



Development of E-Modules with a Guided Inquiry Approach on Ecology and Environmental Change Materials

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Received: July 16, 2022

Revised: November 23, 2022

Accepted: December 17, 2022

Published: December 31, 2022

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DOI: [10.29303/jppipa.v8i6.2350](https://doi.org/10.29303/jppipa.v8i6.2350)

Abstract: The purpose of this study was to produce an E-Module on ecology and environmental change using a guided inquiry approach that is valid, practical, and effective. This type of research is development research using the Plomp model. The development phase of this model begins with the Preliminary research phase, the Development or prototyping phase, and the Assessment phase. The instruments used in this study were validity assessment sheets, practicality assessment sheets, and competency assessment sheets for knowledge, skills, attitudes, motivation, and science process skills. The results showed that the E-Module on ecology and environmental change using a guided inquiry approach based on the expert judgment was very valid with a value of 97.59%. The practicality assessment by the teacher obtained a score of 95.83% with very practical criteria and a student assessment in the field trial (large group evaluation) with a score of 90.45% with very practical criteria. The results of the effectiveness test found that the class using the E-Module on ecology and environmental change with the guided inquiry approach had higher scores than the class that did not use the E-Module, so the use of the E-Module with the guided inquiry approach supplemented with pictures, animations and videos could help students understand the material. It can be concluded that the E-Module on ecology and environmental change with the guided inquiry approach that has been developed is in the category of very valid, very practical, and very effective in improving student learning outcomes.

Keywords: E-Module Development; Ecology and Environmental Change; Flip PDF Professional application; Guided Inquiry

Introduction

The development of science and technology at this time has shown very rapid progress. One of them is in the field of education. The role of science and technology in education is very supportive of the learning process so that it becomes effective and efficient in improving the quality of education. Salirawati (2018) states that in the learning process teaching materials play an important role in organizing effective and efficient learning. One way that can be done to improve learning in schools to be effective and efficient is to develop teaching materials in the form of creative and innovative electronic modules (E-Modules).

E-module is a form of presenting self-learning material that is arranged systematically into certain learning units, which are presented in electronic format,

where each learning activity in it is connected with a link as navigation which makes students more interactive with the program, equipped with by presenting video tutorials, animations and audio to enrich the learning experience (Kemendikbud, 2017). Currently, there are various kinds of applications that have been used by people in developing E-Modules, namely, 3D Page Flip Professional, Kvisoft Flipbook Marker, Appypie, and Flip PDF Professional. Among these applications, an interesting application to develop is Flip PDF Professional.

The Flip PDF Professional application has many advantages including, this application can be presented on various computer devices, Mac, Android, iPhone, Ipad, and other devices which include computers and mobiles. In addition, the Flip PDF Professional application is a flipbook maker application that is rich in

How to Cite:

Subari, A., Chatri, M., Fadilah, M., & Vauzia. (2022). Development of E-Modules with a Guided Inquiry Approach on Ecology and Environmental Change Materials. *Jurnal Penelitian Pendidikan IPA*, 8(6), 2815–2826. <https://doi.org/10.29303/jppipa.v8i6.2350>

interactive page editing features by adding multimedia such as videos from YouTube, images, audio videos, flash, hyperlinks, and others (Flip PDF Professional, 2021). Learning in the 2013 curriculum requires teachers to use a scientific approach in their learning process so that students can build and shape their knowledge. One scientific approach is the guided inquiry approach.

Guided inquiry learning is learning that is carried out with the help of the teacher in developing investigations carried out by students in the form of guiding questions from the start, namely at the time of formulating hypotheses until concluding by students (Safitri et al., 2021). Heksa (2020) states that the advantage of using learning using guided inquiry is that the cognitive, affective, and psychomotor aspects will be balanced so that they are considered more meaningful and on target. Added by Elvira et al. (2020) states that there is a significant difference in the guided inquiry learning model by taking into account the initial abilities of students' knowledge competencies and there are significant differences in the guided inquiry learning model on the competence of students' attitudes and skills.

Based on observations at MAN 2 Jambi schools through interviews with biology teachers with Drs. Ahadianto, M.Sc., several students experienced difficulties and did not understand the concept of ecology and environmental change. This is evidenced by the fact that there are still students who score at the threshold and below the Minimum Completeness Criteria or KKM. The same thing was also stated by Dra. Siti Maryam, M.Pd., that the subject of ecology and environmental change is material that is often an obstacle because there are subjects that have not been conveyed in detail and thoroughly in learning. In this material, the teacher is usually preoccupied with preparing for the even-semester final exam. If time is not possible in learning due to end-of-semester exams, the teacher will give assignments independently to students in the form of summarizing, working on questions from textbooks, and student worksheets related to ecological material and environmental change. Furthermore, based on the results of student interviews, namely 62.81% of students stated that the material on ecology and environmental change in biology learning is material that is difficult and quite difficult for students to understand. This is due to several obstacles such as teaching materials or supporting media in the teaching materials used which are still lacking and have not motivated students and have not supported students to study independently during learning, thus making it difficult for students to find an understanding of the concepts they are learning and students do not understand the material being studied. delivered by the teacher.

The existence of E-Modules using a guided inquiry approach in the learning process will make it easier for students to understand ecological material and environmental change. This is because students are encouraged to be directly involved, actively, and creatively in finding their knowledge and understanding according to their abilities, and students are considered to be involved in learning so that later it will spur student motivation and support students to study independently. Maniotes & Kuhlthau (2014) stated that guided inquiry learning provides emotional satisfaction in building personal knowledge and various learning in students, studies find that students' motivation increases when they build personal knowledge and experience emotional satisfaction in their various learning experiences with other people in the class. Permatasari & Dwiastuti (2016) stated that the guided inquiry-based module affected increasing student motivation. In addition, the existence of an E-Module with a guided inquiry approach will also encourage the creation of learning that emphasizes science process skills in students.

Mahmudah (2017) states that science process skills are students' ability to learn using the scientific method, namely making students directly involved with real objects so that it makes it easier for students to understand the material, students discover the concepts themselves, and train them to ask questions and be more active in learning. Wegasanti & Maulida (2017) stated that in the results of their research, guided inquiry learning on science material can train students' science process skills. Fitriyani (2017) states that the guided inquiry model can improve students' science process skills with the highest indicator of science process skills, namely designing experiments. Zahroh (2016) stated that students' science process skills experienced a significant increase after applying the guided inquiry learning model, namely from an average pre-test score of 39 increasing in the post-test to 72 with classical mastery in the post-test of 84%.

Based on research conducted by Qadariah et al. (2019) it is known that guided inquiry-based modules are very valid and practical for increasing student understanding. Budiarti et al (2016) stated in their research results that learning carried out with the guided inquiry model assisted by the E-Module was more effective than not using the E-Module. The results of Fadhillah & Andromeda's research (2020) show that the E-Module based on the guided inquiry approach developed using the Flip PDF Professional application is valid and practical for use by high school students in the learning process. Furthermore, Seruni et al. (2019) stated that in their research results the E-Module developed using the Flip PDF Professional application obtained an average percentage of responses in field tests, namely

84.39% in good and proper interpretations that could be used in the learning process.

Based on the description of the background of the problem, it is necessary to research the development of E-Modules on ecology and environmental change with a guided inquiry approach to ecology and environmental change at MAN 2 Jambi City.

Method

This type of research is research and development (research and development). This study aims to produce a product in the form of an E-Module with a valid, practical, and effective guided inquiry approach on ecology and environmental change for class X MIA MAN 2 Jambi students. The development model used in this study is the plomp development model. The procedure for developing E-Modules with the plomp model can be seen in Figure 1.

The development stage of this model begins with the preliminary research phase, at this stage, a problem analysis, needs analysis, syllabus analysis, and analysis of the teaching materials used are carried out. Next, is the development or prototyping phase, at this stage, the E-Module design is carried out, then validation and practicality were carried out. Then the last stage is the assessment (Assessment phase), at this stage, an effectiveness test is carried out which aims to determine student learning outcomes.

The test subjects in this study were class X students in the even semester of the 2021/2022 academic year at MAN 2 Jambi City. Subjects were divided into two classes, namely, the experimental class and the control class. The experimental class is a class that uses learning with E-modules with a guided inquiry approach, while the control class is a class that does not use it so that the learning process takes place as usual without using the products developed.

The instruments in this development research were at the initial investigative stage in the form of interview sheets for teachers, students, and a needs questionnaire. Furthermore, at the development or prototype development stage, namely the self-evaluation sheet, and the validity sheet of the E-Module. Then, at the assessment stage, namely practicality assessment sheets, competency assessment sheets for knowledge, skills, attitudes, and added to students' motivation and science process skills.

The data analysis technique used is descriptive analysis. Descriptive data analysis describes the validity, practicality, and effectiveness of the E-Module on ecology and environmental change using a guided inquiry approach. Validity and practicality data analysis techniques were carried out using a modified Likert scale score and effectiveness data analysis was carried out by using the Kolmogorov-Smirnov normality test,

homogeneity test using the Levene test, and hypothesis testing using the T-test using SPSS version 23.0.

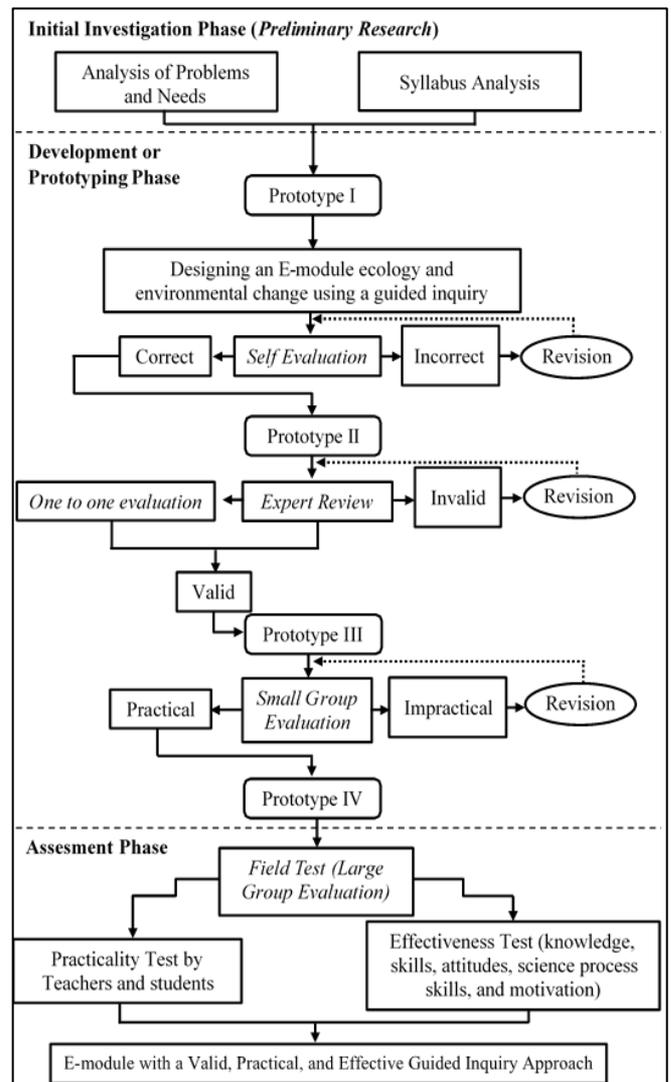


Figure 1. E-module Development Procedure with Guided Inquiry Approach

Result and Discussion

E-Module Validity

The validity of the E-Module begins with the development of prototype I which begins with the design and manufacture of the E-Module product for ecology and environmental change using a guided inquiry approach using the Flip PDF Professional application. The components of the E-Module developed include covers, menus, opening pages, prefaces, table of contents, list of figures, list of tables, introduction, learning, cover, glossary, list of references, answer keys, and author's curriculum vitae. The display of the designed E-Module can be seen in Figure 2.

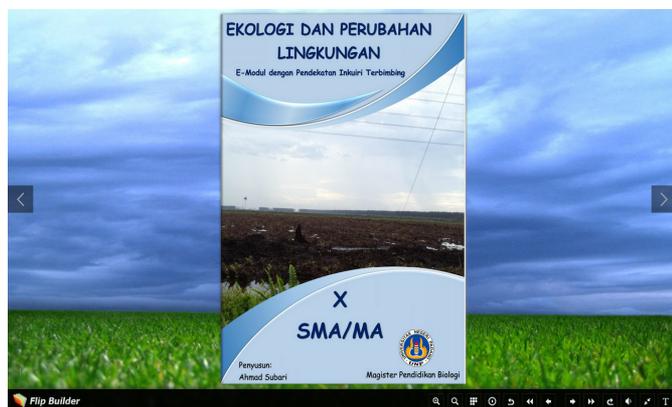


Figure 2. View of the E-Module Cover

E-Modules that have been designed, then carried out a self-evaluation by researchers. Based on the results of self-validation (self-evaluation), improvements were made in the form of adding covers, lists of tables, and glossaries along with descriptions of image and video sources in the description of the material in the Ecology and Environmental Change E-Module with the guided inquiry approach that has been developed. According to Agustine et al. (2014) self-evaluation (Self-evaluation) aims to self-check regarding the development of the e-module, whether it is following the didactic, constructive, and technical aspects that are correct and appropriate, then proceed to the next stage.

Table 1. Results of the Validity Test of Ecology and Environmental Change with the Guided Inquiry Approach

Assessment Aspects	Value (%)	Category
Didactic	95.83	Very Valid
Construct	98.61	Very Valid
Technical	98.33	Very Valid
Total	292.78	
Average Value Validity	97.59	Very Valid

Improvements from self-evaluation produced prototype II. The next stage is the expert review and evaluation one by one (one to one evaluation) of prototype II. At this stage, the E-Module is validated by a team of experts (Expert review). The development of this E-Module is designed to help students and teachers in the learning process. For this reason, the validation stage is carried out by a team of experts or experts (Expert review). The results of the validity of the E-Module can be seen in Table 1.

Based on the results obtained from the validation process, an average value of 97.59% is obtained with a very valid category. This is supported by the opinion of Arikunto (2013) which states that if data obtained from an average assessment of a product being developed is valid, it can be said that the product has been able to have an impact in the form of an overview of the objectives of the development that is appropriate and

correct. with facts and circumstances. Added by Iklima & Fadilah (2022) stated that E-Modules that are categorized as valid are products that can be used and are following the provisions for preparing E-Modules. The validation aspects carried out in the expert assessment include the three assessment requirements namely, didactic, construct, and technical aspects. For more details on each of these aspects are described as follows.

a. Didactic Aspect

The didactic aspect of the E-Module on ecology and environmental change using the guided inquiry approach was declared valid by the validator with a validity value of 95.83% in the very valid category. Based on the criteria for the didactic aspect, it is known that the developed E-Module is following the syllabus and student characteristics and can assist in the learning process so that students understand the material more easily. This is in line with Daryanto (2013) stating that the E-Module is said to be self-contained if all the required learning material is contained in the E-Module.

b. Construct Aspect

The construct aspect of the E-Module on ecology and environmental change with the guided inquiry approach is declared valid with a validity value on the construct aspect of 98.61% with a very valid category. In line with the opinion of Arikunto (2013) stating that data generated from a product is valid, it can be said that the product being developed has provided an overview of its development goals correctly and following the facts and actual conditions.

The e-Module on ecology and environmental change with a guided inquiry approach that fulfills the construct aspect is designed to be used on cell phones. This E-Module contains visual media components in the form of images, text, videos and is designed based on the learning outcomes. Furthermore, the language used in the E-Module on ecology and environmental change with the guided inquiry approach is in accordance with the rules of good and correct Indonesian. According to Hamdani (2011), the language aspect is an aspect that needs to be considered in the preparation of teaching materials and the language used should be simple and easy to understand. Based on the material developed, the E-Module on ecology and environmental change using the guided inquiry approach is stated to have presented clear learning outcomes and subject matter, materials, and evaluations that are appropriate to the learning outcomes have developed the correct concept, and are equipped with a guided inquiry approach.

c. Technical Aspect

The technical aspects of the E-Module on ecology and environmental change using the guided inquiry

approach are declared valid with a technical validity value of 98.33% in the very valid category. The terms or criteria for technical aspects are related to writing, images, videos, and the appearance of a product (Trianto, 2012). Based on the criteria on the technical aspect, it can be stated that the developed E-Module has used the type and size of letters that can be read clearly and the use of appropriate punctuation. Furthermore, the presentation of images on the E-Module already has an explanation, size, and is in accordance with the material presented. Described by Febrianti (2021) states that E-Modules developed using the Flip PDF Professional application are equipped with graphical aspects or visualization of images and videos of the products made, which can make students understand the material being studied because it can stimulate students' sensory organs with videos. in the E-Module. In accordance with the opinion of Prastowo (2015) which states that the presentation of images is needed to support and clarify the content of the material, as well as to increase reader interest. On the technical side, it can be concluded that the E-Module on ecology and environmental change with the guided inquiry approach that has been developed has an attractive cover and content appearance.

The three aspects of the E-Module validation assessment that have been described are a unified whole and mutually support one another to develop an ecological and environmental change E-Module with a good guided inquiry approach and in accordance with the rules. Therefore, the developed E-Module can be used for the next stage of trials. In the next stage, a one-to-one evaluation was carried out, which was an assessment carried out with representative users, namely 3 students with different ability levels to provide input regarding the product that had been developed.

Based on the results of one-to-one evaluation validation, information was obtained that the E-Module on ecology and environmental change using the guided inquiry approach that had been developed received a positive response from students. This can be seen based on the results of the analysis which show that the completeness of the components, language, presentation, and graphics have been fulfilled and are well available. Improvements from the expert review stage and the one-to-one evaluation stage resulted in prototype III. Next, a small group evaluation was carried out by students.

E-Module practicality

The practicality of the E-Module on ecology and environmental change using a guided inquiry approach is carried out for small and large group students, as well as biology teachers. Evaluation of small group evaluations (small group) is carried out through a practical questionnaire instrument given to students to

see the practicality of the E-Module for students in a small number, namely 1 class. The results of the small group evaluation analysis can be seen in Table 2.

Table 2. Results of the E-Module practicality test on ecology and environmental change using a guided inquiry approach to small group evaluations.

Aspect	Value (%)	Criteria
Ease of use	87.33	Very Practical
Usage Efficiency	87.50	Very Practical
Attractiveness	84.38	Very Practical
Easy to interpret	88.89	Very Practical
Have Equivalence	87.04	Very Practical
Total	435.13	
Average (%)	87.03	Very Practical

Based on the results of the small group practicality test in Table 2, an overall average of 87.03% is obtained in the very practical category, which is based on ease of use, efficiency in use, attractiveness, ease of interpretation and equivalents. This shows that the E-Module on ecology and environmental change with the guided inquiry approach developed is already practical and can be used for trials to the next stage.

The result of the development of prototype III is prototype IV. This is because at the small group evaluation stage there were no revisions and the practicality test results showed that the E-Module on ecology and environmental change with the guided inquiry approach was very practical so that it could be used for the Assessment Phase in the field or group trials. large (field test).

In the Assessment Phase, the E-Module assessment of ecology and environmental change was carried out using a guided inquiry approach which included practicality tests by large group students, practicality tests by teachers, and effectiveness tests. At this stage, the activity carried out is an E-Module assessment with a larger sample, in this case 2 classes are used. The purpose of this large group research is to see how practical the E-Module is in ecology and environmental change using a guided inquiry approach.

The large group practicality test (field test) aims to see the practicality of the E-Module on ecology and environmental change with the guided inquiry approach used in the learning process that takes place in actual conditions. In this study, the E-Module practicality test was carried out in 2 classes with a total of 70 students. Aspects that are seen include, namely, ease of use, efficiency of use, attractiveness, easy to interpret and have equivalence. The results of the practicality test analysis in the field test can be seen in Table 3.

Table 3. Results of Ecology E-Module practicality test and environmental change with guided inquiry approach in field trials (Field Test).

Ease of use	Value (%)	Criteria
efficiency of use	90.45	Very Practical
Attractiveness	87.14	Very Practical
Easy to interpret	92.14	Very Practical
Have an equivalent	90.60	Very Practical
Total	91.90	Very Practical
Average (%)	452.23	Very Practical
Ease of use	90.45	Very Practical

Based on the results of the E-Module Practicality Test in the field test (Field Test) in Table 3, it can be seen that the practicality assessment given by students to the E-Module shows an average result of 90.45% in the very practical category. These results indicate that the E-Module on ecology and environmental change with a guided inquiry approach is very practical to be used by students in implementing learning process activities. The next stage is a practicality test by biology teachers in class X.

The practicality test of the E-Module by the teacher was obtained from the practical instrument sheet for the E-Module on ecology and environmental change given to the teacher. The results of the analysis of the practicality of the E-Module data can be seen in Table 4.

Table 4. Results of the E-Module practicality test on ecology and environmental change by the teacher

Aspect	Value (%)	Criteria
Ease of use	87.50	Very Practical
efficiency of use	100.00	Very Practical
Attractiveness	100.00	Very Practical
Easy to interpret	91.67	Very Practical
Have an equivalent	100.00	Very Practical
Total	479.17	Very Practical
Average (%)	95.83	Very Practical

Based on the results of the teacher's practicality in Table 4, it can be seen that the practicality assessment given by the teacher on the E-Module on ecology and environmental change with the guided inquiry approach shows an average result of 95.83% in the very practical category. The practicality test results show that the E-Module is very practical to use by teachers in implementing learning activities. It is also based on ease of use, efficiency in use, attractiveness, easy to interpret and has equivalents.

Based on the results of the evaluation of large group evaluations and biology teachers in class X. The E-Module on ecology and environmental change with the guided inquiry approach developed provides convenience in terms of its use. This convenience is due to the presentation of material using language that is easy to understand and uses clear font sizes. This is in line with the opinion of Nugraha et al. (2013) stated that the convenience obtained by users is one of which is the

language standard or readability of a teaching material seen from the use of good and correct language in accordance with KBBI, the use of simple and uncomplicated language will facilitate students' understanding of the material presented.

In terms of efficiency of use, the E-Module on ecology and environmental change using the guided inquiry approach is very practical. This shows the use of this E-Module according to the time available. The use of E-Modules does not involve a long time and does not interfere with other learning times so that it can be said that the E-Modules developed are efficient in their use. Added by Sukardi (2012) states that practicality can be seen from the implementation time which should be short, fast, and precise.

Based on the aspect of attractiveness, the E-Module on ecology and environmental change with the guided inquiry approach developed has a very practical category. The developed e-module has an attractive appearance so that it can increase student learning interest and the presentation of the material uses a guided inquiry approach, where students can be directly involved actively, and creatively in discovering their knowledge and understanding in the learning process. This is one of the driving factors in improving understanding and student learning outcomes in learning. In line with research conducted by Sarah & Ngaisah (2016) the use of E-Modules with an inquiry approach can improve learning outcomes and make it easier for students to understand subject matter because it is equipped with learning videos and can create learning experiences, arouse curiosity, and joy in students through projects inquiry in learning.

Based on the aspect of ease of interpretation, the E-Module on ecology and environmental change with a guided inquiry approach has very practical criteria. This is because the use of E-Modules is easily understood by teachers and easily interpreted by students. Added by Hamid & Alberida (2021) stated that the Flip PDF Professional application has more advantages, which are easy to use because it can be operated for beginners who don't know the HTML programming language so it is more effective and easier to use in learning.

In the aspect of equivalence, the E-Module on ecology and environmental change with a guided inquiry approach have very practical criteria. This shows that the E-Module has equivalent material to the teaching materials that are commonly used so that it can be an alternative teaching material in the learning process. This E-Module the presentation of material that is relevant to the syllabus, so that it can be used as one of the variations of teaching materials used in biology learning on ecology and environmental change. Sukardi (2012) states that teaching materials can be said to be equivalent if they can be used as substitutes or variations in learning according to student's learning needs.

Based on observations made during practicality tests, it appears that students are very happy and enthusiastic in learning by using the Ecology and Environmental Change E-Module with the guided inquiry approach. This was added by the presence of students who thought that the E-Module was very interesting to read and very relevant for learning. This is because the learning materials in the E-Module can be used on their respective Android and iOS-based smartphones or via computers and laptops. In line with this opinion, Calimag et al. (2014) stated that one of the devices that can be used for educational purposes is a smartphone based on Android or iOS. The next stage is to test the effectiveness of the E-Module on ecology and environmental change using a guided inquiry approach.

E-Module Effectiveness

In the testing phase of the effectiveness of the E-Module, an assessment is carried out to see the effectiveness of the E-Module on ecology and environmental change using the guided inquiry approach that has been developed. The effectiveness of the E-Module is viewed from the competence of knowledge, skills and attitudes and added to the motivational aspects and science process skills in students. The results of the effectiveness assessment showed that the developed E-Module on ecology and environmental change using the guided inquiry approach was effective. Student knowledge competency is obtained through a test technique in the form of a pre-test and post-test of 25 multiple choice questions (objective). Competency skills, attitudes, and science process skills in students are obtained through non-test techniques in the form of observation sheets which are assessed by observers along with validated rubrics. Meanwhile, student motivation was obtained through questionnaires on student responses to learning biology on ecology material after using the E-Module on ecology and environmental change with a guided inquiry approach which was carried out at the end of the meeting. The following is an explanation of the results of the effectiveness test that has been carried out.

a. Knowledge Competence

Data on learning outcomes on knowledge competencies were obtained through learning outcomes tests conducted at the initial and final meetings. The test was given in the form of multiple-choice questions (objective) consisting of 25 items in the form of pre-test and post-test in the experimental and control classes. The learning outcomes of students' knowledge competence using the E-Module on ecology and environmental change with the guided inquiry approach were higher than the control class which did not use the E-Module. This is because the E-Module is equipped with pictures, learning videos, evaluations,

and is supported by learning activities contained in the E-Module which is structured using a guided inquiry approach. Thus, making students can better understand the material being studied.

According to Limatahu et al. (2017) electronic modules can help students improve competence and cognitive understanding, and make it easier for students to learn the contents of the material contained in the E-Module because it is easy to carry anywhere and anytime. Application of learning materials that can be used on smart phones can make students gain a lot of knowledge, in this case the application of learning materials facilitates things that are not covered and not contained in textbooks and allows students to study material effectively and efficiently (Huang et al., 2012).

Table 5. Results of Knowledge Competency Hypothesis Test with Mann Whitney Test (U-Test)

Class	Asymp. Sig. (2-tailed)	Provision Absolute	Information
Experiment (Post-test)	0.000	Asymp. Sig. < 0.05	H ₀ rejected
Control (Post-test)			

Testing the effectiveness of the E-Module on ecology and environmental change using the guided inquiry approach was carried out using non-parametric statistical analysis (Wilcoxon and Mann Whitney test or u-test). This is because based on the results of the normality and homogeneity tests of the data, it is found that the knowledge competency values are not normally distributed and are not homogeneous (same). The Mann Whitney test (U-test) is an alternative to the independent sample t test which aims to determine whether or not there is a difference in the mean of two unpaired samples. The results of the knowledge competence hypothesis test with the Mann Whitney Test (U-Test) can be seen in Table 5.

Based on the Mann Whitney Test (U-Test) it is known that the Asymp. Sig. (2-tailed) students' knowledge competency 0.000 < 0.05 which indicates that H₀ is rejected and H₁ is accepted. So, it can be concluded that there is an effect of the use of the E-Module on learning outcomes in the knowledge competency of class X MIA ecological material students. Therefore, the use of the E-Module on ecology and environmental change with a guided inquiry approach is effectively used for learning biology on ecology and environmental change.

The e-module of ecology and environmental change with a guided inquiry approach used by students during the learning process, based on the results of the assessment shows that there is a positive influence on the learning outcomes of students' knowledge competence. This is supported by Hasibuan & Andromeda (2021) who emphasize that the use of guided inquiry-based E-Modules can make students

learn independently and effectively to improve student learning outcomes. Thus, learning using the guided inquiry approach will involve students directly in learning with everyday life and their environment, so that learning becomes more meaningful, fun, and easy to understand. In addition, in the developed E-Module there are problems related to ecological material and environmental change, thus making students more curious about the solutions to these problems. Added by Ardi et al. (2021) states that learning with problem solving models can improve the learning outcomes of students with low academic abilities.

In the final part, the E-Module on ecology and environmental change with the guided inquiry approach that was developed, evaluation questions are presented for each material equipped with a score along with answer keys that can help students see the learning achievements that have been carried out. Strengthened by research Concerned et al. (2017) stated that the E-Module which is equipped with evaluation questions can measure the level of student mastery of the material discussed in the E-Module.

b. Skills Competency

The results of learning on student skill competencies revealed that the experimental class that used the E-Module on ecology and environmental change with the guided inquiry approach was better than the control class that did not use the E-Module. Assessment of student skills competence is based on presentation assessment and discussion assessment. The results of the skills competency assessment hypothesis test can be seen in Table 6.

Table 6. Skills Competency Hypothesis Test Results with the Mann Whitney Test (U-Test)

Class	Asymp. Sig. (2-tailed)	Provision Absolute	Conclusion
Experiment	0.001	Asymp. Sig. < 0.05	H ₀ rejected

Based on the calculation results of the Mann Whitney Test (U-Test) on student learning outcomes in skill competencies it is known that the Asymp.Sig (2-tailed) = 0.001, this means the Asymp. Sig. < 0.05, then H₀ is rejected and H₁ is accepted. So, it can be concluded that there is an effect of using the ecological E-Module and environmental change with the guided inquiry approach on student learning outcomes in the competency skills of ecological material.

The results of this assessment indicate that the use of ecological E-Modules and environmental change with the guided inquiry approach has an effect on increasing learning outcomes in students' skill competencies. This is in accordance with research conducted by Nugraheni et al. (2015) stated that the modules developed with the

guided inquiry approach were effective in increasing student competency skills. Research from Neuby (2010) also revealed that the inquiry method can build analytical skills, increase students' prior knowledge, and increase student engagement. In addition, the inquiry method can build hypotheses, integrate, and apply new knowledge better to students.

c. Attitude Competence

The results of student learning on attitude competence revealed that the experimental class that used the E-Module on ecology and environmental change with the guided inquiry approach was better than the control class that did not use the E-Module. The results of this assessment indicate that the use of the E-Module has an effect on increasing learning outcomes in students' attitude competencies. The results of the attitude competence hypothesis test can be seen in Table 7.

Table 7. Attitude Competency Hypothesis Test Results with the Mann Whitney Test (U-Test)

Class	Asymp. Sig. (2-tailed)	Provision Absolute	Conclusion
Experiment	0.000	Asymp. Sig. < 0.05	H ₀ rejected

Based on the calculation results of the Mann Whitney test on student learning outcomes in attitude competence, it is known that the value of Asymp.Sig (2-tailed) = 0.000, this means that the value of Asymp. Sig. < 0.05, then H₀ is rejected and H₁ is accepted. So, it can be concluded that there is an effect of using the ecological E-Module and environmental change with the guided inquiry approach on student learning outcomes in the competence of attitudes towards ecological material.

The use of the E-Module on ecology and environmental change with a guided inquiry approach familiarizes students with scientific attitudes, such as being responsible, disciplined and working together. Especially with interesting pictures and videos, evaluations, and learning activities in E-Modules that use a guided inquiry approach. This is in line with Spronken-Smith (2012) stating that inquiry-based research learning is the best pedagogy enabling students to experience the process of knowledge creation and the key attributes in learning that are stimulated by inquiry, student-centered, independent learning, and an active approach.

d. Motivation

Students' motivation towards learning biology on ecology material after using the E-Module on ecology and environmental change with the guided inquiry approach revealed that the experimental class that used

the E-Module was better than the control class that did not use the E-Module. The results of this assessment indicate that the use of the E-Module has an effect on increasing student motivation. The results of the motivational hypothesis test can be seen in Table 8.

Table 8. Results of the Motivation Hypothesis Test with the Mann Whitney Test (U-Test)

Class	Asymp. Sig. (2-tailed)	Provision Absolute	Conclusion
Experiment	0.000	Asymp. Sig. < 0.05	H ₀ rejected
Control			

Based on the results of the calculation of the Mann Whitney test on student motivation, it is known that the value of Asymp.Sig (2-tailed) = 0.000, this means that the value of Asymp. Sig. <0.05, then H₀ is rejected and H₁ is accepted. So it can be concluded that there is an effect of using the ecological E-Module and environmental change with the guided inquiry approach on students' motivation in ecological material.

The use of the E-Module on ecology and environmental change with a guided inquiry approach which includes pictures, tables and graphs, can attract students' attention and increase learning motivation and make it easier for students to understand the material. This is in accordance with the opinion of Prastowo (2015) which states that modules that are arranged creatively and innovatively can motivate students to learn. This is in line with research conducted by Permatasari & Dwiastuti (2016) which states that modules based on the guided inquiry approach have an effect on increasing student motivation. Added by Fadhillah & Andromeda (2020) states that guided inquiry-based E-Modules can increase students' motivation and independent learning.

e. Science Process Skills

Students' science process skills towards learning biology on ecology material after using the E-Module on ecology and environmental change with the guided inquiry approach revealed that the experimental class that used the E-Module was better than the control class that did not use the E-Module. The results of this assessment indicate that the use of the E-Module has an effect on improving students' science process skills. The results of the attitude competence hypothesis test can be seen in Table 9.

Table 9. Results of the Science Process Skills Hypothesis Test with the Mann Whitney Test (U-Test)

Class	Asymp. Sig. (2-tailed)	Provision Absolute	Conclusion
Experiment	0.000	Asymp. Sig. < 0.05	H ₀ rejected
Control			

Based on the calculation results of the Mann Whitney Test on students' science process skills, it is known that the value of Asymp.Sig (2-tailed) = 0.000, this means that the value of Asymp. Sig. <0.05 then H₀ is rejected and H₁ is accepted. So, it can be concluded that there is an effect of using the ecological E-Module and environmental change with the guided inquiry approach on students' science process skills in ecological material.

The use of the E-Module on ecology and environmental change with a guided inquiry approach is effective in growing students' science process skills. Dewi et al. (2017) showed that in the results of his research, the module with the inquiry model that had been developed was able to grow five indicators of students' science process skills, namely predicting, formulating hypotheses, identifying variables, interpreting data, and formulating conclusions. This is in line with research conducted by Palayaswati & Masykuri (2015) which states that there is a significant difference between the science process skills of classes that use modules with the guided inquiry approach and those that do not use modules with the guided inquiry approach. Added by Prihandono et al. (2015) stated that modules developed based on guided inquiry are feasible to use, attract and assist students in understanding concepts, and can improve Science Process Skills in students in the moderate category.

Conclusion

Based on the results of the development that has been carried out, it is concluded that the E-Module of ecology and environmental change with a guided inquiry approach using the Flip PDF Professional application that has been developed has validity in a very valid category based on validator assessments, has practicality in a very practical category based on teacher and student assessments in MAN 2 Jambi, and has effectiveness with a very effective category through the assessment of learning outcomes (knowledge competence, skills, attitudes as well as motivation and science process skills in students).

Acknowledgments

During this research, the author received a lot of support, guidance, direction and input from various parties, for that on this occasion the author would like to thank Dr. Abdurahman, M.Pd., Dr. Darmansyah, M.Pd., and Prof. Dr. Abdul Razak, M.Sc., as the validator. Furthermore, to the Principal of MAN 2 Jambi City H. Ambok Pera Afrizal MA, who has provided the opportunity and permission to carry out this research. Then, to Drs. Ahadiyanto, M.Sc., who has guided and provided input to researchers and contributed to the

implementation of research at MAN 2 Jambi. In addition, Biology teacher Siti Rosiah, S.P., M.Sc., and Dra. Siti Maryam, M.Pd., who has guided and provided input to researchers in the smooth running of this research. As well as students of class X MIA 1, 2 and 4 MAN 2 Jambi in 2020/2021 as test subjects, and colleagues namely Restu Fitriani, S.Pd., M.Sc., Muhammad Fathurrachman, S.M., Lisa Mariati, S.Pd., and Muhammad Solichin, S.Pd., who provided advice, motivation, and input in the research.

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