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The Effect of Guided Inquiry-Based Excretion System E-Module to Improve Critical Thinking and ICT Literacy Skills for Students

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Abstract: E-Modules are teaching materials that are converted digitally by including images, videos, and animations. E-Modules can be integrated with Model Guided Inquiry. The purpose of the study was to determine the effectiveness of learning using guided inquiry-based E-Modules on students' critical thinking skills and ICT Literacy of students on the subject of the class VII excretion system of SMP 2 Ngaringan. The study population was 207 students of SMP N 2 Ngaringan, Central Java, Indonesia. The research sample used 52 students consisting of 26 students in class VII A and 26 students in class VII B. The results showed that there was a significant effect after giving treatment using Guided inquiry-based E-Modules on students' critical thinking skills and ICT literacy. This is evidenced by the acquisition of Posttest scores for the experimental class ranging from 86.91% on a limited scale and 84.69% on an operational test scale with a high category. The implementation of the syntax of students' critical thinking skills using Inquiry-Based E-Modules has a positive impact on students by increasing the implementation aspects of students' critical thinking skills with an average value of around 96.63% in the high category. The results of the Wilcoxon test at SMP N 2 Ngaringan obtained a sig value. 0.000 <0.05, it can be concluded that the hypothesis H0 is rejected and H1 is accepted. Based on these results, it can be concluded that there is a difference in the average value between before being given a lesson using an E-Module Based on Guided Inquiry and after using an E-Module based on Guided Inquiry on the subject of the human excretory system.

Keywords: Critical Thinking Skills; E-Module; Excretion; Guided Inquiry; ICT literacy

Introduction

Natural science is experiencing rapid development of technological advances and the digitalization of learning in the 21st century. Mastery of science and technology (IPTEK) is currently an important key in facing future challenges (Permanasari, 2016). The right step to prepare the generation in the digital era can be done through strengthening 21st century learning. 21st century learning must be supported by good skills in mastering digital technology to be able to compete globally. The readiness of the younger generation to master ICT literacy is their provision to contribute to the digital era. ICT literacy is a multidimensional construct consisting of three separate components: technical use of software and hardware, engagement in cognitive processes, and level of literacy tasks through reading and writing digital materials (Lestari & Prasetyo, 2019; Vergara et al., 2021).

ICT literacy is an activity of using information and communication technology to access, manage, integrate, evaluate, and create information that can be useful for the community while taking into account the ethical and legal values in it (Keane et al., 2016). ICT literacy can also be interpreted if someone has the ability to use computers, communication tools and social networks appropriately, they can then define, access, manage, evaluate, integrate, create and communicate effectively and responsibly (Katz & Macklin, 2006; Lestari & Prasetyo, 2019). The use of ICT and the use of technology

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in learning in Indonesia is still relatively low which causes the low ICT literacy skills of students. This can be caused by the lack of collaboration and school contributions to empower students' ICT literacy skills with the presence of adequate technology and information.

Mastery of ICT literacy of students is still not good in the aspects of processing, evaluating, creating, and communicating information, as well as using the internet safely and responsibly (Lestari & Prasetyo, 2019). Designing and designing digital-based learning needs to be done to prepare students with high quality in mastering ICT literacy to meet the times in the 21st century, of course students are also required to be more critical (Pearson, 2006). Pembelajaran yang menekankan Literasi informasi, tekhnologi dan komunikasi merupakan bentuk literasi abad 21 yang membutuhkan kemampuan berpikir kritis untuk memecahkan masalah berkaitan dengan penggunaan dan pengaturannya (Katz & Macklin, 2006). Critical thinking has a very important role in science learning as a form of applying science in everyday life (Figueira-Sampaio et al., 2013).

Natural Sciences (IPA) in the 2013 curriculum learns about nature and the symptoms that occur in nature which are associated with everyday life through the fields of Biology, Chemistry, and Physics studies (Kemendikbud, 2020; Kurniasih & Sani, 2014; Zubaidah et al., 2017). Environmental problems as a result of globalization are often found in everyday life. However, often the solution has not applied the proper science concepts. Students who have high-order thinking skills will be more critical and can create solutions to environmental problems (Quieng et al., 2015; Sharif & Cho, 2015; Yasin et al., 2019).

Activities in critical thinking include (1) investigation related to finding evidence or a key data from the problem; (2) interpretation relates to interpreting the meaning of the evidence sensibly; (3) make a decision which is the conclusion of the problem (Model et al., 2012; Sismayani et al., n.d.). Critical thinking as: (1) the ability to consider various information obtained from many different sources, process information creatively and logically, analyze, and reach conclusions that are considered defensible and justifiable; and (2) analysis of one's understanding of the problem and how to evaluate the problem in various situations (Campbell, 2015; Noris, M., Saputro, S., 2021b; Prayogi et al., 2018; Yaghoubi, 2013).

Critical thinking skills must be trained on students because critical thinking allows students to analyze their minds in making choices and drawing conclusions intelligently. Critical thinking skills help students to interpret, analyze, infer, evaluate, explain, and self-regulate (Facione, 2011a). Therefore, teachers are required to facilitate students to develop students' critical thinking skills by providing high-level questions, conducting two-way learning, students are required to play an active role through scientific methods such as guided inquiry models.

The guided inquiry learning model focuses on investigating and explaining the relationship between objects and events. In this learning model students can investigate and investigate problems that occur with scientific skills. The teacher facilitates by providing direction and guidance to arouse curiosity so that it can encourage students' critical thinking skills. The syntax of guided inquiry learning starts from the questions posed by the teacher. Then do the collection of ideas to solve problems to the questions given and make hypotheses to be tested or questions to be answered. After this activity, design and carry out experiments, collect evidence, draw conclusions, and communicate results (Inkuiri et al., 2018; Kristanto & Susilo, 2015; Vlassi & Karaliota, 2013). The guided inquiry learning model can also be integrated into the learning module to make it easier for teachers to train and empower students' critical thinking and ICT literacy skills.

In addition to the print module, there is an electronic module that can be easily accessed by students with android/laptops. Students do not have to bring books because they can access a lot of information related to learning in their spare time. The use of this e-module can optimize the use of information and communication technology by educators to support student activity using digital technology (ICT) in the learning process. However, most e-modules only contain material transferred from printed books and have not been equipped with animated videos or simulations in the science process that can increase students' interest in learning while facilitating learning in terms of improving students' critical thinking skills.

The integration of the guided inquiry learning model into the E-Module has the advantage of being able to improve critical thinking skills and character formation as expected and help students optimize students' ICT literacy skills. Guided inquiry learning places special emphasis on the core concepts of cognitive learning and discovery learning with the aim of developing higher order thinking (Lee, 2014).

Based on the background explanation above, the researcher conducted a study by providing guided inquiry-based E-Module learning treatments to improve students' critical thinking skills and ICT literacy on the subject of the VII grade student's excretion system at SMP 2 Ngaringan, Central Java, Indonesia. The purpose of the study was to determine the effectiveness of the use of the guided inquiry-based E-Module excretion system on students' critical thinking skills and ICT literacy.

Method

The research was conducted at SMP Negeri 2, with the address Jl. Gajah Mada No.20, North Simpang, Purwodadi, Kec. Purwodadi, Grobogan Regency, Central Java 58111. Research Design is a quasi-experimental Pretest-Posttest design. The research design used two groups of subjects, namely the experimental group and the control group. The experiment was treated with the use of e-module guided inquiry on the human excretory system material on students' critical thinking skills and ICT Literacy. While the control group was given a learning action with the method commonly used by the teacher.

Field trials were carried out in two classes consisting of experimental and control classes selected by purposive sampling at SMP Negeri 3 Purwodadi. The purpose of the field trial was to determine the level of effectiveness of guided inquiry-based E-Modules to improve students' critical thinking skills and ICT literacy on the subject matter of the human excretory system. The following is a trial design using the pre-test post-test control Gorub design.

Table 1. PreTest PostTest Control Group Research Design

Group	Pretest	Treatment	Postest
Experiment Class	T1	X1	T2
Control Class	T3	X2	T4

Explanation:
X1 : Learning using guided inquiry e-module on human excretory system material
X2 : Learning using the 2013 Curriculum Science Student Book
T1A: Pretest of critical thinking ability of experimental class
T1B: Pretest ICT literacy experimental class
T2A: Posttest of critical thinking ability of experimental class
T2B: Posttest ICT literacy experimental class
T3A: Pretest of critical thinking ability of control class
T3B: Pretest ICT literacy in the control class
T4A: Control class critical thinking ability posttest
T4B: Posttest ICT literacy class control

The study population was 207 students of SMP N 2 Ngaringan, Central Java, Indonesia. The research sample used 52 students consisting of 26 students in class VII A and 26 students in class VII B. The control and experimental classes had the same academic ability. The same academic ability can be seen from the results of daily tests and interviews with science teachers.

Analysis of the implementation of learning based on the results of the trial was carried out by calculating the percentage of implementation of learning with the Formula 1:

$$k \frac{skor\ tiap\ aspek}{skor\ maksimal\ tiap\ aspek} x\ 100\ \% \qquad (1)$$

The data obtained is then converted to the results of the percentage of learning implementation (k) into a qualitative value based on the 5 scale assessment criteria adapted from Sudjana (Mahmudah, 1981).

Table 2. Percentage of implementation of Guided Inquiry-Based E-Module learning.

Percentage of implementation	Category
$k \geq 90$	Very good
$80 \leq k < 90$	Good
$70 \leq k < 80$	Pretty good
$60 \leq k < 70$	Deficient
$k < 60$	Not Good

Analysis The effectiveness of the Guided Inquiry-based e-module on the excretory system material to improve students' critical thinking skills and ICT literacy was analyzed using the N-gain score.

$$N - Gain\ Score\ \frac{s\ post - s\ pre}{s\ maks - s\ pre} x\ 100\ \% \qquad (2)$$

Based on the results of the operational field test phase, then the value is convectioned with the IBM SPSS Statistic 24 application. The formula for finding the N-gain score according to Hake (Zulaichah et al., 2021)

Table 3. Criteria for Gain score

Range	Category
$g \geq 0{,}7$	High
$0.3 \leq g < 0.7$	Medium
$g < 0.3$	Low

Tests for normality and homogeneity of data were carried out to determine the normality of a data and determine which further test to use (parametric or non-parametric statistics). The data can be said to be normally distributed if the significance level is 5% with the calculation result greater than 0.05. The normality test was carried out using the Kolmogorov-Smirnov test statistic (Kolmogorov-Smirnov Test) through the SPSS 24 program.

Result and Discussion

The era of globalization demands the ability of several competencies, one of which is the ability to think critically. In addition to critical thinking skills and ICT literacy also need to be improved. IP learning by utilizing advances in information and communication technology needs to be familiarized to students. The skills of mastering information and communication technology (ICT literacy) in the 21st century era are needed by students because they will be easier to access and utilize information from various sources via the

internet. Students are still not actively involved in the use of ICT in the learning process.

In science learning, teaching materials are needed to help the implementation of learning to achieve learning objectives. Electronic modules (e-modules) are one of the teaching materials that can support learning (Aini, 2021; Sumarmi et al., 2021). Utilization of E-modules is considered more practical, effective, and efficient in terms of access and maintenance (Jambi, 2019). Critical thinking skills and ICT Literacy that have not been accommodated properly can be overcome with guided inquiry-based e-modules. The components of the guided inquiry model are orientation, problem formulation, hypothesis formulation, data collection, hypothesis testing, and conclusion formulation (Aulia et al., 2018; Windiastuti et al., 2018; Zammiluni et al., 2018). The six components of the guided inquiry model can train and facilitate indicators on ICT literacy critical thinking skills. The use of this e-module is expected to improve students' critical thinking skills and ICT literacy.

The learning devices used in previous studies have gone through the normality test and homogeneity test stages. The results of the normality test of the research instrument are as follows:

Table 4. The results of the limited-scale normality test and the operational field scale.

School	Class	Kolmogrov-Smirnov Test Results			
		Limited scale		Operational Field Scale	
		Normality	Information	Normality	Information.
SMP N 2 Ngaringan	Experiment	0.136	Normal	0.079	Normal
	Control	0.173	Normal	0.056	Normal

Based on the results of the normality test (Kolmogrov-Smirnov) above, the normality value of the initial data on a limited scale was obtained, ranging from 0.136 for the experimental class and 0.173 for the control class. The value of p=0.200>0.05, it means that both the data of the experimental class and the control class are normally distributed. So that the data can be further tested. Meanwhile, in the operational field test, the data is normally distributed. This is indicated by the value of sig. 0.139 > 0.05 for the experimental class and 0.159 for the control class, so the data can be said to be normally distributed.

Table 5. The results of the homogeneity test of limited scale and operational field scale.

School	Class	Kolmogrov-Smirnov Test Results			
			Limited scale	Operational Field Scale	
		Homogeneity	Information	Homogeneity	Information
SMP N 2 Ngaringan	Experiment	0.124	Homogeneous	0.549	Homogeneous
	Control		Homogeneous		Homogeneous

The results of the data homogeneity test showed that the two data were categorized as homogeneous. This is indicated by the homogeneity value of the experimental class ranging from 0.124 on a limited scale and 0.549 on an operational field scale. The value of sig.> 0.05, it means that the data is homogeneously distributed.

The results showed that there was a significant effect after giving treatment using Guided Inquiry-based E-Modules on students' critical thinking skills and ICT literacy. This is evidenced by the acquisition of Posttest scores for the experimental class ranging from 86.91% on a limited scale and 84.69% on an operational test scale with a high category. The ability to think critically is one of the skills in the 21st century that must be possessed by students (Susilowati et al., 2018). Critical thinking ability is a cognitive process and activity to acquire knowledge (Nasir, Muh., Wahab Jufri, 2015).

The use of Guided Inquiry-based E-Modules on excretory system materials is considered to be able to empower students' critical thinking skills and ICT literacy. Learning tools that have been integrated with guided inquiry syntax encourage students to play an active role. The syntax of guided inquiry includes orientation, problem formulation, formulating hypotheses, collecting data, analyzing data, concluding (Chen et al., 2017; Kuhlthau et al., 2015; Pedaste et al., 2015). The main purpose of the guided inquiry learning model is to understand the essence of learning and develop inquiry skills (Karpudewan & Mohd Ali Khan, 2017). Another purpose of this learning model is to require students to be able to grow thinking skills (García González & Veiga Díaz, 2015).

E-Module has a high level of effectiveness so that it can be used to empower students' low, medium, and high critical thinking skills. This Guided inquiry-based E-Modul optimization is a resolution for teachers to improve student learning outcomes, especially in the aspect of critical thinking skills. In addition, the designed E-module can also empower students' ICT

literacy skills by involving students to play an active role and take a role in constructing digital-based learning. The following are the results of students' critical thinking skills and ICT literacy tests:

Table 6. Gain Score test results on a limited scale and operational field scale for students of SMP 2 Ngaringan, Central Java, Indonesia.

School	Class	Limited Scale Test			Operational Field Test		
		Pretest	Postest	Description	Pretest	Postest	Description
Smp N 2 Ngaringan	Experiment	43.02	86.91	High	40.57	84.89	High
	Control	33.91	70.05	High	42.81	74.06	High

Learning using guided inquiry-based E-Modules is able to empower and improve students' critical thinking skills and ICT literacy. E-Modul is a digital-based converted module that contains text, images, animations, videos, and other electronic-based components (Herawati & Muhtadi, 2018). Learning with E-Modules provides a meaningful learning experience for students (Ayu Wina Hastari et al., 2019). Students in the 21st century are competent students in the field of technology because they live side by side with technology along with the times.

Table 7. Results of the implementation of each aspect of ICT Literacy using Guided Inquiry Based E Modules:

ICT Literacy	Score Acquisition (%)
Access	83.97
Manage	82.69
Evaluation	87.5
Integrate	85.58
Communication	84.29
Average	84.806

The implementation of ICT literacy using Guided Inquiry-Based E-Modules obtained an average score of around 84.80% with a good category. in the aspect of accessing around 83.97%, managing 82.69%. Evaluation 87.5%, integrating 85.58%, communication 84.29%. this shows that the use of guided inquiry-based E-modules can empower students' ICT literacy skills.

ICT literacy is the ability to use computers, communication tools and social networks appropriately so that they can define, access, manage, evaluate, integrate, create and communicate effectively and responsibly (Rusydiyah et al., 2020; Sermsirikarnjana, Pongsuwat and Kiddee & Pupat, 2017). An important component that shows someone has ICT literacy is being able to manage, organize, integrate, evaluate information and build new knowledge and communicate (Afandi et al., 2019; Lestari & Prasetyo, 2019).

Thinking ability can be empowered by giving E-MODUL based on Guided Inquiry. Critical thinking skills that are empowered in this study include: 1) Interpretation, the ability to state and understand the intent of events or procedures. *2) Analysis,* the ability to identify the right conclusions between statements and explanations based on existing information and opinions. *3) Evaluation,* namely the ability to assess the accuracy of statements by assessing experiences or situations, using logic. *4) Inference,* the ability to identify the factors needed to make a statement by paying attention to relevant information in drawing conclusions. *5) Explanation,* the ability to express opinions or reasons based on the results obtained and logical considerations (Darhim et al., 2020; Facione, 2011b; Noris, M., Saputro, S., 2021a; Seventika et al., 2018; Utami et al., 2017). The results of the implementation of critical thinking skills syntax using Guided Inquiry-Based E-Module

Table 8. Results of implementing each aspect of students' critical thinking skills using Guided Inquiry-Based E-Modules.

Critical Thinking Skills	Score Acquisition (%)
interpretation	99.67
analysis	94.23
inference	98.4
evaluation	97.11
explain	98.07
self regulation	92.3
average	96.63

The implementation of the syntax of students' critical thinking skills using Inquiry-Based E-Modules has a positive impact on students by increasing the implementation aspects of students' critical thinking skills with an average value of around 96.63% in the high category. In the aspect of interpretation, it is 99.67%, analysis is 94.23%, inference is 98.40%, evaluation is 97.11%, explains 98.07%, self-regulation is 92.63%. This shows that learning by using inquiry-based E-modules can empower students' critical thinking skills with the involvement and active role of students in every aspect.

The results of the Wilcoxon test at SMP N 2 Ngaringan before and after being treated using an E-Module Based on Guided Inquiry at negative rank there was no posttest value lower than the pretest value, meaning that the provision of E-modules is considered to be able to improve students' critical thinking skills seen from the increase Student Posttest scores. This can be seen in the table of the results of the Wilcoxon test of

critical thinking skills and student literacy ICT as follows:

Table 9. Wilcoxon test results of critical thinking skills and ICT literacy of SMP 2 Ngaringan, Central Java, Indonesia.

Wilcoxon Test Results Value of Critical Thinking Ability and ICT Literacy		N	Ranks Mean Rank	Sum of Ranks
KBK Experiment - KBK Control	Negative Ranks	0[a]	0.00	0.00
	Positive Ranks	26[b]	13.50	351.00
	Ties	0[c]		
	Total	26		
Experimental ICT - Control ICT	Negative Ranks	0[d]	0.00	0.00
	Positive Ranks	26[e]	13.50	351.00
	Ties	0[f]		
	Total	26		

Obtaining the Mean Rank Aspects of students' critical thinking skills and ICT Literacy ranged from .00. while in the positive rank that 26 students experienced an increase of 13.50 with a Sum of Ranks Value of 351.00, it means that there is a difference after using the Guided Inquiry-Based E-Module. While the value of Ties shows 0 which indicates that there are no students who have the same Pretest and Posttest scores on the aspects of students' critical thinking skills and ICT literacy.

Table 10. Wilcoxon Asymp test results. Sig. (2-tailed) SMP 2 Ngaringan, Central Java, Indonesia.

	Test Statisticsa	
	KBK Eksperiment - KBK Control	ICT Eksperimen - ICT Kontrol
Z	-4.460[b]	-4.468[b]
Asymp. Sig. (2-tailed)	0.000	0.000

The results of the Wilcoxon test at SMP N 2 Ngaringan obtained the Asymp value. Sig. (2-tailed) ranges from 0.000 <0.05, so it can be concluded that the hypothesis H0 is rejected and H1 is accepted (Setyono, 2015). Based on these results, it can be concluded that there is a difference in the average value between before being given learning using an E-Module Based on Guided Inquiry and after using an E-Module based on Guided Inquiry on the subject of the human excretory system. The value of Z in the aspect of critical thinking skills ranges from -4.460, while in the ICT literacy aspect it ranges -4.468.

Based on the results of the Wilcoxon test, it can be concluded that the provision of learning by using Guided Inquiry-based E-Modules on the human excretory system material for class VII SMP 2 Ngaringan can improve students' critical thinking skills and students' ICT literacy. Students' critical thinking and ICT skills can be seen from the implementation of the components of the KBK and ICT aspects which are guided by the guided inquiry syntax. The Inquiry-Based Excretion System E-Modul is an alternative solution that must be accommodated by the teacher. In addition to increasing student competence, the work system of teacher professionalism is also required to be able to face the times, information and technology in 21st century learning.

Conclusion

The results showed that there was a significant effect after giving treatment using Guided Inquiry-based E-Modules on students' critical thinking skills and ICT literacy. This is evidenced by the acquisition of Posttest scores for the experimental class ranging from 86.91% on a limited scale and 84.69% on an operational test scale with a high category. The implementation of the syntax of students' critical thinking skills using Inquiry-Based E-Modules has a positive impact on students by increasing the implementation aspects of students' critical thinking skills with an average value of around 96.63% in the high category. The results of the Wilcoxon test at SMP N 2 Ngaringan obtained a sig value. 0.000 <0.05, it can be concluded that the hypothesis H0 is rejected and H1 is accepted (Setyono, 2015). Based on these results, it can be concluded that there is a difference in the average value between before being given learning using an E-Module Based on Guided Inquiry and after using an E-Module based on Guided Inquiry on the subject of the human excretory system.

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