



The Effect of Digital-Based Interactive Modules to Improve Student's Critical Thinking Skills and Learning Motivation on Biology Learning

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Abstract: Biology learning is learning that requires teaching materials that can facilitate the delivery of abstract and complex material. This research aims to determine the effect of digital-based interactive modules on students' critical thinking skills and learning motivation at SMA Negeri 9 Bengkulu City. This research is a type of Quasi-Experimental research. The sample used in collecting research data was 65 students taken from class X MIPA 2 as the experimental class and X MIPA 3 as the control class. The instruments used were critical thinking skills test sheets and student learning motivation questionnaires. The results showed that students' critical thinking skills and learning motivation were better compared to the control class. This is shown by the significance value for these two variables, namely 0.00 0.05. The results of this research confirm that the use of teaching materials in the form of interactive digital modules in biology learning is effective in facilitating students to develop their thinking skills. The use of teaching materials that utilize technology will foster students' learning motivation because they are considered relevant to students' learning needs in the current technological era.

Keywords: Critical thinking skills; Digital-based interactive modules; Learning motivation

Introduction

Technological developments during the era of the Industrial Revolution 4.0 also had an impact on the world of education (Rahmatina et al., 2019). The development of the world of education can be seen from learning processes such as curriculum development, use of learning models, selection of learning methods, use of teaching materials, and other learning tools (Kenedi et al., 2018). Learning devices are a collection of learning resources that enable students and teachers to carry out learning activities (Santi et al., 2015). The need for education is like never before because technology and science are advancing, and it demands people who continue to learn and update their knowledge (Darmadi, 2011). Apart from advances in technology, research in the field of learning widens the knowledge of educators, and students are ensured to be more than just recipients

of information and passive respondents to the environment (Fathurrohman, 2017). Technological developments are increasingly rapid, encouraging a combination of printing technology and computer technology in learning activities. Learning by using appropriate teaching materials, and by the times and conditions of students can create a more enjoyable learning process and make students more interested in learning.

Teaching materials are a set of information related to the material to be studied (Hamimah et al., 2019). Teaching materials can be interpreted as any information or text that is arranged coherently to support the implementation of learning objectives. The forms of teaching materials are textbooks, modules, student worksheets (LKPD), and handouts. In line with Cahyadi's opinion (2019) which states that teaching materials are not only in conventional form but in

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electronic form such as e-books, e-modules, audio compact discs, and cassettes. Based on previous research, it was stated that teaching materials can increase student interest, motivation and attention which have an impact on improving the quality of learning (Kurniawan et al., 2019). Educators' strategies that do not utilize technology such as media and other learning support facilities can make students tend to be less interested in the learning process (Syahiddah et al., 2021). Teaching materials applied are only informative so that critical thinking skills and student motivation are still not well developed. One of the teaching materials that is effectively used is digital-based interactive modules.

Modules are digital media that are easy to carry anywhere, effective, and can hone student independence in understanding teaching material (Hastin, 2020). Learning modules are expected to be able to motivate students in learning and contain complete material to increase a strong understanding of the material so that learning can be carried out in an interesting way in class with the electronic learning module (Hidayat, 2017). According to Yolanda (2021) which states that the module has completeness such as self-study instructions, materials, sample questions, evaluations, and assessment guidelines that can be applied as guidelines for the achievement of learning activities studied. Modules are digital media that have the advantage of being easy to carry anywhere, effective, and able to train students' independence in understanding a teaching material and independently solving problems that have been obtained in learning activities. In line with the opinion of Ramadayanti (2021) who stated that when compared to print modules, modules have advantages, namely their interactive nature, ease of navigation, can be filled of images, audio, video, and animation, and also has a test menu or formative quiz with automatic feedback.

The module is defined as a learning medium using a computer that displays text, images, graphics, audio, animation, and video in the learning process (A. Nugraha et al., 2015). Learning modules are expected to be able to motivate students in learning, and contain complete material to increase a strong understanding of the material so that learning can be carried out in an interesting way in class with the electronic learning module (Hidayat, 2017). According to Budiarti et al. (2016) the use of modules in the learning process will foster creativity, critical, productive thinking habits and create active, effective, innovative and fun conditions.

The module is a supporting learning resource in teaching and learning activities. Thus, the use of learning modules really supports the ongoing learning process. The module is defined as a single unit of

teaching material that can be used for independent study because it is delivered in the form of *self-instruction*. This is supported by previous research including research used by Apriliana (2018) which showed results that the use of digital modules can improve critical thinking skills. Furthermore, it is supported by research conducted by Marcelina et al. (2022) which shows the results that the development of modules to train students' critical thinking skills is said to be very suitable for use as teaching materials for students. Not only that, further research research supported by Wahyuni (2020) also shows that modules can develop aspects of critical thinking skills. In addition to increasing critical thinking, the use of digital-based interactive modules is also able to increase student learning motivation. Furthermore, it is supported by research from Paska et al. (2017) which shows that the results of research using modules can motivate students. This is supported by research results from Zaharah et al. (2020) which also show that using electronic models can increase student motivation.

Critical thinking is a reflective way of thinking that makes sense or is based on logic that focuses on determining what to do (Fuad et al., 2017). One way to foster critical thinking skills is through appropriate, interesting, and flexible learning media (Amalia et al., 2017). As stated by Cahyani et al. (2020) if students have good learning motivation, the learning process will achieve success. Critical thinking skills are related to students' learning motivation. Students who are highly motivated to learn enable them to obtain high learning outcomes as well, meaning that the higher the motivation, the more intensity of effort and effort is made, the higher the ability to think critically (A. J. Nugraha et al., 2017). According to Fajari et al. (2020) the higher the students' motivation to learn, the higher their critical thinking skills.

Motivation is a driving force within students that encourages learning activities, guarantees continuity of learning activities, and provides direction to learning activities so that it will achieve the objectives of the lesson (Perdana et al., 2017). Self-motivation is very important to produce potential, enthusiasm, and have the desire to succeed (Ramirez, 2018). Student motivation is also influenced by parental background (Yusrizal et al., 2017).

The results of observations that researchers have made in Biology learning at SMAN 9 Bengkulu city show that critical thinking skills and student learning motivation in class have not been effective. This is in accordance with what was conveyed by the biology teacher at SMA Negeri 9 Bengkulu City that the KKM score was 76, but many children's scores had not yet reached the KKM score. So it is necessary to encourage

students to improve their critical thinking skills and learning motivation. One of the efforts made to create interactive teaching materials was carried out by Afriana et al. (2023) who researched the development of digital-based interactive modules. Therefore, this research is a follow-up research that aims to see the effectiveness of previously developed interactive digital modules in increasing critical thinking and learning motivation.

Method

This research is a type of quasi-experimental research that was carried out in March – April 2023 with the research population being all students of SMA Negeri 9 Bengkulu City. The sample used in the research consisted of 2 classes, namely 2 experimental classes and one control class. Data collection in this research was carried out by giving critical thinking skills tests to students and student learning motivation questionnaire sheets for both experimental and control classes.

Data analysis begins by applying prerequisite tests in the form of normality tests and homogeneity tests. In this study, the normality test was carried out using the Kolmogorov-Smirnov test, and the homogeneity test was carried out using the Levene test at a significance level of 5%. Next, the research hypothesis was tested using the Independent Sample t-test using the SPSS program.

Result and Discussion

The research data obtained began by analyzing the prerequisite tests, namely the Normality and Homogeneity tests. The following is a normality test for critical thinking skills.

Table 1. Normality Test of Critical Thinking Skills Pretest

Ability aspect	Class	Kolmogorov-Smirnov		
		Statistics	Df	Sig
Think critically	Experiment	0.144	32	0.089
	Control	0.175	33	0.012

Table 5. Independent Sample T-Test *Posttest* Critical Thinking Skills

		Lavene's test for Equality of variance		t-test for equality of mean		
		F	Sig.	Q	Df	Sig.(2-tailed)
Critical thinking	Equal variances assumed	0.19	0.04	5.66	63	0.00
	Equal variances not assumed			5.66	6.28	0.00

Table 5 explains that there is a significant effect of implementing interactive digital modules (experimental class) on biology learning on improving students' critical thinking skills compared to conventional learning (control class). This is indicated by the significant value obtained, namely 0.00 (0.00<0.05).

Based on this data, it is known that the significance value for the critical thinking ability variable is 0.012 (Sig > 0.05) so the data can be said to be normally distributed.

Table 2. Homogeneity Test of Critical Thinking Ability Pretest Variants

Lavender Statistics	Df1	Df2	Sig
0.242	1	63	0.625

Table 2 describes the results of the homogeneity test with a significance value obtained of 0.625, which means it is greater than 0.05 (0.625 > 0.05) so it can be concluded that the data variance is homogeneous.

Critical Thinking Skills after Being Given Treatment (Posttest)

Table 3. Posttest Normality Test for Critical Thinking Skills

Ability aspect	Class	Kolmogorov-Smirnov		
		Statistics	Df	Sig
Think critically	Experiment	0.22	32	0.08
	Control	0.52	34	0.08

Based on this data, it is known that the significance value obtained is 0.08 (Sig > 0.05), so the data is normally distributed.

Table 4. Homogeneity Test of Posttest Variants of Critical Thinking Skills

Lavender Statistics	Df1	Df2	Sig
0.019	1	63	0.890

The significance value obtained is 0.890 which means greater than 0.05 (0.890 > 0.05) so it can be concluded that the variance is homogeneous.

Based on the results of the prerequisite tests that have been carried out, it can be concluded that the data is normally distributed and homogeneous. Thus, the research data was continued with hypothesis testing through independent sample t-test analysis. The results can be seen in Table 5.

Table 6 describes that there is a significant effect of implementing interactive digital modules (experimental class) on biology learning on improving students' learning motivation compared to conventional learning (control class). This is indicated by the significant value obtained, namely 0.00 (0.00<0.05).

Table 6. Independent Sample T-Test Student’s Learning Motivation

Student’s learning motivation		Lavene’s test for Equality of variant		t-test for equality of mean		
		F	Sig.	T	Df	Sig.(2-tailed)
Student’s learning motivation	Equal variances assumed	0.08	0.02	3.26	63	0.00
	Equal variances not assumed			2.25	5.66	0.00

The critical thinking skills of students at SMA Negeri 9 Bengkulu City can improve for the better after being given treatment using digital-based interactive modules in science subjects on ecosystem material, because this module is interesting and easy to understand which displays text, images, graphics, audio, animation and video, so that it can increase students' interest in the biology learning process. This is in line with the opinion of Nugraha et al. (2015) that digital-based interactive modules are very interesting because they are presented in the form of text, images, graphics, audio, animation, and video in the learning process.

According to Nufus et al. (2020) stated that in this digital-based interactive module, there are videos and animations that attract students to more easily understand the material presented. The same thing was also stated by Raffli et al. (2019) who stated that there were several features presented in the interactive module. In the module, the explanation of the material is also equipped with videos and practice questions which are designed interactively. In addition, there is also a video tutorial on how to use it. As was conveyed by Niswara et al. (2019) which stated that to make it easier for students to go to the page they want to go to, a table of contents is also provided which can be clicked so that the display can immediately change to the desired page. This can create quality learning and have broad insight so that it can achieve the expected goals.

The learning process through digital-based interactive modules to improve critical thinking is very easy to do because it uses language that is easy to understand and precise writing so it doesn't confuse students. This is to the research of Winatha et al. (2018) which states that the use of language in digital-based interactive modules is adapted to the language used in students' daily lives. The simplicity of the language used can make it seem as if students are interacting directly with the teacher through the module. Besides the use of language, other factors affect students' understanding of the material presented, namely writing patterns. According to Sianturi et al. (2020) who stated that a fixed writing pattern can make it easier for students to recognize important discussions in the reading. This, causes these students to be enthusiastic about learning and able to complete assignments well.

Digital-based interactive modules can be used flexibly without any space and time limitations. By using digital-based interactive modules, students can study

anytime and anywhere if they are connected to an internet connection. Apart from that, they can also access the digital-based interactive module without having to be connected to the network, but before that they have to download it first. Thus, even though students are not in the same place as the teacher, the learning process can still take place. Distance learning requires students to be more independent in learning and at the same time requires students to be more critical in understanding a problem. The use of interactive modules also aims to increase student independence in learning and improve students' critical thinking skills. According to Diana & Sukestiyarno (2019), which states that the use of modules can be accessed anytime and anywhere. So that students can learn to be more critical in dealing with a problem. Then, students are also expected that after carrying out independent learning using the module there will be an increase in students' mathematical critical thinking skills compared to before students used interactive digital-based modules independently in the learning process. The same thing was also stated by Liu (2016) who stated that digital-based interactive modules can improve students' critical thinking skills in the learning process. This indicates that the use of digital-based interactive modules can improve students' ability to think critically because digital interactive modules are designed so that students can learn independently.

The use of digital interactive modules also aims to describe material conceptually so as to increase students' understanding and memory of the material. By using digital interactive modules, there is an increase in students' understanding of lesson concepts. By the opinion of Iwamoto et al. (2016) states that learning using interactive modules can increase student understanding and improve student memory. In its development, digital interactive modules are designed in a concise, straightforward manner, get to the point of discussion, and are adjusted according to students' way of thinking so they don't cause students to get bored while reading them. Following the opinion of Budiarti (2016) which states that electronic modules are arranged concisely, the description of the material is not too long, this is what makes students learn more fun and not boring.

Another benefit obtained through the use of digital-based interactive modules as learning media is to empower scientific literacy and improve students' critical thinking skills. Learning by using digital-based interactive modules is expected to be self-study at home

and anywhere. According to Muzijah et al. (2020) who stated that in this interactive module, students are expected to be able to understand the material through various readings as well as written information that has been interestingly prepared by the teacher, this, of course, will also increase students' interest in reading so that students' learning outcomes can experience enhancement.

Furthermore, digital-based interactive modules present pictures as well as text as well as interesting questions to increase learning motivation at SMA Negeri 9 Bengkulu City. This requires students to be more active in learning activities. Following the opinion of Melisa et al. (2018) which states that several factors cause high student learning motivation towards learning is learning which requires students to be active in carrying out activities, besides that active students will provide more enthusiasm in solving problems so that they have a sense of responsibility in doing assignments so that student learning motivation becomes better or even becomes higher. In line with the opinion of Silvia et al. (2020), which shows that digital-based interactive modules are very feasible and effective for increasing student learning motivation. Then research conducted by Azizah et al. (2021) shows that digital interactive modules help increase student motivation.

Delivery of material using digital-based interactive modules fosters learning motivation for students by presenting interesting material that is complemented by videos so students don't feel bored. Surjono (2017) states that one way to increase student motivation is by using multimedia in the form of interactive modules that contain videos and pictures so that children become interested and don't feel bored in the learning process. In line with Damayanti et al. (2020) who stated that the delivery of material uses teaching media in the form of digital-based interactive modules to be able to explain material in an interesting way accompanied by animation, images, or video. These teaching media make it easier for teachers to increase student learning motivation. Sari's research (2020) states that by learning using digital-based interactive modules students feel more motivated and effective in the learning process. In addition to increasing learning motivation through digital interactive modules, learning using digital interactive modules can also make it easy for students to learn learning material (Maswan et al., 2017).

Encouraging student learning motivation in ecosystem material that uses digital-based interactive modules to increase student learning motivation if the learning process is fun so that students are actively involved in the learning process being carried out. This follows the opinion of Aprillia et al. (2018) which states that learning using digital-based interactive modules is

interesting, enjoyable, and fun learning. So, the overall conclusion drawn by researchers in carrying out their research is that digital-based interactive modules can increase critical thinking and learning motivation at SMA Negeri 9 Bengkulu City.

Conclusion

Based on the results of the research, it can be implicated as follows: Judging from the process of teaching and learning activities, it shows that digital-based interactive modules are to improve critical thinking skills and learning motivation at SMA Negeri 9 Bengkulu City. And it is very suitable for learning anywhere and anytime. Can be used for schools or various parties who want to complement and develop learning that is used to overcome student boredom in the learning process. With this digital-based interactive module, it is hoped that it can help students overcome learning difficulties, especially in ecosystem material, so that it can reduce student assumptions that learning biology is a difficult subject. Besides that, it can also help teachers in the learning process so that it is easy to explain abstract concepts to become more concrete.

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Author Contributions

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Conflicts of Interest

The authors declare no conflict of interest.

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