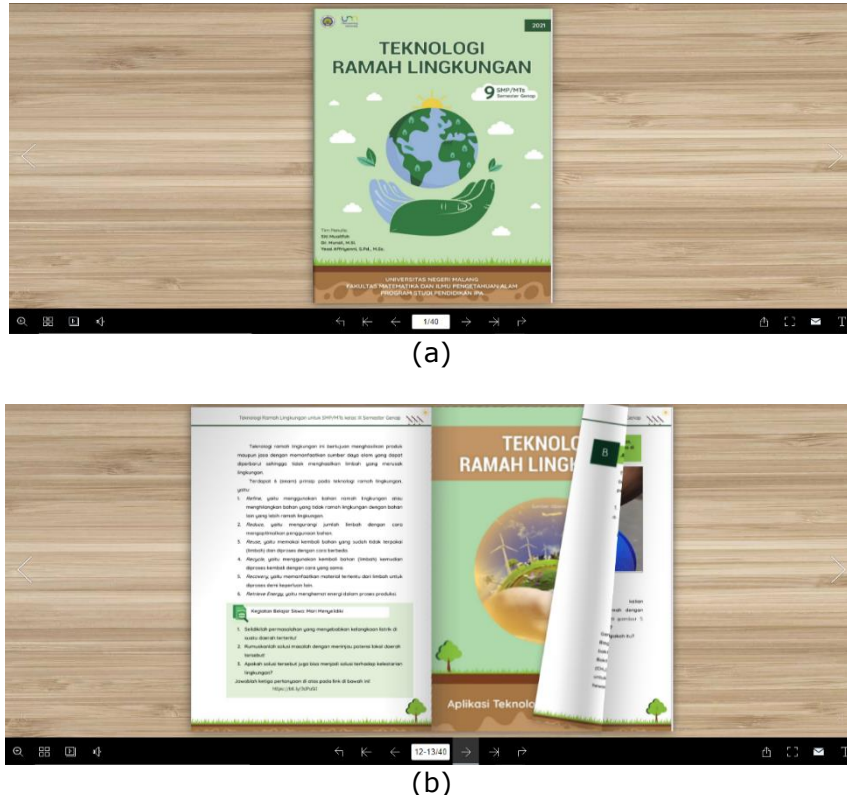
**Table 1.** Flipbook validity level category by percentage.

No	Percentage	Category
1.	81 - 100	Very valid
2.	61 - 80	Valid
3.	41 - 60	Valid enough
4.	21 - 40	Less valid
5.	0 - 39	Invalid

## Results and Discussion

Based on the analysis of needs in the form of observations and interviews conducted at SMPN 4 Malang, daily learning is conducted online, students' learning motivation decreases, students' problem solving skills are still low and learning materials are used in the form of printed books, articles from the internet, Youtube videos and PPT provided by teachers through Google Classroom. Students' learning motivation is said to decrease judging by the lack of students attending virtual classes, delays in collecting assignments never even collecting assignments. Then, the teacher responds that it takes the development of interesting teaching materials that students can use as self-help handles during online learning. This is because during online learning teachers cannot fully monitor students in learning. Therefore, students need to study independently at home. Therefore, the purpose of this research is to develop students' self-taught materials in the form of PBL-based flipbook e-modules on Environmentally Friendly Technology materials.

Flipbook was successfully developed using a flipbook maker application called Flip PDF Corporate Edition. This flipbook has specifications that are A4 size, totaling 40 pages, has exe format and html link, can be opened in Windows and Smartphone, there are video examples of Environmentally Friendly Technology that can be played and available student learning activities that can stimulate students' problem solving skills. This exe file has the advantage of being able to open on all mobile devices without the need to install certain applications first (Affriyenni, et al., 2021). However, the exe file has a large size so it can drain storage (Silalahi, 2020). E-module flipbook as a digital learning material has the advantage of being able to open anytime and anywhere as long as a mobile device is available to open it (Marsuki, et al., 2021). View of the flipbook can be seen in Figure 1.



**Figure 1.** (a) Flipbook E-module Display Home (Cover Page), (b) Flipbook E-module Content Display.

Based on Figure 1, the flipbook looks like a real flipped book. However, on the flipbook this is virtual only. The flipbook sheet-shaped display with the addition of paper sound effects that are reversed can add to the attractiveness of teaching materials and can invite students to be more interested in learning. The arrangement of materials in the flipbook can be seen in Table 2.

**Table 2.** Content flipbook Environmentally Friendly Technology

No	Content
1.	Foreword
2.	Instructions for Use
3.	Goals To Achieve
4.	Table of Contents
5.	Understanding and Principles of Environmentally Friendly Technology
6.	Student Learning Activities: Let's Observe
7.	Student Learning Activities: Let's Investigate
8.	Eco-Friendly Technology Applications
9.	Energy Saving Behavior
10.	Technology Is Not Environmentally Friendly
11.	Student Learning Activities: Let's Process
12.	Student Learning Activities: Let's Evaluate
13.	Summary
14.	Author Team

The flipbook e-module presents material on the understanding of environmentally friendly technology, environmentally friendly technology applications, energy-efficient behavior and non-environmentally friendly technologies. In each example of an eco-friendly technology application, there are videos that can increase students' knowledge. With this video can add to the attractiveness of e-module. Good video used for learning process (Hidayati, et al., 2019). In addition, there are also student learning activities based on environmental problem solving. In it there are 4 (four) Student Learning Activities (KBS) that reflect the syntax of PBL. The four student learning activities are KBS: Let's Observe, KBS: Let's Investigate, KBS: Let's Process and KBS: Let's Evaluate.

KBS: Let's Observe the activities of students observing images of urban and inland situations at night and then analyzing them. This KBS reflects the first PBL syntax of orientation to the problem. The uneven distribution of electricity in the regions in Indonesia is a topic of problems in the students' assignments.

KBS: Let's Investigate contains instructions on student activities to conduct a search / investigation of the problem of electricity scarcity in a particular area as well as the state of the environment that becomes the local potential of the area. In kbs this reflects the second PBL syntax which is student organizing. Here, the command to perform a search serves to conditioning and organizing students in performing learning tasks.

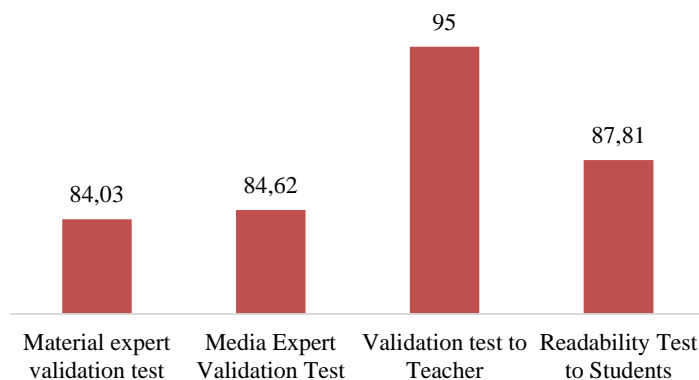
KBS: Let's Process contains instructions students process the results of the investigation by producing writings containing problem solutions based on the attached LKPD. In kbs this reflects the syntax of the third, fourth and fifth PBL, namely mentoring for research, developing and presenting the work, and problem solving analysis. In this KBS there is a lkpd task template link that contains instructions, commands and a place to fill as a guide to students during the work of learning assignments. The result of this work in the form of LKPD sheet becomes the work of students who contain solutions to the problem of difficulty of electricity supply in certain areas. In this KBS there is also a Google Form link to collect the work. Then, the work will be analyzed by the teacher through Google Drive.

The Google Form link on KBS serves as a place for students to collect the results of their learning activities (Pertiwi, et al., 2021). This is because the principle of the module itself is as an independent learning material for students without the help of the teacher (Najuah, et al., 2020). Although teachers cannot accompany students to study, they can still control and monitor students' learning activities. So, the cognitive aspect can still be measured when students do learning activities using this flipbook e-module. With this KBS, critical and creative thinking skills in solving problems will be trained from home (Pertiwi, et al., 2021).

KBS: Let's Evaluate contains a student command concluding the results of learning activities as a form of self-evaluation during learning by using the e-module flipbook. In this KBS reflects the fifth PBL syntax which is the analysis and evaluation of the troubleshooting process.

In the PBL learning model, students are given authentic problems. In this e-module, authentic problems are given in the form of limitations or lack of electricity supply in an area (Yolantia, et al., 2021). Then, students develop knowledge, investigate and formulate a problem solving through KBS: Let's Investigate and KBS: Let's Process. Thus, this PBL-based e-module can help students in finding problems independently while practicing critical thinking skills (Loyens, et al., 2015).

After the flipbook e-module is completed, then conducted material expert validation test, media expert validation, teacher validation and readability test to students. The percentage results of the material, media, teacher and readability expert validation test scores are shown in the graph in Figure 2.



**Figure 2.** Percentage of Material, Media, Teacher and Readability Validation Test Results.

Based on the results of the material expert validation test percentage, media experts and teachers can be said that pbl-based flipbook e-modules on environmentally friendly technology materials are categorized as very valid or worth using. Meanwhile, based on the results of readability tests to students, it can be said that pbl-based flipbook e-modules on Environmentally Friendly Technology materials are very well categorized.

In the readability test results data, as many as 75% of students strongly agree and 25% of students agree that this PBL-based flipbook e-module can help learn Environmentally Friendly Technology materials in the current pandemic. This means that in line with the development research conducted by Misbah, et al. (2021) e-modules are a worthy teaching material for use during the covid-19 pandemic. The use of e-modules in learning can improve and train students' technological literacy habits (Silalahi, 2020). Where it is important to have students as a young generation in the current era of industrial revolution (Astini, 2020; Pramana, et al., 2020).

The advantages of this flipbook e-module is practical, because it can be opened on desktop and mobile without having to have a certain helper application, presenting knowledge in the form of audio visuals in the form of video, practicing the attitude of student independence because all forms of work are done independently without the guidance of teachers through student learning activities collected to Google Form links on e-modules and attractive e-module displays such as digital display of books or magazines (Pratiwi, et al., 2021). Meanwhile, the drawback of this flipbook e-module is the size of the exe file which is quite large which is 283,987 KB.

## **Conclusion**

Products in the form of PBL-based flipbook e-modules have been successfully developed with a percentage of eligibility from materials experts, media and teachers of 84.03, 84.62 and 95.00%. In terms of presentation to students, the percentage of 87.81%. It can be concluded that pbl-based flipbook e-module on environmentally friendly technology material is considered very feasible and very good to be used as self-learning material for grade IX junior high school students during online learning.

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