Developing E-Module Material on the Digestive System in Animals to Improve Students' Critical Thinking Ability and Independence

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Article Info	Abstract
	The potential that must be developed and formed in tertiary institutions is the ability to think critically and be independent. In addition, equalization of learning outcomes through education at the KKNI level (Indonesian National Qualifications Framework) which states that students graduating from diploma 4 or undergraduate programs are equivalent to level six, where graduates are expected to have logical, critical thinking and are expected to be able to demonstrate independent, quality, and measurable performance. This study aims to analyze the validity of the e-module, test the effectiveness of the e-module in increasing critical thinking skills and independence in learning animal physiology from the digestive system material, and examine student responses related to the e-module. This study uses the 4-D Thiagarajan model (Define, Design, Develop and Disseminate). Based on the results of the recapitulation of the e-module assessment by the material and media expert validator, it was stated that the e-module on the digestive systems of animals is very suitable for use in learning. The effectiveness of the digestive system e-module in animals related to the ability to think critically and independently before and after using the digestive system e-module experienced an increase in critical thinking skills and independence in the moderate category. The results of the observation data on student independence in learning are very good. Student responses to the use of e-modules as learning media can make it easier for students to understand learning material, especially material about the digestive system.

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INTRODUCTION

Technology has an important influence on the education sector, for example in learning methods, the learning environment, and assessment (Devore & Singh, 2020; Wilcox & Pollock, 2019). Examples of information technology that affects education are the internet and Android. The internet is used as a shared learning medium besides books and teachers, while Android is used as a tool or media that is widely used by students and is now one of the media and learning styles of the 21st century (Nealbert et al., 2014). The condition of the world education system in the past two years has implemented an online system (in the network) due to a pandemic, namely Covid-19, which was designated as a global pandemic and designated as a national emergency status. With this pandemic, the learning system that was originally carried out offline has now gone online. The impact of online learning includes that the enthusiasm for student learning decreases, students are less active in learning.

The purpose of using information and communication technology (ICT) in education is to support learning so that it is more effective, and besides that, technology has the potential to facilitate the development of skills in learning (Nussbaum et al., 2021). One solution that will be given is to provide learning media. According to Verawati et al (2022), developing learning media can improve students' abilities. The additional learning media that is the solution is an e-module, which is expected to provide student readiness for learning. In addition, the use of modules can provide practical learning for students in independent learning when in class (Nambiar, 2020). The module in this case is a teaching material that is arranged systematically using language that students can easily understand according to their level of knowledge and age so that they can study independently with minimal assistance or guidance from the teacher. Also, because it is electronic, the e-module can be accessed anywhere and anytime, making its use more practical. Modules can facilitate understanding of concepts and have a positive impact on student learning outcomes (Apriadi, 2018). This is in line with Logan's research (2021), which found that the use of e-modules is the most innovative strategy for increasing student abilities.

The potential that must be developed and formed in tertiary institutions is the ability to think critically and be independent. In addition, equalization of learning outcomes through education at the KKNI level (Indonesian National Qualifications Framework) states that students graduating from a diploma 4 or undergraduate program are equivalent to level six, where graduates are expected to have logical, critical thinking and are expected to be able to demonstrate independent, quality, and measurable performance. Facione (2015) states that critical thinking is thinking that has a purpose, namely proving something, interpreting what something means, or solving problems. Critical thinking also includes activities to analyze and interpret data in scientific discovery activities. Critical thinking skills are in high demand in the workplace. Meanwhile, according to Fatihah (2016), learning independence is shown by the ability to be able to solve problems faced by behavior. With changes in behavior, students have an increase in thinking, learning to be independent without relying on help from other people and not relying on learning only from educators because educators act as facilitators and consultants, so educators are not the only source of knowledge and can use a variety of resources and media for learning.

Based on the results of interviews, observations, and analysis of RPS conducted, there were several findings obtained, namely that the learning method most often carried out was group presentations or lectures by lecturers, and the learning resources used by educators and lecturers in the learning process were still minimal, sourced only from textbooks and journals or articles that students prepared themselves. Not infrequently, there are some students who are lazy in looking for references before starting to learn, causing the learning process to be less than optimal in terms of solving problems or tasks given when learning is still minimal due to the limited books they have. Therefore, students want a guidebook to support practical material that can be used anywhere and anytime. This research will develop e-modules, e-modules in tertiary institutions in animal physiology courses, particularly in the food digestive system material, to improve students' critical thinking skills and independence. The developed e-module is expected

to help lecturers determine student success in understanding learning material.

METHODS

This research is a 4-D model development study by Thiagarajan et al (1974), which includes 4 stages: define, design, develop, and disseminate. The defined stage includes facts and a series of needs in learning animal physiology at IAIN Syekh Nurjati Cirebon. The second stage of the design includes the development of learning materials and the initial design of the e-module using the Flip PDF Corporation application. The third stage is develop, which includes the development of e-modules with text, images, videos, and journal links as additional reading material, selecting formats, and conducting trials on students. The final step is to disseminate the results by providing limited soft files and links to the final results of the e-module to the lecturer in the animal physiology course at IAIN Syekh Nurjati Cirebon.

The developed e-module is an e-module that has a role that strongly supports the visualization of abstract ideas, can facilitate the learning system or understanding of the material being taught, and the delivery of the material can be more interesting with additional pictures and videos, the availability of journal links that are easily accessible for additional knowledge, besides that the module will also add new knowledge, quizzes, and discussion questions to improve students' critical thinking skills and independence.

Research data includes e-module validation data using a validation questionnaire given to material and media expert lecturers by attaching a questionnaire and e-module link that have been developed. practicality questionnaire by lecturers, courses, and readability questionnaire by 7th semester students after using the e-book on a limited trial. Data from the material and media validators, teacher practicality, and student readability were analyzed using the Likert scale. To assess the effectiveness of the e-module to improve critical thinking skills (results of the pretest and posttest), while to see the effectiveness of the e-module for independence, observational data and questionnaire pretest and posttest independence are required. The results of the pretest and posttest data were analyzed using the N-Gain test, while the observation data used the Likert scale.

RESULTS AND DISCUSSION

The validity of the e-module on the digestive system of animals was assessed by two expert lecturers whose aim was to examine the feasibility of the product and obtain suggestions or input on the product being developed. The validity of the e-module is assessed based on the opinions of material and media experts. The module is said to be valid when the value obtained is > 60%. According to material experts, in terms of material and learning, it is categorized according to the results of the feasibility conservation of e-modules for the digestive systems of animals. The score for evaluating the results of the e-module validation according to material experts is presented in Table 1.

Table 1. The results of e-module validation according to material experts

No	Aspect	Achievement Score/Maximum Score	Score (%)	Score	Category
1.	Fill	44/52	84	A	Very good
2.	Language	18/20	90	A	Very good
3.	Presentation	14/16	88	A	Very good
4.	Graphics	7/8	88	A	Very good
5.	Against Learning	12/12	100	A	Very good
6.	Total	95/108	88	A	Very good

Based on Table 1, it can be seen that the value obtained from the validation results of the e-module by material experts reached a value of 88% in the very good category. It can be said that the developed e-module is feasible and can be used in the learning process. The material validation carried out aims to obtain the validity of the e-module material, whether it is in accordance with the learning RPS or not, in

line with the opinion of Septora (2019) that the contents of the module developed must be in accordance with the needs and objectives of learning. Even though it has been categorized as very good, there are still inputs and comments given by material experts that need to be considered and used to improve or revise the e-modules, including improving discussion questions to make them more interactive and final assignments so that they can further improve thinking skills and abilities. student psychology. According to media experts, e-module validation is viewed from the perspectives of the assessment of graphical, linguistic, feasibility, and presentation aspects, as well as the assessment of the effectiveness of learning. The score for the evaluation of the results of the e-module validation according to media experts is presented in Table 2.

Table 2. The results of e-module validation according to media experts

No	Aspect	Achievement Score/Maximum Score	Score (%)	Score	Category
1.	Graphics	19/20	95	A	Very good
2.	Language	20/20	100	A	Very good
3.	Eligibility And Presentation	19/20	95	A	Very good
4.	Against Learning	24/24	100	A	Very good
5.	Total	82/84	98	A	Very good

Based on Table 2, it can be seen that the value obtained from the e-module validation results by media experts reached a value of 98% in the very good category. It can be said that the developed e-module is feasible and can be used in the learning process, even though it has been categorized as very good. However, there are still inputs and comments given by media experts that need to be considered and used to improve or revise the e-modules made, including, namely, improving font size, video display on e-modules, summaries, glossaries, and related indicators of critical thinking. The evaluation of the e-module on the digestive system of animals in terms of practicality was assessed by the lecturer in the animal physiology course according to the display aspects between the front and back covers, material, language, and presentation. The score for the evaluation of the e-module validation results according to the lecturer in the animal physiology course is presented in Table 3.

Table 3. Practicality assessment results according to lecturers in animal physiology courses

No	Aspect	Achievement Score/ Maximum Score	Score (%)	Score	Category
1.	A view of the front and back covers	8/8	100	A	Very good
2.	Material	32/32	100	A	Very good
3.	Language	18/20	90	A	Very good
4.	Presentation	16/16	100	A	Very good
5.	Total	74/76	98	A	Very good

Based on Table 3, it can be seen that the value obtained from the validation results of the e-module by the lecturer in the animal physiology course reached a value of 98% in the very good category. It can be said that the developed e-module can be categorized as practical and can be used in the learning process, even though it has been categorized as very good. However, there are still inputs and comments given by lecturers in animal physiology courses that need attention and are used to improve or revise the e-module, including improving the appearance of images and video sizes. This module helps students learn because it contains materials, pictures, videos, and journal links related to material on the digestive systems of animals in animal physiology courses. The design of the e-module digestive system for animals that has been validated is then revised according to input from the three experts. In addition, feasibility was also assessed through a limited test (readability) by 15 semester 7 students. The average results of the limited trial (readability) of students showed that the

e-module on the food digestive system in animals is in a very good category, so it is suitable for use in learning activities.

Putra, Wirawan, & Pradnyana (2017) explained that the limitations of print media in schools open up opportunities for integrating a teaching material supplement with the latest information technology, such as e-modules, to support the achievement of 21st century skills. Information and communication technology is growing and influencing the world of education, especially in the learning process. The existence of pictures and videos on the module makes it easier to convey material to students so that they understand the material better (Laili, 2019). E-modules prove that learning can be more effective, can be done anywhere, and at any time (Wardaya et al., 2021).

The quality of the e-module on the digestive system of animals is also reviewed in light of the practicality of using the e-module based on responses to a questionnaire from lecturers in animal physiology courses. This response questionnaire was obtained from a food digestive system e-module trial in animals. The activities carried out during this trial included the lecturer filling out a product practicality questionnaire. Based on the results of

field product trials, it was found that the average value of the lecturer's response to the e-module of the animal digestive system was 88%, with a very good category. The results of the responses of e-module users in this study indicate that e-module products are feasible and practical for use in learning animal physiology courses. E-modules that have been properly revised according to the suggestions given by the lecturer. After revision, the product is then tested in the field.

Effectiveness is a measure of the success of e-modules in the learning process. In this case, the effectiveness of the digestive system e-module is assessed from two aspects, namely, the ability to think critically and independence. The effectiveness of the e-module in improving critical thinking skills is determined by the pretest taken before using the e-module and the posttest taken after treatment. The critical thinking indicators used in the questions are critical thinking indicators according to Facione and only use 4 indicators, including interpretation, analysis, inference, and explanation. There is a difference in the average score of students' critical thinking skills presented in the form of a bar chart in Figure 1.
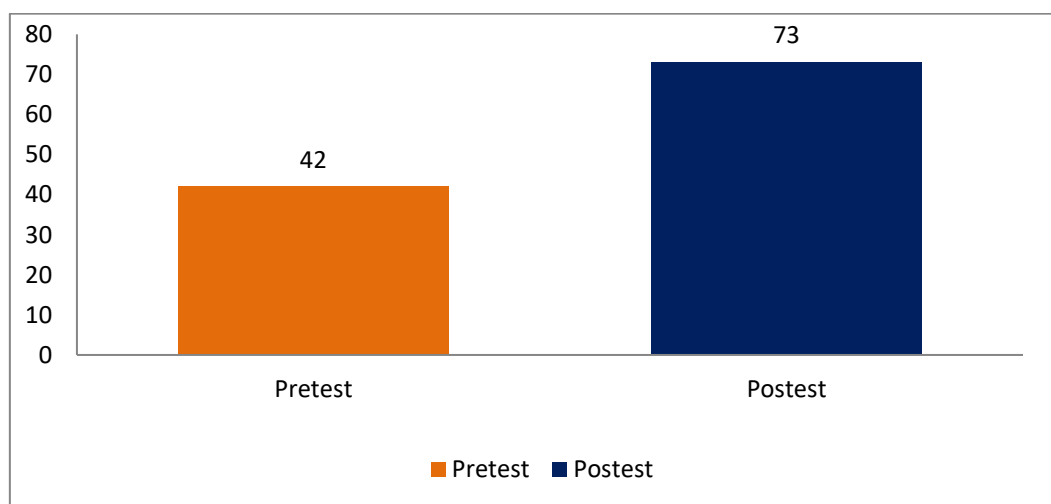

Figure 1. Differences in pretest and posttest scores

Based on Figure 1, it shows that the average score of students' critical thinking skills is higher in the posttest score and that there is an increase of 31. The average score in the pretest is 42 and the score in the posttest is 73 with an N-gain of 0.52 in the moderate category. The difference in these values indicates an increase in critical thinking skills after

using the e-module. The developed e-module is also effectively used in learning. This is in line with research conducted by Nurhidayat et al (2021), where there are differences in scores before and after using the e-module. Therefore, the e-module is designed to simplify and assist students in learning.

The second effectiveness of the e-module is independence. Data on independence obtained through questionnaires and observations. The independence questionnaire uses a Likert scale of 1-4. The questionnaire was made using indicators of independence, including independence, having self-confidence, behaving with discipline, having a sense of responsibility, acting on one's own initiative, the tempo and rhythm of learning, the use of teaching resources and materials, and the ability to reflect. This questionnaire was given before and after using the e-learning module. The results of the pretest and posttest questionnaires and the N-gain attitude of student independence can be seen in Table 4.

Table 4. Student independence questionnaire results

No	Indicator of independence	Mean		Gain	Classification
		Pretest	*Posttest*		
1.	Independence	77.05	88.30	0.48	Medium
2.	Have confidence	76.97	87.70	0.31	Medium
3.	Disciplined behavior	78.48	85.30	0.30	Medium
4.	Have a sense of responsibility	74.24	84.70	0.35	Medium
5.	Behave on own initiative	74.66	79.43	0.16	Low
6.	Learning tempo and rhythm	65.00	78.64	0.38	Medium
7.	Use of teaching resources/materials	63.64	96.06	0.89	High
8.	Reflection ability	63.22	95.91	0.89	High
9.	Average	72.00	86.00	0.51	Medium

Based on Table 4, it shows that there is an increase in the overall average score of independence indicators from the results of the pretest and posttest questionnaires of 14.00 with an average pretest value of 72.00 and 88.00 posttest with a moderate classification after using the e-module. Data on the increase in the average value of indicators with the lowest average score in the pretest and posttest, namely the learning tempo and rhythm of 65.00 and 78.64, in addition to the indicator values with the highest average score in the pretest and posttest, namely the use of learning resources of 63.64 and 96.06, then the average score that experienced the highest to lowest increase in the pretest and posttest independence questionnaire, namely the ability to reflect, use of teaching materials, learning tempo and rhythm, independence, self-confidence, sense of responsibility, disciplined behavior, and behavior based on own initiative of 32.69, 32.43, 13.64, 10.80, 10.70, 10.46, 6.82 and 4.77. The average N-gain score of all indicators is 0.51, with a moderate classification. It can be concluded that e-modules are effectively used in the learning process to increase student independence. In line with research conducted by Linda et al (2018), the use of e-modules can increase independence because the function of e-modules is as a means of independent learning. E-modules can also make students learn at their own pace (Daryanto, 2013).

Through the learning process that takes place, the attitude of independence of students is analyzed using an observation sheet. The observation sheet refers to five indicators of independence: independence from other people, having a sense of self-confidence, having disciplined behavior, having a sense of responsibility, and using learning resources. Data from observations of student independence are presented in Table 5.

Table 6. Observation results of student independence

No	Aspect	Score	Maximum Score	Score	Category
1.	Independence from others	6	9	A	Very good
2.	Have a sense of self-confidence	5.6	9	B	Good
3.	Behave discipline	6	9	A	Very good
4.	Responsibility	6	9	A	Very good
5.	Use of learning resources	6	9	A	Very good
6.	Average	5.9	9	A	Very good

Based on Table 5 of the results of student observations regarding independence, the total score obtained was 5.9 in the very good category. The details of each aspect include independence from other people with a score of 6 in very good categories, self-confidence at 5.6 in good categories, disciplined behavior with a good score of 6 in good categories, a sense of responsibility with a score of 6, and the use of learning resources with a score of 6. It can be concluded that students have very good independence skills. In line with research conducted by Logan et al. (2021), the use of independent e-modules is an innovative teaching strategy to help increase learning success and results. Besides that, the use of e-modules will enable students to be more actively involved in their own learning. Musakhanova (2022) states that the independent learning process provides positive results for learning, but by looking at several approaches, one of which is that assignments must be given fairly (in many cases, core tasks are assigned to students gradually), tertiary institutions can help students work independently .

According to the Ministry of National Education, the developed e-module is in accordance with five aspects, namely self-instructional, self-contained, stand-alone, adaptive, and user-friendly. Which for each aspect, namely the aspect of independence from other people gets a score of 6, the aspect of having a sense of self-confidence gets a score of 5.6, the aspect of disciplined behavior gets a score of 6, the aspect of having a sense of responsibility gets a score of 6, and the aspect of using learning resources gets a score of 6 with the overall value of A category is very good; this value is obtained from the results of observations made during 3 meetings by 2 observers. The results of the observations made allow it to be concluded that student independence in learning is very good.

The use of e-modules in the learning process is one way to create learning that prioritizes student activity. This is because e-modules are learning tools that contain material and evaluation methods that are designed systematically. Modules can also assist students in facilitating information understanding.according to the learning ability of each individual. This statement is supported by the results of research conducted by researchers based on a student response questionnaire, which shows 94% in the very good category. The interest aspect received a score of 92%, material 96%, feature content 96%, language 90%, and an overall score of A very good category. Students report that using e-modules in the lecture process smoothes the learning process, provides an interesting learning experience, and provides convenience in the learning process. Based on this elaboration, student responses to the use of e-modules as learning media can make it easier for students to understand learning material, especially material about the digestive system.

CONCLUSION

Based on the research conducted, it can be concluded that the e-module of the food digestive system in animals is valid based on the assessments of material experts and media experts and is effectively used in learning. There are differences in the results of the pretest and posttest analyses of students' critical thinking skills and independence before and after using the food digestive system e-module, with an increase in critical thinking skills and independence in the moderate category. The results of the observation data on student independence in learning are very good. Student responses to the use of e-modules as learning media can make it easier for students to understand learning material, especially material about the digestive system.

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