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The Development of Biology Practicum Guidebook using Scientific Approach Based on Guided Inquiry for Senior High School Students

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Abstract The guided inquiry practicum guidebook is an effective tool for actively engaging students in the learning process. It was observed that biology teachers and students at MAN 1 Banyuwangi solely rely on textbooks and other basic media for the learning process. This study aims to provide a comprehensive description of the validity, student responses, and usefulness of producing a biology practicum guidebook using a Guided Inquiry based Scientific approach for class XI Science students at MAN 1 Banyuwangi. The research and development method used is the ADDIE approach. The research was carried out at MAN 1 Banyuwangi, using interview guidelines and questionnaire sheets as data collection instruments. This research utilized one material expert validator, one media expert validator, one language expert validator, one assessment expert validator, and one Biology Teacher. This validation is conducted to assess the authenticity of the educational resource. The research findings indicate that the average validation results from material experts achieved a percentage of 84.43% with highly valid criteria. Similarly, the average validation results from media experts attained a percentage of 95.10% with highly valid criteria. The linguist validation yielded a percentage of 90.27%, the evaluation expert validation achieved a percentage of 95.10%, and the teacher validation obtained a percentage of 97.5%, all with highly valid criteria. Furthermore, the average student response questionnaire yielded a result of 91% with excellent criteria. According to the findings of this study, it can be inferred that the product in the form of a practical guidebook is classified as highly valid and highly practical.

Keywords: ADDIE, Biology practicum guidebook, Guided inquiry, MAN 1 Banyuwangi, Scientific approach

INTRODUCTION

Learning is the cognitive process that acquires knowledge and skills through the exchange of information and experiences between teachers and learners. Hence, during the process of education, an instructor has the ability to employ diverse strategies, frameworks, and instructional techniques that they believe will facilitate students' comprehension and assimilation of the offered material. The 2013 curriculum mandates that learning activities be focused on the students. The learning process is designed to maximize students' potential, facilitating their acquisition of knowledge and fostering their active engagement in the learning process.

According to the findings from a needs analysis interview conducted on January 11, 2023, with Mrs. Ani, a biology teacher at MAN 1 Banyuwangi, it was observed that both biology teachers and students solely rely on textbooks and other basic media for the learning process. According to the analysis of student demands, 5 classes including a total of 150 students acknowledged the presence of discrepancies in teaching materials or learning media. In addition, Mrs. Ani stated that the utilization of standard textbooks and instructional materials lacked attractiveness during the learning process, resulting in pupils lacking motivation and displaying laziness in engaging with the subject matter and practical exercises. The development and provision of learning media are necessary to ensure effective learning processes for students (Harahap & Nasution, 2022; Sofyan & Nasution, 2022; Harahap et al., 2020). The use of instructional media plays a crucial role in enhancing students' understanding of biological concepts, enabling them to grasp the material more thoroughly and effectively (Kamil et al., 2023; Nadifah et al., 2023; Rizka et al., 2022; Afriza & Nasution, 2022).

Practical learning activities channel students' creativity towards applying the concepts they have acquired. As stated by Sari & Siwi (2018), practicum is a component of teaching that provides students with the chance to apply and put into practice what they have learned in theory, in real-life settings. Practical exercises are crucial in the process of learning biology. According to Sumarmin & Roza (2019), it is necessary to do practical activities in order to attain learning objectives. In order to ensure the successful implementation of practicum activities, it is necessary to have well-structured and efficient practicum instructions.

Learning media play a crucial role in supporting students' learning activities (Nasution, 2023; Nasution, 2022), and the Biology Practicum Guidebook stands as one of these instructional aids (Siregar at al., 2022). The practicum handbook is an important instrument for directing students through the effective completion of laboratory tasks, guaranteeing strict adherence to prescribed procedures, and reducing the chance of errors. Its detailed instructions not only make it easier to carry out practical tasks, but they also help to foster a scientific learning environment. By giving step-by-step instructions, the manual enables students to actively participate in hands-on experimentation, creating a greater grasp of scientific concepts and procedures. Furthermore, the booklet includes practical

recommendations that provide educators with vital insights and comments on the efficiency of various learning strategies. Through continuous assessment and refinement, educators can tailor their instructional approaches to better meet the needs of individual students, thereby enhancing the overall learning experience in the laboratory setting (Nufus et al., 2019).

In the biology learning process, it is crucial for students to actively engage in learning activities, such as posing inquiries, completing practice questions, and contributing ideas, in order to facilitate the learning process. This pertains to the instructional techniques and models employed by educators during the process of learning. The lecture method often leads to a lack of motivation to learn among students. Therefore, it is necessary to adopt the inquiry method to actively involve students in the learning process.

Inquiry-based learning prioritizes the exploration and discovery process in order to directly access the learning material. Students are responsible for independently seeking and locating learning materials, while educators serve as facilitators and direct students in their learning process. The inquiry method is an educational approach in which students engage in active exploration and utilize diverse sources of information and ideas to gain a deeper comprehension of a problem, topic, or issue. The inquiry technique is an inductive way to acquiring knowledge that focuses on student action. It is a student-centered approach to learning, where the teacher's direction is not the primary focus (Sumarni & Mansurdin, 2020).

Scientific method defined as a set of established procedures for acquiring knowledge, including methods for making accurate observations, interpreting findings, and generalizing discoveries. The Minister of Education and Culture of the Republic of Indonesia, in Regulation Number 81A of 2013, outlines the five primary learning experiences in the curriculum implementation process, commonly referred to as the scientific approach stages. These stages include observation, inquiry, data collection, making connections, and communication. The scientific approach is utilized in multiple facets of education under the 2013 Curriculum, such as the development of instructional materials or learning resources. Developing educational tools based on the scientific approach is a widespread and important activity, especially in the realm of science education (Romdaniyah et al., 2023).

The guided inquiry practicum handbook is an option for involving students directly in the learning process, serving as an alternative to standard practicum manuals. In this modality, the teacher assumes the role of a facilitator, providing an explanation of the problem to the subject of observation, experimentation, or inquiry in order to acquire findings. The overall activity instructions are omitted in this guided inquiry-based practicum manual, requiring students to independently devise their own activity steps using the material provided in the manual. In this exercise, the teacher assumes the role of an information provider who guides students in problem-solving, with the goal of preventing failure in practical tasks and misunderstandings in comprehension.

METHOD

This study applies to Research and Development (R&D). Research and development (R&D) is used for producing specific items for the administrative, educational, and social sectors that require production (Sugiyono, 2015). This study employs the ADDIE development model. The ADDIE model of development consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). The ADDIE model is a systematic model used to achieve desired objectives by representing steps in a structured manner.

The research and development stages of the ADDIE model consist of five steps.

1. Analysis

The initial phase of the ADDIE paradigm is the analysis stage. This stage is conducted to identify the issues and circumstances of the surrounding environment that are present in the field of biology education. Researchers conducted a needs analysis and developed biology learning materials relevant to the product being created. The researchers conducted a comprehensive investigation, beginning with an examination of student requirements and concluding with an evaluation of biology laboratory practicums. The needs analysis process is conducted by the use of observation instruments, which are directly implemented by researchers in the classroom during the practicum process (Nuraida, 2022). The analysis step involves validating the performance gap, establishing instructional goals, confirming the intended audience, identifying necessary resources, determining the prospective delivery system, and formulating a project management plan.

2. Design

The subsequent phase entails the design process. The purpose of design is to provide blueprints for the construction of materials and equipment that will be utilised during the development phase. The practical manual's design was produced via the Canva tool. The researcher created a preliminary design using a storyboard format. The design stage is the second phase of ADDIE development, which includes conducting a task inventory, formulating performance objectives, and devising testing methodologies.

The purpose of design is to construct the structure and content of the practical guide, as well as the tools that will be utilised during the development phase. This practical guide will subsequently be printed on A4 paper with the intention of maximising its visual appeal, so captivating students' interest in pursuing its contents. Subsequently, the subsequent action entails fabricating an apparatus specifically designed for the purpose of verification. The creation of instruments for validators is approached from three perspectives: material validity, media validity, and linguistic validity.

3. Development

During the third stage, the focus is on creating learning materials based on the design that was previously developed. The initial stage involves creating content and choosing or creating it. The goods generated in this step will undergo validation by subject matter specialists, media specialists, linguistics experts, biology educators, and will be tested through small-scale trials with student feedback. Subsequently, the creation of instructional guidelines for the students will take place. This stage is implemented to furnish information during the process of directing students through instructions. Instructional tactics are offered to help students who are able to concentrate on learning tasks improve their learning experience. There are three distinct methods for directing pupils in utilising learning media: organisation, format, and quality. Subsequently, the subsequent course of action entails formulating explicit instructions for the teacher. This measure is implemented to furnish educators with information that will assist and streamline the learning process. This section specifically addresses the components that empower educators to direct pupils through deliberate teaching tactics. The process of providing help to students is analogous to providing guidance to educators in the same developmental category. Guidance guides for educators are utilised to fulfil various objectives, wherein educators act as mentors or facilitators by employing instructional methodologies.

4. Implementation

The purpose of this implementation stage is to evaluate the product by gathering feedback from students. This student's evaluation pertains to the educational media product presented as a practical manual. The field trial phase was conducted on all pupils of class XI IPA 2 MAN 1 Banyuwangi. At this point, the students' feedback on the product was evaluated, and the efficacy of the practical manual was assessed. The method employed to assess the feasibility of the product involves administering a survey among pupils. The objective of this trial is to ascertain the reactions of students towards the intended product.

5. Evaluation

This stage represents the ultimate phase in the ADDIE development model study. At this stage, the researcher conducted product revision based on the assessment data obtained during the deployment phase. The weaknesses and shortcomings identified during the implementation phase are then utilised to enhance the teaching materials that have been created. If the collected results are deemed valid, they can serve as a point of reference for subsequent research.

Data Collection Tools

The data gathering instruments employed in this study consist of interview guides and questionnaires. The goal of the interview is to gather preliminary information regarding the learning media utilised in the learning process, learning methodologies, students' learning challenges and hindrances, learning motivation, teaching materials, and the circumstances during the biology learning process. The researcher interviewed Mrs. Ani, who is a biology teacher for class XI

Science students at MAN 1 Banyuwangi, as part of this study. Two types of questionnaires were employed in this study: validation questionnaires and student response questionnaires.

The research employed a questionnaire designed as a checklist, with a scoring system for each component. The assessment of these aspects was based on the criteria established for the generated instructional materials. The data utilised is derived from all constituent parts of the validation questionnaire, employing a Likert scale, the widely accepted scale for educational questionnaire, with four response options, specifically categorised as very poor, poor, good, and very good. The included documents include a student needs questionnaire, a material expert validation sheet, a media expert validation, an Indonesian language validation, and student replies.

Data analysis technique

The data received from validation by experts in materials, media, linguistics, biology teachers, and student replies were analysed by computing the scores and subsequently converting them into percentages. The formula employed to compute data from material experts and media experts is the formula outlined by Nasution (2017) as follows:

$P = \frac{f}{N}$ x 100 %

Description:

P = percentage figures for questionnaire data

f = total score obtained

N = maximum score

Subsequently, the obtained feasibility % is categorised according to Table 1. Media learning in the form of a practical manual is considered theoretically possible if the feasibility percentage is ≥ 51 %.

Table 1. Validity criteria.

Score	Criteria
81≤ P ≤100%	Very Good
61≤ P <81 %	Good
41 ≤ P <61 %	Good enough
21 ≤ P <41 %	Bad
0 ≤ P <21 %	Very Bad

FINDINGS AND DISCUSSION

Product validity

The content eligibility passed validation by material specialists, resulting in a suitability score of 78.1%. The presentation received a score of 89.5% for its presentation support, while the linguistic feasibility aspect received a score of 85.7%. Therefore, out of the 27 questions, the material expert validator has

provided an average score of 84.43%, falling inside the highly valid category. This data is presented in Table 2. From the findings of the material expert validation, it is evident the biology practicum manual developed was deemed highly valid.

Table 2. Material expert validation results.

No	Assessment Aspects	Percentage
1	Content Eligibility	78,1 %
2	Presentation Support	89,5 %
3	Linguistic Feasibility	85,7 %
	Mean	**84,43%**
	Criteria	**Very Valid**

The validation conducted by media specialists yielded a feasibility score of 94.2% for the feasibility of presentation and 96% for the graphic eligibility component. Therefore, out of a total of 32 questions, the media expert validator has provided an average score of 95.10%, falling inside the highly valid category as shown in Table 3. According to the assessment by media experts, it is evident the biology practicum manual developed was deemed highly valid.

Table 3. Media expert validation results.

No	Assessment Aspects	Percentage
1	Feasibility of Presentation	94,2 %
2	Graphic Eligibility	96 %
	Mean	**95,10%**
	Criteria	**Very Valid**

The Indonesian linguist validation yielded a 91.66% accuracy rate for the straightforwardness element, 100% for the communicative aspect, 87.5% for the dialogue and interactive aspect, and 87.5% for the part of suitability to student development. The language suitability yielded a 75% whereas the use of terms achieved a perfect 100%. Therefore, out of the 12 questions, the linguist validator's average result is 90.27%, falling under the very valid category as shown in Table 4. According to the findings of the linguist validation, it is evident the biology practicum manual developed was deemed highly valid.

Table 4. Indonesian language expert validation results.

No	Assessment Aspects	Percentage
1	Straightforwardness	91,66%
2	Communicative	100%
3	Dialogue and Interactive	87,5%
4	Suitability to student development	87,5%
5	Language suitability	75%
6	Use of terms	100%
	Mean	90,27%
	Criteria	**Very Valid**

The practitioners' validation of the material yielded the following results: material suitability - 89%, readability - 87.5%, presentation of the practical manual -

93.75%, graphics - 100%, and material profile - 95%. Based on the analysis of 22 questions, the practical validators have provided an average rating of 97.5%, indicating a highly valid category. This information is presented in Table 5. According to the expert practitioner validation results, it may be inferred that the generated biology practicum manual is very valid. According to Arikunto (2012), the validity of learning media is assessed by its alignment with established criteria. This means that the test results should be in agreement with these criteria.

Table 5. Practicioner validation results.

No	Assessment Aspects	Percentage
1	Material Suitability	90,62%
2	Legibility	87,5%
3	Presentation of the Practical Manual	93,75%
4	Practical Manual Presentation Design	100%
5	Response	95%
	Mean	**97.5%**
	Criteria	**Very Valid**

Product Practicality

The product's practicality was determined through experiments conducted on students from class XI IPA 2 at MAN 1 Banyuwangi. According to the data presented in Table 6, the proportion of student responses was 91%. This figure is within the range of 81% to 100%, which is considered very feasible. Hence, the students' feedback on the practicum handbook was highly positive, indicating that the developed biology practicum manual product was seen exceptionally useful. The purpose of developing the product is to facilitate its utilization in practical activities, enabling practitioners to work in a systematic and focused manner.

As per student feedback, the biology developed practical manual product employs a scientific approach through guided inquiry. It is visually appealing, with clear and comprehensible language. The manual includes clear pictures, supporting information, and every word is pronounced distinctly. Students also expressed positive opinions about the biology practicum manual. This biology practicum manual is user-friendly and has the potential to enhance enthusiasm for studying. According to Anggraeni (2015), the utilization of learning media during the learning process can lead to the development of new desires and interests, enhance motivation, inspire students to engage in learning, and even have psychological effects on students. Furthermore, transforming the laboratory manual into technological formats in the future can yield numerous benefits (Harahap et al., 2019), thus it is recommended to be pursued.

Table 6. Student response to the product in the trial.

No.	Respondent	Score	Max	Percentage	Criteria
1	Student 1	79	80	99%	very feasible
2	Student 2	79	80	99%	very feasible
3	Student 3	70	80	88%	very feasible
4	Student 4	72	80	90%	very feasible
5	Student 5	78	80	98%	very feasible
6	Student 6	65	80	81%	very feasible

No.	Respondent	Score	Max	Percentage	Criteria
7	Student 7	69	80	86%	very feasible
8	Student 8	75	80	94%	very feasible
9	Student 9	75	80	94%	very feasible
10	Student 10	77	80	96%	very feasible
11	Student 11	67	80	84%	very feasible
12	Student 12	61	80	76%	very feasible
13	Student 13	80	80	100%	very feasible
14	Student 14	78	80	98%	very feasible
15	Student 15	64	80	80%	very feasible
16	Student 16	79	80	99%	very feasible
17	Student 17	67	80	84%	very feasible
18	Student 18	58	80	73%	very feasible
19	Student 19	78	80	98%	very feasible
20	Student 20	79	80	99%	very feasible
21	Student 21	80	80	100%	very feasible
22	Student 22	71	80	89%	very feasible
23	Student 23	71	80	89%	very feasible
24	Student 24	75	80	94%	very feasible
25	Student 25	74	80	93%	very feasible
26	Student 26	65	80	81%	very feasible
27	Student 27	78	80	98%	very feasible
28	Student 28	75	80	94%	very feasible
29	Student 29	74	80	93%	very feasible
30	Student 30	74	80	93%	very feasible
	Total	**2187**	**2400**	**91%**	**very feasible**
	Mean	**72,9%**	**80**		

CONCLUSION

The research findings demonstrate the high validity of the developed product. The conclusion was derived from the validation results conducted by experts in various fields. Material experts achieved an average percentage of 84.43% with highly valid criteria, media experts achieved an average percentage of 95.10% with highly valid criteria, language experts achieved a percentage of 90.27% with highly valid criteria, and teacher validation resulted in a percentage of 97.5% with highly valid criteria. The research findings demonstrate that the designed product is very functional. This conclusion was derived from the findings of the student response questionnaire, which yielded an average score of 91% with excellent standards. Based on the findings of this study, it can be inferred that the product in the form of a practical handbook is classified as highly valid and highly practical.

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