Validity of E-Inquiry-Based Practical Instructions to Enhance Critical Thinking in Plant Anatomy Learning

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Abstract

The development of technology is currently accelerating at an unprecedented rate. One of the uses of technology in education is to teach or support media in learning. This study aimed to design E-instructions for the stomata observation practicum inquiry method to enhance critical thinking in learning valid plant anatomy and to determine the validity of these E-instructions in improving critical thinking in learning plant anatomy. The method in this research is the ADDIE method, which has several stages: analysis, design, development, implementation, and evaluation. This research data was collected using validity instruments in the form of validity sheets. This research uses a descriptive quantitative data analysis technique to describe the validity. The validity test results are the following average: the material aspect receives an average of 85.8%, the systematic aspect gets a validity value of 84.3%, the language aspect achieves a value of 88.3%, and the graphic aspect receives a value of 89.3%. The average score for all aspects of the assessment is 86.9%. Based on the scores of the three expert validators, it can be concluded that the results of the validation of the Inquiry-Approach Practicum E-Instructions to Improve Critical Thinking in Plant Anatomy Learning are in the very valid category.

Keywords: e-instructions, inquiry, practicum, stomata, validity

INTRODUCTION

In today's world of education, supporting media is needed in learning by utilizing technology in the form of interesting applications. Information and Communication Technology (ICT) in education is invaluable for educators in learning. Through the use of ICT, we can enhance the quality of education, specifically by providing wide access to science and implementing quality education (Tekege, 2017). One of the benefits of information technology that is easily accessible is the website. One of the benefits of the website is that it serves as a learning resource, which contains information about using learning media (Wiryotinoyo et al., 2020). Almost all learning requires a website as a medium of information, one of which is in learning biology. Biology is one of the lessons in school or college that requires experimental or investigative efforts using scientific research data (Setiawan et al., 2021). Biology learning is a concrete approach to developing competencies.

Biology has several branches of science, one of which is plant anatomy. Plant anatomy is a science that focuses on studying the structure and components of the inside of a plant. (Alisani et al., 2022; Ayub et al., 2021; Khaerati et al., 2022). The concept of plant anatomy includes the structure of plant tissues, one of which is epidermal tissue, namely stomata (Aulia et al., 2023). Stomata are located on the leaf surface (Akbar et al., 2023; Mukti et al., 2022; Sholeha et al., 2022). Learning plant anatomy, especially stomata, requires practicum activities. Practicum is one of the learning methods that can provide direct experience to prove a theory or concept (Rahmadani, 2022). The practicum activities will affect the knowledge and understanding of the material (Ary et al., 2018). In addition, practicum

activities can develop curiosity and foster activity, cooperative attitudes, and accuracy in students (Rahmadani, 2022). If the practicum activity has a good procedure, it will get several approaches by doing experiments, collecting data, and analyzing the information collected (Meitri & Darmayanti, 2022). Teaching materials are also necessary in practicum activities because inadequate teaching materials can impact the thinking process (Rahayu & Ismawati, 2020). One of the teaching materials that can be provided is in the form of practicum instructions.

Practicum instructions are guidelines for practicum implementation that contain procedures for preparation, implementation, data analysis, and reporting (Ningsih et al., 2021). The existence of practicum instructions can help guide and assist educators during practicum activities, thereby facilitating the achievement of practicum goals (Setiawan et al., 2021). The important points in the practicum instructions are the title of the practicum to be carried out, the process or work procedure, the observation sheet, and the questions that will be used to find out what is known after the practicum activity (Budiarti & Oka, 2017). In line with that, according to Rustaman & Wulan (2007), in (Susanto et al., 2020) Student worksheets (LKPD) as instructions for carrying out good laboratory activities should have several aspects, such as 1) activity objectives, 2) theoretical basis, 3) availability of tools and materials, 4) work procedures, 5) how to assemble tools, 6) interpretation of observation data, 7) data analysis, and 8) conclusions from practicum activities. Many things are obtained in practicum activities, including training skills, providing opportunities for students to apply and integrate the knowledge and skills they have in practice, proving something scientifically / doing scientific inquiry, and appreciating science and inquiry skills (Nisa, 2017). The inquiry approach is a learning model that trains students to learn to identify, collect, organize, and solve problems (Puspita et al., 2018). The inquiry approach can help students connect learning materials with real-life experiences, so that learning will be more interesting and enjoyable for students, and students can apply it in their daily lives (Muhaimin et al., 2024). The inquiry approach needs to be innovated by integrating it with current technological developments to support innovative and interactive inquiry learning. One graphic design innovation tool that can support this is the Canva application.

Canva is one of the graphic design applications that can be used online (Monoarfa & Haling, 2021; Pratama et al., 2023; Zebua, 2023). There are several advantages to Canva, including attractive and practical graphic designs. Canva can also be accessed via PC or Android, with support for JPG, PNG, and PDF format exports (Suharyanto et al., 2022). The main feature of Canva that makes millions of people love it is the availability of a wide variety of templates, but some are paid (Kala'lembang et al., 2021). As a technology-based application, Canva provides a learning space for every teacher to carry out a lesson using learning media (Astuti, 2021). Some research has been conducted on Canva, such as by Rahmawati & Atmojo (2021), utilizing Canva as a digital media platform for 21st-century learning videos in science education. Permata Puspita Hapsari and Zulherman (2021) have utilized Canva as an animated video media development in science learning. Dwi Nur Indah Sari et al. (2023) and Wijaksono & Prima (2022) utilize the Canva application as a learning medium. The same research was also conducted by Kharissidqi & Firmansyah (2022), utilizing the Canva application as an effective learning medium. Previous research on the validity of practicum instructions has also been conducted by several researchers, such as Saputra et al. (2022), to determine the validity and readability of scientific approach-based practicum guides on plant tissue material. The same research was conducted by Setiawan et al. (2021), which tested the validity and practicality of guided inquiry-based science learning practicum handbooks, and the results were declared valid. Based on previous research, many have utilized the Canva application in the world of education, including as a learning medium and for creating animated videos. However, no one has employed Canva in designing practical instructions for stomata. Utilizing the Canva application to help design practical E-

instructions is a novelty. The design of this practicum E-instruction can be used as a guide in carrying out the practicum with practical, structured steps and can improve critical thinking.

Critical thinking skills include a person's ability to consider and assess data logically and reflectively, as well as the real context, situation, and concept of the problem using their insights (Muchtar et al., 2021). Critical thinking leads to analyzing an idea systematically and specifically, distinguishing something carefully and precisely, and identifying, reviewing, and developing thinking processes using logic and evidence in a perfect direction (Hendi et al., 2020). Problems often faced in practicum activities are facilities and infrastructure, including the lack of guidance. Practical activities that take a long time to prepare tools and materials, therefore, require practical instructions for their preparation. Based on the problems faced, the exposure to previous research, and the utilization of the Canva application, the problem formulation arises 1) how to design E-instructions for stomata practicum with an inquiry approach to improve critical thinking in learning valid plant anatomy, 2) what is the validity of E-Instructions for stomata practicum with an inquiry approach to improving critical thinking in learning plant anatomy and the design results with the Canva application? The objectives of this study are: 1) to design E-instructions for stomata observation practicum inquiry method to improve critical thinking in learning valid plant anatomy, and 2) to determine the validity of E-instructions for practicum to improve critical thinking in learning plant anatomy.

RESEARCH METHOD

This research is development research. The development model is adapted to the ADDIE model, a generic learning design (Bakhrun, 2021). ADDIE stages, namely analysis, design, development, implementation, and evaluation (Lestari & Cintamulya, 2022; Mongi & Hendry, 2021). An image of the ADDIE method that refers to Mongi & Hendry (2021) is found in Figure 1.
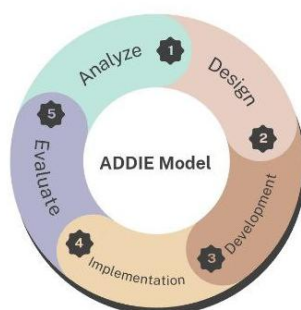
Figure 1. ADDIE method image

Several stages were carried out in obtaining the results of the validation of E-Instructions for stomata practicum with an inquiry approach to improve critical thinking in learning plant anatomy as follows: a) (Analyze) The analysis stage is used to analyze student needs in practical activities in the laboratory and identify problems regarding practical instructions that become obstacles in practical activities in the laboratory. b) (Design) There are several stages in developing products, some of which are developed according to the learning stages of the inquiry learning model. The design uses elements of images in the Canva application and also supports images, such as images of stomata practicum results. c) (Development) The development stage is the stage of realizing the product to be developed. After this stage, the e-instruction product for the stomata lab using an inquiry approach to improve critical thinking in plant anatomy learning will be validated by three biology education lecturers as validators with validity requirements that include material validity, systematics, grammar, and media.

The data for this study were collected using a validity instrument in the form of a validation sheet. The validation sheet was used to obtain quantitative data in the form of product validation assessment scores and qualitative data in the form of comments and suggestions from the three validators. The data analysis technique used in this study was quantitative descriptive, which was used to describe the validity data of the stomata practicum E-instruction with an inquiry approach to improve critical thinking skills in plant anatomy learning used for students. The calculation of all scores on the validation sheet used Likert scale criteria, referring to Ulandari & Mitarlis (2021) as in Table 1.

Table 1. Categories and Item Scores Likert Scale Validity

Skor	Category
5	Excellent
4	Good
3	Fair
2	Deficient
1	Not good

Source: Ulandari & Mitarlis, (2021)

The overall value of each validation criterion from the validation of material aspects, systematics, grammar, and graphics is recapitulated with the number of respondents obtained from the questionnaire results. The questionnaire is arranged on a Likert scale with positive categories, namely positive statements with the highest weight (Zuhri, 2020). Furthermore, the score obtained from each criterion is divided by the maximum score of each criterion and multiplied by 100%. The data obtained is in the form of qualitative data, which is quantified using Likert scale measurements with the following formula:

$$V = \frac{Skor\ Item\ yang\ diperoleh}{Skor\ maksimum}\ 100\%$$

The percentage results of the data obtained will be interpreted by the validity criteria Maesaroh & Fatisa (2022) referred to in Table 2.

Table 2. Validity category of practicum instructions

Percentage of Achievement	Interpretation
81% - 100%	Highly Valid
61% - 80%	Valid
41% - 60%	Moderately Valid
21% - 40%	Less Valid
0% - 20%	Invalid

Source: (Maesaroh & Fatisa, 2022)

RESULTS AND DISCUSSION

This development research results in an E-Inquiry-Based Practical Instruction to Enhance Critical Thinking in Plant Anatomy Learning using the ADDIE method. The stages of the ADDIE method are analysis (analyze), design (design), development (development), implementation (implementation), and evaluation (evaluate). The Analysis stage is used to analyze the needs of laboratory practical activities and identify problems regarding practical instructions that hinder students in practical activities in the laboratory. The analysis stage also examines students' needs for

practical activities. It identifies the material as the objective of the E-Inquiry-Based Practical Instructions to Enhance Critical Thinking in Plant Anatomy Learning.

Design: There are several stages in preparing development products, some of which are developed according to the learning stages of the inquiry learning model in Table 3 and the critical thinking syntax presented in Table 4.

Table 3. Stages of Inquiry

Stage	Description
Stage 1 Orientation	To motivate learners, teachers prepare them for the learning process by explaining the topic, objectives, and learning outcomes they must achieve, the main tasks they must complete to fulfill the objectives, and the importance of the topic and learning activities.
Stage 2 Formulating the Problem	Help learners develop and understand real situations by guiding and facilitating.
Stage 3 Formulating Hypothesis	Helping students ask different questions increases their capacity to hypothesize by allowing them to develop different short-term solutions or approximations of potential solutions to the problems they have researched.
Stage 4 Collecting data	Assist learners by asking questions that inspire them to consider where they can get the information they want.
Stage 5 Testing the Hypothesis	Guide students in testing hypotheses that are considered acceptable based on the data and information obtained. The most important thing in testing a hypothesis is to reformulate it or consider other factors that may influence it.
Stage 6 Formulating the Problem	Guide students in the process of describing the findings obtained based on the results of hypothesis testing. To reach accurate conclusions, teachers should be able to show students which data is relevant.

Source: (Gunardi, 2020)

Table 4. Indicators of critical thinking skills

Steps	Activities	Indicators
1	Providing simple explanations Building basic skills	1. Focus on a question 2. Analyze the argument 3. Asking and answering questions
2	Building basic skills	1. Assess the credibility of the source, whether the source is reliable or not 2. Observe and assess observation reports
3	Summarize	1. Deduction activities and deduction assessment 2. Inducing or considering the results of induction 3. Making and determining the value of considerations
4	advance clarification	1. Identify terms and consider a definition 2. Identify assumptions
5	Strategies and tactics	1. Deciding on a course of action 2. Interacting with others

Source: (Adisty et al., 2021; Affandy et al., 2019)

Development The development stage is the stage of realizing the product to be developed, which is presented in Table 1 as product outputs and suggestions given by validators in the validity test.

Table 5. Revised Results of the E-Validity Test of the Practicum Manual

No	Feedback / Suggestions	Revision
1.	The learning outcomes in the E-practicum instructions are less specific and precise about the topic of discussion, so they need to be improved to make them easier to understand.	Learning outcomes are presented according to the suggestions of expert validators for clearer and more specific sentences.
2.	The indicator section uses capital letters inaccurately. This writing must pay attention to capital letters, so it is recommended to replace words in the middle of sentences with lowercase prefixes to make sentences neater and in accordance with EYD.	Change capital letters in the middle of sentences to lowercase letters and adjust them to the correct Indonesian language rules.
3.	The Learning Objectives listed must be clearer and more specific so that they can provide an overview and guidance on using E-practicum instructions.	The learning objectives should be more specific according to the topic of discussion or the material in the practicum E-instructions.
4.	The presentation on the inquiry approach slide is appropriate for the exploration stage. There are the term students, and it should be changed to students so that it is in accordance with the level of users of the practicum E-instructions.	Change the term "learners" to "students" according to the user level of the E-practicum manual.

After this stage, the E-Inquiry-Based Practical Instructions to Improve Critical Thinking in Plant Anatomy Learning will be validated by three biology education lecturers, who will assess its validity in terms of material, systematics, grammar, and media. In creating interactive multimedia or e-learning, you must pay attention to the suitability of learning aspects, materials, and grammar because all are interrelated to create good interactive multimedia (Putri et al., 2021). This stage also has a validation process, which is carried out to obtain a validity value and determine the feasibility of the product to be used in practicum activities. In addition, this stage is also used to improve product design that gets suggestions from validators so that this product is suitable for use in practicum activities in the laboratory learning objectives or practicum activities. This stage will get scores from 3 validators. The validation value of the E-Instructions for Plant Inquiry Approach Practical Work is presented in Table 6.

Table 6. Validation Score of E-Practicum Instructions

No	Assessment Aspects	Score Validator			Average	Description
		Validator I	Validator II	Validator III		
1	Content/material	82,5%	77,5%	97,5%	85,8%	Very Valid
2	Systematics	88,8%	75,7%	88,8%	84,3%	Very Valid
3	Language	95%	80%	90%	88,3%	Very Valid
4	Graphics	94%	78%	96%	89,3%	Very Valid
	Average criteria score				86,9%	Very Valid

Based on Table 3, the validation value of the content/material aspect from the three expert validators obtained an average of 85.8%, meaning that the level of validity of the e-module from the content/material aspect is included in the very valid category. The material presented in this media is adapted to the indicators and objectives of learning plant anatomy in practical activities on stomata material for students. This aligns with previous research conducted by Landina & Agustiana (2022). Materials based on KD and indicators can help teachers know the limitations in providing learning materials to students and make students more focused on the material provided. The feasibility of coursebook content includes a) how well the content is explained about the curriculum, b) how accurate the material is, and c) the material supporting learning (Ningtyas & Rahmawati, 2023). The systematics aspect gets an average validity score of 84.3%, which is included in the valid category. This practicum guide is presented with the location of the main menu, and the steps of the practicum guide are systematic and coherent. Systematics in E-Practicum instructions with an inquiry approach are easy to access and use. The presentation of neatly arranged and structured material is one of the main criteria that support the feasibility of presentation (Anggriani et al., 2024). The features in the E-practicum instructions are designed to be attractive and appropriate to the student's level, as well as consistent font and size choices to make it easier for readers. Letters (fonts) have characteristics of function and meaning, so appropriate use is important to convey the meaning and minimize misunderstanding (Asri & Dwiningsih, 2022). Writing sentences in a medium written with good and correct language makes it easier for students to understand the material and does not cause multiple interpretations (Ramanda et al., 2023).

The results of language validity get an average score of 88.3%, which is included in the very valid category. The language contained in the E-Inquiry-Based Practical Instructions to Enhance Critical Thinking in Plant Anatomy Learning is presented in a language that is easy to understand. The spelling of the material presented has been standardized by language development. According to Rihanah & Irma (2022), students should use standard and interesting language to understand the content of the material presented. In addition, selecting appropriate terms and words and using uncomplicated language are important points that show excellent quality in making teaching materials

(Aprianka et al., 2021). The graphic aspect in this study received a validity value of 89.3%, which is included in the very valid category. This Inquiry-Approach Practicum E-Instructions product to Improve Students' Critical Thinking in Plant Anatomy Learning is presented with a consistent font size, is comfortable to read, and has an attractive layout of icons and illustrations. According to Khairini & Yogica (2021), the size of the text is appropriate and clear, the layout, illustrations, and learning videos are easy to understand, as well as the display design that suits the needs of students. According to Mawarni et al. (2022), an attractive, beautiful, and interactive graphical component can motivate students to learn, reduce boredom, facilitate the acceptance of learning materials, and improve student learning outcomes.

The results of the overall validity of the average of the four aspects get a value of 86.9%, which is included in the very valid category. Arikunto (2005) stated this in Fajarianingtyas & Hidayat (2019), if the data generated from a product is valid, it means that the product developed has described the development objectives correctly and in line with reality and the actual situation. This practical e-instruction also contains an E-LKPD, which contains several evaluation questions for students after using the practical e-instruction using the Inquiry approach. According to Oktavia et al. (2024), E-LKPD that contains HOTS-based questions will enable these students to think more critically in solving problems. Critical thinking skills are integrating and reasoning to analyze facts, create and defend ideas, make comparisons, and draw conclusions to solve problems. (Hamdani M. et al., 2019). The content, language, presentation, and graphical aspects have been assessed with excellent quality, ensuring that the material presented is explicit, precise, and visually appealing.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the E-Inquiry Approach Practical Instructions to Improve Students' Critical Thinking in Plant Anatomy Learning, developed using the ADDIE method of analysis, design, development, and implementation, obtained a validity value of 86.9% from all aspects. Based on this, the developed E-Instructions Practical product is included in the very valid category. In this study, it only reached the validity stage, so further research is needed regarding effectiveness and practicality testing.

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