Validity of Interactive Biology Teaching Module for Coordination System Integrated with Inquiry learning Model to Improve Critical Thinking

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Abstract

The world of education is required to prepare Human Resources that are able to compete and have an impact nationally and globally in order to welcome the 5.0 era. One of the things that needs to be prepared in the world of education is the ability to think critically. Based on observations, students' critical thinking skills are not optimal and learning still relies on books available at school, so innovative teaching models and materials are needed. One of them is by designing an interactive teaching module that is integrated with the *Inquiry learning* model. For this reason, the purpose of this research is to design interactive teaching modules and test the validity of teaching modules integrated with *Inquiry learning* to improve critical thinking on coordination system material. This research method is the ADDIE development model to produce teaching module products. The data collection technique is the validation method using the teaching module validation sheet instrument which is carried out by three expert validators, namely three biology teachers. The aspects assessed in the teaching module validation instrument include; Teaching module design, material aspects, learning steps, language feasibility aspects. This study shows that the results of the teaching module test in the teaching module design aspect are 90.17%, 90% material aspect, 90.63% learning step aspect and 85.94% language feasibility aspect so that the average result of the interactive teaching module validity test is 89.18% with very valid criteria. The conclusion of the validity of the interactive teaching module of integrated coordination system material with the *Inquiry learning* model to improve students' critical thinking is 89.18%. Therefore, it can be said that the interactive biology teaching module on coordination system material integrated with the *Inquiry learning* model developed is valid.

Keywords: Interactive teaching module, *Inquiry learning*, Critical thinking

1. Introduction

This year 2023 is entering the Era Society 5.0 which is the triumph of the digital world. The era of society 5.0 has changed global perceptions, especially changing progress in the field of education. The character of students who must be prepared in facing the era of society 5.0 is the 4C characteristics, namely Communication, Critical Thinking and Problem Solving, Creativity and Innovation, and Collaboration. (Purba et al., 2023). High-level skills, one of which is critical thinking, is also one of the skills that must be prepared by students in producing quality human resources. (Agnafia, 2019).

Based on literature studies including (Astuti et al., 2018; Indayani et al., 2021; Jannah & Atmojo, 2022) stated that the learning system has not optimized students' critical

thinking skills and also still does not use many technology-based teaching modules. In the learning process, package books provided by the school are used. Students have not maximally used the teaching module because they usually use the activities in the package book, besides that students consider biology difficult to understand because of the amount of memorization from textbooks and the absence of sufficient visualization for each discussion of teaching material.

In overcoming these problems, media and learning models that support the critical thinking process are needed. (Malyani & Cintamulya, 2017). Learning media that can be developed is learning media that contains new innovations in utilizing technology as a learning medium. (Hamzah & Khoiruman, 2022). One of the learning media to support the critical thinking process is teaching modules. The use of technology-based teaching modules can overcome one of the problems in the learning process (Suryani, 2016). In addition, it is necessary to develop learning models and teaching materials that are more effective and efficient in empowering students' critical thinking skills so that learning is of higher quality (Yudasmara & Purnami, 2016). One of the innovative learning models is the *Inquiry* learning model (Ahmatika, 2017). *Inquiry learning* model is a learning model that tries to provide direct experience to students and aims to obtain and obtain information by making observations or experiments to find answers or solve problems to questions or problem formulations by using critical and logical thinking skills. (Kusmaryono & Setiawati, 2013)..

Several studies on interactive teaching modules show that the use of interactive multimedia-based teaching modules can effectively improve critical thinking when compared to using conventional media. (Wulandari et al., 2019). Another study mentioned that there were differences in the learning outcomes of students who used interactive multimedia with textbooks on the nervous system subconcept in high school. In addition, interactive multimedia learning is also able to improve student learning outcomes, these results are evidenced by the average acquisition of learning outcomes of students who use interactive multimedia obtaining better results than students who learn by using textbooks (Wilsa, 2019).

Several studies show how the guided *Inquiry* model influences students' critical thinking skills, the guided *Inquiry* learning model is one of the effective learning models in improving critical thinking skills including in improving critical thinking skills in students. (Falahudin et al., 2016; Firdaus & Wilujeng, 2018; Fitriyah et al., 2021). There is even research that shows differences in critical thinking skills between students who are taught using the guided *inquiry* learning model and students who are taught using conventional learning models. (Kristanto & Susilo, 2016).

Based on this explanation, researchers are interested in conducting research on the development of teaching materials in the form of teaching modules. Generally, educators state that biological material that is difficult for students to understand in learning biology is coordination system material. Coordination system material includes the nervous system, hormones and senses. Based on the difficulty level of the coordination system material, this research is focused on this material. In addition, this material has not been, studied with *Inquiry learning* based, so the problem that arises in this study is how the validity of interactive biology teaching modules integrated with *Inquiry learning* to improve critical thinking in class XI SMA / MA. The objectives to be achieved in this study are:

1. Designing an interactive biology teaching module on coordination system material integrated with *Inquiry learning to* improve students' critical thinking.
2. Describe the validity of the *Inquiry learning* integrated coordination system teaching module to improve students' critical thinking.

2. Research Methods

This type of research is development research to produce products, namely in the form of interactive biology teaching modules integrated with *Inquiry learning* on coordination system material to improve critical thinking. While the development model used is the ADDIE Model (*Analysis, Design, Development or Production, Implementation or Delivery and Evaluation)* developed by Dick and Carry (1996). The data collection technique is the validation method using a teaching module validation sheet instrument conducted by four expert validators, namely three biology teachers and one biology lecturer. The aspects assessed in the teaching module validation instrument include; module design, module material, learning steps, problem questions, language feasibility (Lestari et al., 2018). Data from the teaching module validation results were analyzed by calculating the mode value of the score given by the validator. The data obtained is in the form of scores from each criterion (Table 1) which has been determined referring to the criteria Riduwan (2013).

Table 1. Likert Scale Criteria

Score	Criteria
4	Very good
3	Good
2	Good Enough
1	Less Good

The results of the validation value obtained are then interpreted using the following formula:

$$\text{Teaching module validity score \%} = \frac{\text{Total score obtained}}{\text{Total score}} \times 100\%$$

The score results obtained from the teaching module validation are interpreted referring to Riduwan (2013) as in Table 2:

Criteria for Interpretation of Validation Result Score

Score	Criteria
85-100	Very valid
70-84,9	Valid
55-69,9	Valid enough
40-54,9	Less valid
25-39,9	Invalid

The teaching module is declared valid if the average score obtained is $\geqslant$ 70%. Data analysis using descriptive with the criteria above (Mariatun & Wahab, 2022).

3. Results and Discussion

3.1 Results

3.1.1 Final Preliminary Analysis

At this stage, researchers conducted interviews and document analysis of teaching modules made by biology teachers of SMAN 1 Tuban in February 2024, based on the results of these interviews, data were obtained:

1. The teacher's learning process has applied the *Inquiry learning* approach to demand active participation of students. However, the implementation has not run optimally, especially in critical thinking activities.
2. The learning resources used do not meet the needs of students and learning objectives.
3. Learners have different learning styles and methods. Based on the results of document analysis, it is known that the teaching materials made by teachers are still in the form of package books provided by the school.
4. Biology material that is difficult for students to understand is the Coordination System. This material is considered too much, complicated and difficult for students to understand.

To overcome this, researchers provide an alternative to these problems by developing an interactive teaching moodul integrated with *Inquiry learning* on Coordination System material to improve critical thinking.

3.1.2. Learner Analysis

The results of analyzing students through observation show that students who are in class XI SMA have an age of 16-17 years. Based on Piaget's learning theory in (Meinura, 2022) at the age of 11-18 years old is at the formal operational stage with the main characteristics of its development being able to think abstractly, logically, draw conclusions, interpret, and develop hypotheses. The results of the analysis become the basis that students who are in grade XI have been able to develop cognitive and psychomotor potential, so they are skilled in the use of learning media including teaching materials such as interactive teaching modules. In addition, students of that age range are assumed to have been able to implement activities related to *Inquiry learning*.

3.1.3. Task Analysis

This analysis is carried out to detail the learning material that will be written in the teaching module. This analysis includes content structure analysis which includes learning outcomes (CP) and learning objectives (TP) for coordination system material so that the flow of learning objectives (ATP) can be formulated.

3.1.4. Concept Analysis

In the Coordination System material, the concepts identified are the nervous system, sensory system, hormones and abnormalities or disorders in the coordination system. After identifying the concepts of the Coordination System material, the flow of learning objectives that are referred to from the learning objectives is produced.

3.1.5. Objective Analysis

The reference for the formulation of learning objectives is the competency achievement indicators that refer to the Merdeka Curriculum.

3.1.6. Design Stage

The teaching module was developed in accordance with the development steps that have been compiled by Permendikbudristek (2022). This interactive teaching module was created using the Canva application. The teaching module components include cover, preface, table of contents, list of images, list of tables, instructions for use, learning outcomes, learning objectives, material descriptions, inqury learning steps equipped with ability test activities, evaluation and reflection.

The design of the interactive teaching module integrated with *Inquiry learning* is shown in the example below:

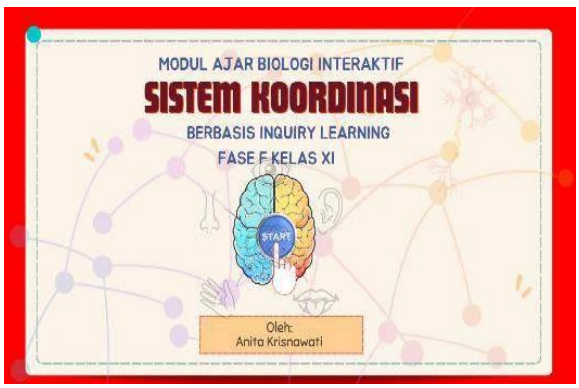

Figure 1.The Cover of the Interactive Module

Figure 2. The table of contents

Figure 3. Interactive teaching module instructions

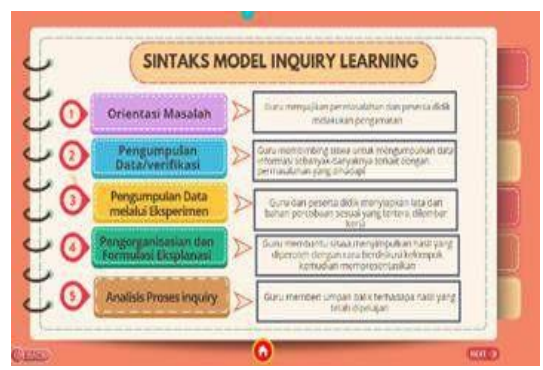

Figure 4. Syntax of Inqury learning

Figure 5. Interactive Teaching Module Material

Figure 6. Learning Activities

Figure 7. Checking the understanding Module

Figure 8. Evaluation and Reflection

3.1.7. Development Stage

a. Teaching module validation

The validation of the interactive jar module of coordination system material integrated with *Inquiry learning* to improve critical thinking in class XI SMA/MA was carried out by four validators, two Biology teachers of SMAN 1 Tuban, one biology teacher of SMAN 3 Tuban and one lecturer of Universitas Muhammdiyah Jember. The validity analysis of the interactive teaching module is briefly shown in Table 3 below:

Table 3. Results of Validation of interactive teaching modules on coordination system material integrated with *Inquiry learning*.

No	Assessment Aspect	Validator Score				Average	Criteria
		Validator 1	Validator 2	Validator 3	Validator 4		
1	Teaching Module Design	96.42%	89.28%	89.28%	85.71%	90.17%	

2	Material	95%	95%	85%	85%	90%	
3	Learning Step	93.75%	93.75%	87.50%	87.50%	90.63%	
4	Language Feasibility	87.50%	81.25%	81.25%	93.75%	85.94%	
			Average score			89.18%	Very valid

The results of the validity of the interactive teaching module of integrated coordination system material with *Inquiry learning* in Table 3 obtained a value of 89.18% with very valid criteria.

3.2 Discussion

Data validity analysis from the validity questionnaire of the interactive teaching module of integrated coordination system material with *Inquiry learning* and teachers is based on four components, namely interactive teaching module design, teaching module material, learning steps, language feasibility. The results of data analysis show that the interactive teaching module of coordination system material integrated with *Inquiry learning* has an average validity value of 89.18% with a very valid category.

In terms of design aspects, the interactive teaching module is declared very valid with a value of 90.17%, the teaching module design contains a cover, layout appearance (title, illustration, logo), display of type and font size that is attractive and easy to read, color and layout, attractive images, practical teaching modules and easy to use. The material is presented with clear writing and fonts. According to Permendikbudristek (2022), the letters used in printed teaching materials should not be too small and easy to read. In addition, the background color selection contrasts with the letters so that the writing is easy to read. In special parts such as need to remember and motivation, different writing is used so that it is more interesting to read. According to the opinion of Syahrul (2019) that the presentation in this interactive teaching module uses an attractive appearance with a match between text color, font, and background that considers aesthetic as well as functional aspects to make it easier for students to use it as a learning resource. Fonts have characteristics of function and meaning so that appropriate use is important so that the meaning can be conveyed and minimize misunderstanding. Likewise with the statement from Mumpuni & Nurbaeti (2019) that the combination of color and background used is designed to be comfortable and easy to read in order to produce an attractive appearance so that it can affect the reading interest of students.

The material aspect of the validation results is 90%, which means that the interactive teaching module developed is in accordance with the learning outcomes and formulation of learning objectives, the completeness of the material, presentation, videos and images are in accordance with the learning material and also practice questions can support learning. This is in accordance with the applicable curriculum, namely the independent

curriculum. Permendikbudristek (2022) which states that the teaching materials developed must be in accordance with the demands of the curriculum. This is also in accordance with the statements of Nuryasana & Desiningrum (2020) and Ritonga et al., (2022) which reveal that materials or subject matter that are arranged coherently and systematically can display something intact from the competencies to be mastered by students in the learning process.

In terms of learning steps, the interactive teaching module is declared very valid with a value of 90.63%, meaning that this interactive teaching module is in accordance with the *Inquiry learning* steps, the presentation leads to a critical thinking process, the sequence of learning is appropriate and also the images/video support students in understanding the material. This is in accordance with the standard process contained in Permendikbudristek (2022) that quality learning experiences are carried out by applying material to real problems or contexts so that students can think critically. The above is in line with the results of research which states that the Inquiry learning model is a form of activity that can form independent students and strengthen critical thinking skills in various contexts (Arnyana, 2019). Media / learning resources in the process used must be adapted to learning objectives, cognitive development of students and efficient to use. This is in line with the results of research which states that the learning resources used must be in line with the learning objectives and cognitive development of students, as well as effective and efficient to use (Laili, 2019).

In terms of linguistic aspects, the interactive teaching module was declared very valid with a score of 85.94%. The linguistic component concerns the use of sentences that are clear and do not cause confusion, double meaning for students, in accordance with Indonesian language rules and in accordance with the development of students' thinking. According to Permendikbudristek (2022) teaching materials must contain clear and simple sentences, sentences are not too long. This interactive teaching module has undergone several revisions in the linguistic aspect. Likewise, the results of Wulandari & Mudinillah's research (2022) and Azhari et al., (2024) state that the linguistic aspects assessed include linguistic rules that are in accordance with Refined Spelling, correct and effective sentence structure, and information conveyed clearly, using language as an easy-to-understand communication tool so as not to cause confusion, confusion and obscurity for users of the teaching module. Based on the validity value of the linguistic aspect, the interactive teaching module of coordination system material integrated with inquri learning has used good and correct Indonesian language. Overall, the value of the results of the validity test of the interactive teaching module of coordination system material integrated with *Inquiry learning* is 89.18%. Therefore, it can be said that the interactive teaching module of coordination system material integrated with *Inquiry learning* developed has been very valid. The teaching module developed is very valid and feasible to use, both from the aspects of design, material content, learning steps and language. In accordance with the statement (Budianto et al., 2021) that modules that are very valid are

suitable for use. The teaching module developed has the advantage of being interactive based as well as integrated with the *Inquiry learning* model to improve critical thinking skills in each learning syntax.

4. Conclusion

The validity test results of the interactive teaching module of coordination system material integrated with *Inquiry learning* to improve students' critical thinking is 89.18%. Therefore, it can be said that the interactive teaching module of coordination system material integrated with *Inquiry learning* developed has been very valid**.**

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