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Development of Guided Inquiry-Based Science Electronic Teaching Materials to Increase Student Learning Motivation

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ABSTRACT

This study aims to produce electronic teaching materials based on guided inquiry that are feasible and practical to use in science learning to increase learning motivation. The type of research used is research and development using the 4-D development model. According to experts, electronic teaching materials are assessed based on feasibility, the practicality of use based on student assessments, and the effect of using electronic teaching materials on increasing student learning motivation. The instruments used in this study consisted of teaching material of feasibility assessment sheets, practicality sheets, and learning motivation questionnaires. The results showed that: 1) the developed electronic teaching materials had a feasibility level with a value of 77.0 or with eligibility criteria in the good category, 2) the practicality of electronic teaching materials based on student response assessments had a practicality level with a value of 93.0 or with the criteria very good, 3) the electronic teaching materials developed are effective for increasing students' learning motivation.

INTRODUCTION

The rapid change and development of Information and Communication Technology (ICT) are related to the use of ICT in the implementation of learning in the classroom. ICT is a component that helps in community interaction activities and student learning (Alt, 2018). ICT can be a tool or media in learning to convey information and material to students. The development of ICT-based learning requires infrastructure elements and teachers who are competent in developing these teaching materials so that they can be integrated into learning. ICT-based learning strategies can unlock students' potential in preparing themselves to face the challenges of everyday life (Bulic & Blazevic, 2020).

One of the implementations of ICT in learning can be in the form of ICT-based or electronic teaching materials. Developing electronic teaching materials for learning is one of the many competencies teachers must master regarding professional competence. A teacher must be proficient in making electronic teaching materials and be able to use ICT well. Professional teachers can teach about the process and use of information technology in the environment where students live. It can make it easier for students to adapt based on environmental demands (Qomario & Putry Agung, 2018)

Electronic teaching materials can influence students' learning motivation to improve learning outcomes. Through electronic teaching materials, students can be motivated when learning takes place and can increase learning activities outside the classroom (Andani & Yulian, 2018; Kurniawati, 2020). *Motivation* can be defined as an internal condition that functions to activate and direct behavior. Student learning motivation and engagement behavior are the keys to improving the quality of learning to achieve educational goals. Student motivation is important to their involvement, especially during the learning process. Increasing the number of students who are motivated to learn can make success in their actions. Several factors can contribute to student motivation: peer involvement, teacher skills, and effective use of technology (Theses et al., 2017).

Implementation of electronic teaching materials can be done through science learning. Some of the science material taught in schools has the property of being unable to be presented directly in front of students due to space and time limitations. For example, presenting large objects or creatures in the class or vice versa. Therefore, teaching materials are needed that can help show students parts of microscopic and abstract objects during the learning process. Applying these teaching materials can help sharpen students' knowledge, which is expected to increase learning motivation (Aulia et al., 2020).

Electronic teaching materials can be integrated with certain learning models to create more meaningful learning. Learning will be more meaningful if collaborative methods are applied between students (Hamza et al., 2022). In addition, teachers are also needed who play an important role in supporting students' learning process by handling specific domains of scientific knowledge in each phase of the investigation (van et al., 2016). The appropriate learning model to support this learning is one of them, namely the guided inquiry model, which is a learning process. which emphasizes the process of critical and analytical thinking to seek and find answers to the problems asked (Margunayasa et al., 2019; Rambe et al., 2020). Guided inquiry effectively encourages student involvement and motivation to understand the material better (Irdalisa et al., 2020; Rahayu, 2021). Learning by applying guided inquiry can increase student learning motivation based on collaboration performance between friends to improve student learning outcomes.

However, based on the preliminary study, problems with students' learning motivation were identified. The results of distributing the questionnaire to 10 junior high school students revealed a fact that the learning motivation of students in learning science was still in the low category. It is known from the attitude of less responsive students when studying learning material that is considered difficult. A lack of motivation to learn can also be seen in the activities of passive students in asking questions. It also aligns with students' habits of needing more literacy in reading the material to be taught before learning occurs.

The problems above require serious efforts so that the problem can be solved. Efforts to increase student motivation to learn and improve learning achievement can be achieved by providing learning resources that stimulate students in learning activities and can provide comprehensive information. The implementation of teaching materials now is wider than printed materials but can be developed widely in electronic teaching materials. Teaching materials prepared in an electronic format can be combined with instructional videos that students cannot access through open print or textbooks.

According to the findings of Iwantara et al. (2014), there are differences in learning motivation and understanding of students' concepts among students who learn to use real media, charts, and Youtube video media, with the results showing that real media and Youtube video media are superior in instilling motivation. And students' conceptual understanding. Kurniawati (2020) states that electronic teaching materials (e-modules) can be used as teaching materials to support learning activities and foster student learning

motivation. The use of electronic teaching materials also has an impact on students because they are integrated with devices that students often use in everyday life.

Based on these problems, it is necessary to develop guided inquiry-based electronic teaching materials to help increase students' learning motivation in learning science. The availability of guided inquiry-based electronic teaching materials is expected to assist in solving students' learning motivation problems. Thus, this research and development aim to produce electronic teaching materials based on guided inquiry to increase students' learning motivation.

METHODS

This research is an implementation of the type of research and development. The development model used is based on the 4-D (Four D Model), with the defined stages being defined, designed, developed, and disseminated (Thiagarajan et al., 1974). The product of this research is an electronic teaching material based on Guided Inquiry on metabolic material designed to increase students' learning motivation.

At the define stage, several analyses were carried out: initial analysis, student analysis, task analysis, concept analysis, and setting learning objectives. Needs analysis is carried out to collect information on the needs of school teaching materials, how learning activities occur, and what problems teachers and students face during the learning process. The data used to analyze the need for teaching materials was collected through a questionnaire distributed to teachers and students. Student analysis was conducted to determine students' motivation to learn at school. The task analysis includes an analysis of core competencies (CC), basic competencies (BC), learning indicators, and learning objectives. Concept analysis of energy transformation material is done by identifying facts, concepts, principles, and theories and compiling concept maps. Goal setting is done to set specific learning goals that will be achieved through guided inquiry-based electronic teaching materials.

The design phase is carried out by preparing research instruments, selecting the media to be used, product specification formats, and product designs that will be used to prepare the initial product design or product draft. The development stage includes product feasibility tests, practicality tests on product use, and the effect of product use on increasing student learning motivation. The product feasibility test is assessed from content feasibility, language, presentation, and graphics. Students' assessment of the practicality of product use in terms of usability, ease of use, attractiveness, and clarity through the limited test stages. Furthermore, a field test was conducted to review the product's effectiveness in increasing students' learning motivation after using the developed product.

The product was tested at Kerinci Public Middle School 5, Jambi Province, in the odd semester of the 2021/2022 school year. The subjects of this study were students of class VII SMP. The number of respondents in the limited trial was 15, with the criteria for students' initial abilities: high, medium, and low. The field trial consisted of 22 randomly selected students and was treated with a one-group pretest-posttest design. The instruments used in this study consisted of teaching material of feasibility assessment sheets, practicality sheets, and a learning motivation questionnaire developed with a Likert scale. Data were analyzed by calculating the average and converting the score to a scale of 5, as proposed by Sukardjo (2013). The average score obtained is calculated using Equation 1.

$$\bar{X} = \frac{\Sigma x}{n} \quad \text{.....(1)}$$

Information:

$\bar{X}$ = mean or average

$\sum x$ = total score
N = amount of data.

Next, the calculation of the ideal mean $\bar{X}_i$ and standard deviation (Sbi) is then performed. Then the scores are converted to values with the criteria and comparisons shown in Table 1 (Sukardjo, 2013).

Table 1. Conversion of Actual Score to Scale 5

Score Intervals	Value	Category
$\bar{X} > \bar{X}_i + 1{,}80$ SBi	A	Very Good
$\bar{X}_i + 0{,}60$ Sbi $< \bar{X} \leq \bar{X}_i + 1{,}80$ Sbi	B	Good
$\bar{X}_i - 0{,}60$ Sbi $< \bar{X} \leq \bar{X}_i + 0{,}60$ Sbi	C	Enough
$\bar{X}_i - 1{,}80$ Sbi $< \bar{X} \leq \bar{X}_i - 0{,}60$ Sbi	D	Not Good
$\bar{X} < \bar{X}_i - 1{,}80$ Sbi	E	Very Not Good

Information:
$\bar{X}_i$ = 1/2 (ideal maximum score + ideal minimum score)
Sb = 1/6 (ideal maximum score -ideal minimum score)
$\bar{X}$ = actual score

RESULTS AND DISCUSSION

Results

This research and development resulted in a product of guided inquiry-based electronic teaching materials designed to increase students' learning motivation and cognitive learning outcomes. The development of guided inquiry-based electronic teaching materials was carried out through four stages with the following results.

1. Define

The define stage consists of initial analysis activities, student analysis, task analysis, concept analysis, and setting learning objectives. The research results at the defined stage are in Table 2.

Table 2. The Results of The Initial Knowledge Analysis at the Defined Stage

Define stage activities	Information
Initial analysis	The limited use of technology in learning and presentation of learning materials is dominated by printed teaching materials, namely textbooks and SWS
Student analysis	The learning motivation of students is still in the low category
Task analysis	Determination of basic competencies, namely BC 3.5 and 4.5 in science material for class VII SMP
Concept analysis	Essential materials about energy in everyday life and concept maps
Learning objectives	Learning objectives to be achieved through the use of guided inquiry-based electronic teaching materials

2. Design

The design stage is done by compiling a benchmark reference test to obtain a research instrument in the form of a learning motivation questionnaire to measure students' learning motivation in learning science. In the next stage, media selection is carried out, namely Canva. It determines product format specifications consisting of covers, instructions for use, preface, table of contents, basic competencies, objectives, list of materials, videos, learning materials, evaluation questions, and references. Then, a product design or grid was prepared to guide the development of guided inquiry-based electronic teaching materials, as shown in Table 3. Products were made using Heyzine Flipbooks to obtain electronic teaching materials easily accessible via the web with smartphones or laptops.

Table 3. Design of Electronic Teaching Materials

Component	Information
Cover	Contains the UNY logo, the title of the teaching material, the identity of the author, and the identity of the reviewer of the teaching material
Instructions for use	Includes 8 instructions for using teaching materials which explain how to use teaching materials via a smartphone or laptop
Foreword	Thanks to those who helped in completing the product
List of contents	A list of the titles of the sections of electronic teaching materials arranged sequentially, accompanied by page numbers
Basic Competency (BC)	BC 3.5 and 4.5 Middle School Science based on the 2013 curriculum
Objective	Learning Objectives by achievement indicators
Material List	Topics to be discussed in electronic teaching materials: Metabolism, Catabolism, and Anabolism
Videos List	Photosynthesis process video
Learning materials	Includes discussion of each topic and sub-topic in which there are Guided Inquiry learning stages
Evaluation questions	Consists of multiple-choice questions
Reference	The reading list used in the preparation of electronic teaching materials

3. Develop

The development stage is carried out by testing the feasibility of the electronic teaching materials that have been prepared. Four experts assessed the feasibility of electronic teaching materials by considering the components of eligibility for content, language, presentation, and graphics (High School Development Directorate, 2008). The instrument for measuring product feasibility is a feasibility assessment sheet comprising 19 aspects. The results of the feasibility assessment are presented in Table 4.

Table 4. Guided Inquiry-Based Electronic Teaching Material Feasibility Assessment Scores

Component	Average	Value	Category
Content	80,0	A	Very good
Language	78,4	A	Good
Serving	77,0	A	Good
Graphic	72,4	B	Good

The results of the feasibility assessment of electronic teaching materials obtained an average score of the four components, namely 77 in the good category. Furthermore, improvements were made according to experts' advice covering all assessment components.

After the electronic teaching materials were revised, a limited trial was conducted on 15 students to assess the practicality of using the teaching materials. The practical test results for using electronic teaching materials are presented in Table 5.

Table 5. Average Practicality Score of Using Guided Inquiry-Based Electronic Teaching Materials

Component	Average	Value	Category
Utility	92,7	A	Very good
Ease of Use	94,9	A	Very good
Attractiveness	93,1	A	Very good
Clarity	91,4	A	Very good

Based on the analysis of student response data, an average score of 93 was obtained, which placed guided inquiry-based electronic teaching materials to obtain practicality in the very good category. It shows that students can obtain learning materials from electronic teaching materials and use them properly. Student responses regarding using electronic teaching materials also show functional teaching materials for science learning. After the electronic teaching materials are declared feasible and practical, field trials are conducted to assess the product's effectiveness in positively impacting students' learning motivation. The data collected was then analyzed by calculating the percentage of learning motivation. The results of the analysis of students' learning motivation are shown in Figure 1.

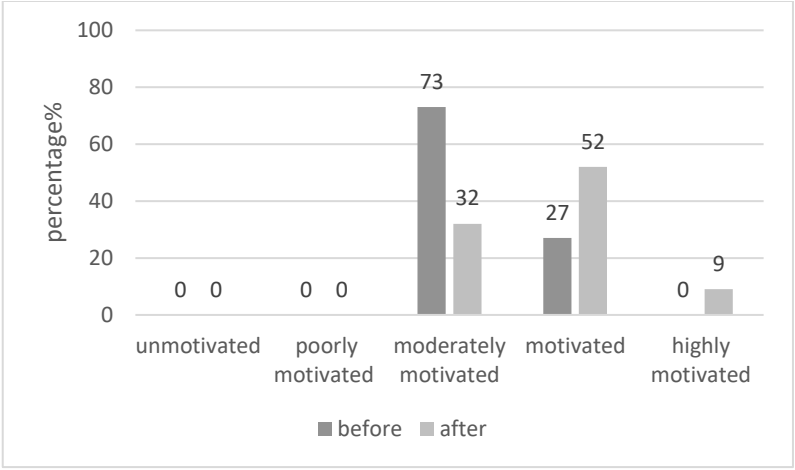

Figure 1. Percentage of Learning Motivation

The purpose of measuring student learning motivation is to measure the level of student learning motivation and its development when it has finished learning with the help of developed teaching materials. Based on the data in Figure 1, students' learning motivation has increased after learning using guided inquiry-based electronic teaching materials. Before using the product, it was found that 27% of students were motivated to learn science, whereas after using electronic teaching materials, there was an increase of 52%. In addition, there is also an increase in student motivation from 0% who are highly motivated to 9%.

The effectiveness of guided inquiry-based electronic teaching materials in increasing learning motivation was determined based on non-parametric statistical tests using the SPSS-assisted Wilcoxon test version 21. Based on statistical tests, the Asymp. sig.(2-tailed) value was 0.000. The sig value obtained is smaller than 0.005, so it can be interpreted that guided inquiry-based electronic teaching materials effectively increase students' learning motivation.

Discussion

According to experts, the results of the feasibility assessment show that guided inquiry-based electronic teaching materials are feasible for use in science learning. The teaching materials have met the content, language, presentation, and graphics feasibility. The content/content of teaching materials contained in guided inquiry-based electronic teaching materials is by competency standards and basic competencies, according to the needs of students, contains the appropriate material substance, is useful for broadening knowledge, and is by moral and social values. The feasibility of the developed teaching materials is also related to linguistic aspects, which have good readability, contain clear information, comply with the rules of the Indonesian language, and use effective and efficient sentences. The advanced teaching materials also meet the feasibility of the presentation aspect, which shows that the teaching materials have clear objectives, are presented systematically, provide motivation and stimulus, and present complete information. In the graphical aspect, teaching materials meet eligibility because they have used appropriate fonts, good layouts, graphics such as pictures, and attractive display designs.

Guided inquiry-based electronic teaching materials have practicality in the very good category. Based on the data obtained from the limited test results, it is known that the resulting teaching materials meet the aspects of usability, ease of use, attractiveness, and clarity. Electronic teaching materials can help students increase independence in learning, help them understand learning material, add insight, and encourage the courage to excel. The resulting teaching materials are also practical when viewed from the ease of use. Student responses indicate that science electronic teaching materials are efficient for learning, use language that is easy to understand, contain clear material and exercises, and are easy to use anywhere and anytime. Teaching materials meet the aspect of attractiveness because they meet an attractive appearance design, science material is presented with complete illustrations, pictures, and appropriate photos, the type of writing font can be read clearly, and attractive color combinations. The student's response to clarity also shows the practicality of the teaching materials produced. The pictures and videos presented are clear by fulfilling the clarity of learning objectives, instructions presented, writing, materials, activities, and worksheets.

Based on the data presented in Figure 1, guided inquiry-based electronic teaching materials influence students' learning motivation. The results of the two average differences using the Wilcoxson test show the average difference in student motivation, which shows a significant difference between learning motivation before and after using the product. Electronic teaching materials attract students' interest because the presentation is attractive and integrated with technology. Electronic teaching materials are more attractive to students because they are integrated with learning videos that are easily accessible from student devices. This finding is in line with the findings (Godzicki et al., 2013), which state that the implementation of technology has a role in engaging students in relevant learning. The role of technology in assisting the implementation of online learning is by using electronic-based learning media (Maghfiroh et al., 2023). Technology use positively correlates with students' motivation and involvement in learning (Elshareif & Mohamed, 2021; Onyema, 2019). Based on research (Alenezi, 2020) states that the more electronic teaching materials are used, the higher the performance of students and the more efficient teaching of teachers. In general, motivated students have the characteristics of being active in asking questions, discussing, and being persistent in doing assignments (Firmansyah et al., 2016).

The increased learning motivation of students is also influenced by guided inquiry-based learning, which is integrated into electronic teaching materials. Guided inquiry-based learning can positively impact student development, help achieve learning goals, and train students to be more active when learning (Fahlevi et al., 2022; Joshi & Lau, 2021; Lazonder &

Harmsen, 2016). Guided inquiry contributes to students understanding of topics related to learning activities (Castro & Morales, 2017; Feyzioğlu & Demirci, 2021; Sarioglan & Gedik, 2020). Guided inquiry effectiveness can be increased through technology in learning and influencing students to engage in learning and learn science concepts deeply (Onyema et al., 2019). Guided inquiry integration is an appropriate approach for students in high schools because it can adjust the level of inquiry to the abilities of students so that it can improve student learning outcomes (Wen et al., 2020).

CONCLUSION

Based on product research and development, the following conclusions are obtained: 1) guided inquiry-based electronic teaching materials are appropriate for use in science learning with a feasibility level of 77.0 or in the good category, 2) guided inquiry-based electronic teaching materials have a level of practicality with a value 93.0 or with very good criteria, 3) guided inquiry-based electronic teaching materials are effective for increasing students' learning motivation. Thus, guided inquiry-based electronic teaching materials are feasible and practical for use in science learning and have a positive influence on increasing students' learning motivation.

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