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DEVELOPMENT OF A PRACTICUM GUIDE FOR REPRODUCTION MATERIAL IN PLANTS INTEGRATED WITH MODIFIED FREE INQUIRY FOR CLASS XI SMA/MA

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Abstract. This study aims to create a practicum guide for reproduction in plants, which is a sub-chapter of regulatory process in plants. The guide is integrated with modified free inquiry to assist and facilitate teachers and students, as well as to establish a more consistent approach to conducting practicum activities in order to achieve learning objectives. This research was R&D and employed the Plomp Model, which comprises three stages, namely introduction, development, and evaluation. The feasibility testing subjects consisted of three students using individual techniques and six students in small groups. The practicality test is conducted by teachers and students from the XI class of SMAN 1 Koto XI Tarusan, Pesisir Selatan Regency. Observation and questionnaires were implemented as data collection techniques. Descriptive analysis is employed to analyse data. The results of this study demonstrated that the practicum guide developed was highly valid (90.90%), highly feasible (85% and 85.83%), and highly practical (96.94% and 89.51%). Consequently, the development of a practicum guide for plant reproduction that is integrated with modified free inquiry can be implemented in the practicum process, as it has satisfied the criteria of validity, feasibility, and practicality in use.

Keywords: modified free inquiry, practicum guide

INTRODUCTION

Practicum activities are one of the requirements in science subject for the Merdeka Curriculum. Students' science process skills can be enhanced through practicum activities, regardless of whether they possess them or not (Ningsi et al., 2021), as well as student performance skills (Candra and Hidayati, 2020). Nevertheless, these science process skills and performance skills are still lacking in a significant number of students. Consequently, the implementation of practicums in educational institutions is imperative, as they have the potential to enhance students' thinking skills and facilitate their comprehension of the subject matter. Pane and Simangunsong (2021) reported that the practicum guide designed was consistent with the material and learning objectives. The guide can direct students in the execution of the correct procedures for conducting experiments during practicum activities.

SMAN 1 Koto XI Tarusan Pesisir Selatan Regency is endowed with comprehensive learning facilities, including science laboratories that are available for biology practicum activities with practicum materials and equipment. Nevertheless, biology practicum activities are conducted by teachers in class XI IPA on a very infrequent basis. In reality, teachers have not conducted practicum activities in a manner that is consistent with the curriculum's requirements and the needs of students. Additionally, teachers do not have practicum guides that students

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can utilise during practicum activities. A practicum guide is required to conduct practicum activities, both during the preparation phase and during the practicum itself. Practicum guides can facilitate the completion of practicum activities for both students and teachers (Rahmi and Silvina, 2019) while practicum implementation necessitates a practicum guide (Permatasari et al., 2021). The practicum guide is a critical practicum facility (Uzlifat dkk., 2018).

The teacher of class XI SMAN 1 Koto XI Tarusan, Pesisir Selatan Regency solely employed the practicum guide specified in the printed book in response to the absence of the practicum guide. It is discovered that the practicum guide solely instructs students and teachers to conduct experiments, and the majority of the material is not recommended for practicum activities, as a result of the book's content analysis.

There are not many teachers who have practicum guides that are in alignment with the curriculum and student needs while students require teacher guidance during the practicum activities. As discovered by Ningsi et al., (2021), the available practicum guides are not in accordance with the curriculum, as practicum activities must primarily enhance students' scientific learning abilities. However, the current practicum guides still instruct students to complete the practicum by simply adhering to the procedures outlined in the guide. Azzahra and Supriatno, (2023) also noted that the design of practicum activities in printed books is still in need of improvement in the conceptual, practical, and knowledge construction aspects, as well as the low suitability of practicum activities with learning objectives and the inappropriate work steps used. The practicum guide is a necessary instrument for practicum activities, serving as a reference. Masruri (2020) also discovered that the absence of infrastructure and facilities to facilitate practicum activities is a frequent issue in schools.

It is imperative to establish practicum guides for learning in order to facilitate the systematic and organised work of students, as well as to contribute to the development of students' attitudes and skills regarding the scientific process. Waluyo and Parmin (2014) concur that practicum guides are necessary for the execution of practicum activities. The development of students' scientific attitudes and performance is influenced by practicum guides. Practicum guides can be a valuable learning resource that supports learning during experiments, fosters student interest in practicum, and helps students understand the procedures of practicum. Additionally, students can learn the systematic nature of writing practicum reports. Consequently, practicum guides are a critical component of the learning process. It is also agreed upon by Rahmadani (2022) that practicum guides or instructions are the most critical components that must be developed.

The material on regulatory process in plants addresses the following topics: organ tissues and organ systems, transport in plants, reproduction in plants, and irritability in plants. The majority of the material in the sub-material on plant reproduction is focused on the observation of growth patterns following the reproductive process, including both vegetative and generative growth. Nevertheless, students conduct observation activities exclusively on plants that have completed growth components (flowering or fruiting) in the environment in which they reside. Consequently, the process of growth during and after reproduction is not observed. Therefore, it is crucial for students to participate in practicums in order to gain a comprehensive understanding of the reproduction process in plants, enabling students to comprehend the material on plant reproduction.

The results of interviews with students regarding their preferences for biology learning with practicum activities revealed that 88.88% of students enjoyed

practicum activities, 89.47% of students had participated in practicum activities at least once, and as many as 78.94% of students used textbooks equipped with practicum guides. However, no special books were used, and as many as 100% of students required teacher guidance when conducting practicums. Therefore, it is crucial to develop a practicum guide that is applicable both within and outside the laboratory, based on the data that has been collected.

A practicum guide that is effective in the learning process offers a comprehensive interpretation or perspective on the learning outcomes of biology. This also demonstrates that the practicum activities conducted assist students in comprehending the subject matter, thereby enhancing the character of their learning and their learning outcomes. Practicums enable students to acquire knowledge of objects directly, both through observation and experimentation, which can enhance their retention and potentially improve their academic performance. According to Bago, (2018), the effectiveness of laboratory learning can be influenced by the presence of a practicum guide.

The modified free inquiry approach is incorporated into the practicum guide to enhance the science process skills of students. Damopolii et al., (2014) and Hapsari et al., (2020) asserted that the modified free inquiry strategy in practicum activities can equip students with the ability to autonomously learn and identify solutions to preexisting issues. Students are capable of engaging in critical and integrative thinking regarding existing issues. Students are afforded the opportunity to solve problems, acquire data, and analyse it in order to draw conclusions through the use of modified free inquiry. According to Nurhadi et al., (2023), the modified free inquiry learning strategy necessitates students to have the ability to think critically in order to resolve issues that were posed at the outset of the meeting. It is anticipated that this study offers science teachers solutions to facilitate the effective and efficient implementation of practicum learning.

METHOD

This study was classified as Research and Development and employed Plomp Model, which comprised three stages: preliminary studies, prototypes, and assessments (Plomp dan Nieveen, 2013). This study was reported up to the prototype stage, specifically the product feasibility aspect. The product development trial subject was class XI IPA second semester, and the research was conducted in class XI of SMA N 1 Koto XI Tarusan, Pesisir Selatan Regency, from October 2023 to January 2024.

The preliminary research commenced with the examination of learning needs and problems, the analysis of curriculum content, and the content analysis of biology textbooks for class XI SMA/MA. In order to gather fundamental information regarding learning problems, interviews with teachers and students were conducted, as well as observations of the learning process. The curriculum was analysed by comparing the current curriculum with the curriculum at the school and examining the contents. The content of the book was analysed by examining the regulatory process material in plants in the book used by the teacher in the learning process. The analysis included the following aspects: (a) the suitability of learning outcomes, elements, and learning objectives (b) the breadth of material as seen from the suitability of the material with all learning outcomes (c) the depth of material in the book as seen from the pictures, tables, and graphs that are presented, and (d) factual, conceptual, and procedural material and current material. The analysed book was the book written by Solihat et al., (2022) Ministry of Education, Culture, Research and Technology, Biology SMA/MA Class XI.

The prototyping stage is implemented as the next step, which is an iterative design phase that is designed to enhance and furnish the product. The practicum guide for reproduction material in plants was designed by integrating the components of the guide with the phases of modified free inquiry. Subsequently, a validation test was conducted with a validator to evaluate the validity of the content, linguistic, didactic, and graphical components of the practicum guide by utilising modified free inquiry material on the reproductive process in plants. Additionally, the teaching materials that have been validated were continued with the revised prototype 1, which was subjected to feasibility testing by three students with varying abilities (high, medium, and low). The revised prototype 2 was then subjected to feasibility testing by six randomly selected students in small groups. The chart in Figure 1 illustrates the Plomp model's stages.

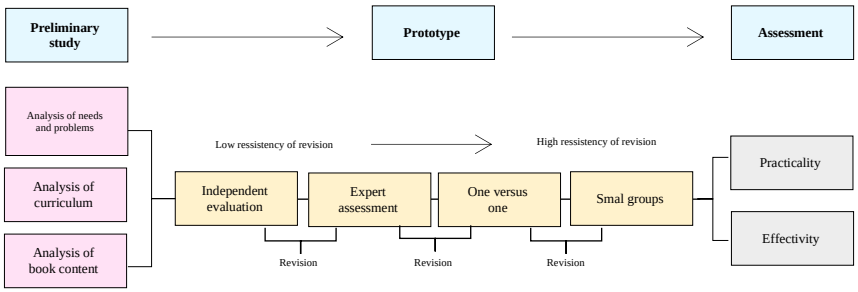


Figure 1. Diagram of the Plomp Model's development work stages (Plomp & Nieveen, 2013)

Validity and feasibility assessments were implemented utilising feasibility questionnaires and validity questionnaires. Statements were organised according to a Likert scale in the questionnaire. The validity and feasibility data processing results were analysed using the percentage formula modified from Riduwan, (2013) and included in the validity/feasibility criteria as outlined in Table 1. The data in this study were processed using a percentage formula that was modified from Riduwan, (2013). The validity and feasibility data processing results were subsequently descriptively analysed.

$$Nx = \frac{JSP}{JSM} \times 100\%$$

JSM = JN x JI x ST

Keterangan :

Nx	=	Validity/Feasibility Score
JSP	=	Total Score Acquisition (summed from all scores assessed by the validator/user)
JSM	=	Total Maximum Score
Jx	=	Number of Validators/Users
JI	=	Number of Indicators
ST	=	Highest Score

Table 1. Results of Average Values of Validity, and Feasibility

Value Criteria (%)	Category	
	Validity	**Feasibility**
81-100	Very Valid	Very Feasible
61-80	Valid	Feasible
41-60	Valid Enough	Feasible Enough
21-40	Less Valid	Less Feasible
0-20	Invalid	Not Feasible

RESULTS AND DISCUSSION

The practicum guide for plant reproduction with modified free inquiry was devised using the preliminary study. The practicum guide was designed by combining the components of the guide and the modified free inquiry work steps. The components of the practicum guide, which include the cover, preface, practicum title, practicum objectives, theoretical basis, tools and materials, and practicum work methods, are cited from Setiawan et al., (2020). The components of the practicum guide are subsequently incorporated with modified free inquiry in accordance with Trianto (2014). This process involves the following steps: orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses, and drawing conclusions. The design results were self-evaluated in order to rectify their own design errors, and subsequently evaluated by the validator. The validation value of the reproduction practicum guide in plant class XI SMA/MA incorporated with modified free inquiry is illustrated in Table 2.

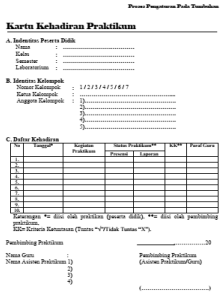
Table 2. Results of the Assessment of the Practicum Guide Validator

No.	Aspects	Validation Value			JSP	JSM	NV (%)	Validity Criteria
		V1	V2	V3				
1	Contents	66	-	-	66	75	88	Very Valid
2	Linguistics	32	32	31	95	105	90,48	Very Valid
3	Didactics	-	68	-	68	70	97,14	Very Valid
4	Graphics	-	-	66	66	75	88	Very Valid
Average							90,90	Very Valid

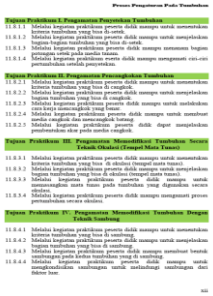
Description: V1 = content validation, V2 = didactic validation, V3 = learning media validation, JSP = Total Score Acquisition, JSM = Total Maximum Score, NV = Validity Value

The average validity value of the reproduction practicum guide in plant class XI SMA/MA integrated with modified free inquiry developed is highly valid (90.90%), as determined by expert assessment. The practicum guide was further tested to the feasibility test stage with minimal revisions, as all aspects of the assessment are in the very valid range (88-90.48%). Figure 2 illustrates the practicum guide prototype.

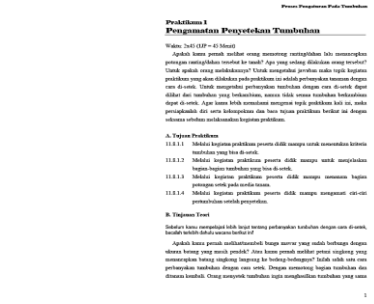
Cover design of practicum guide


Kartu Kehadiran Praktikum

Practicum attendance card design

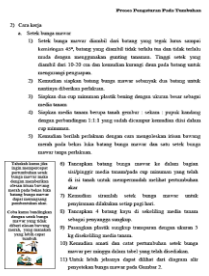


Design of practicum objectives

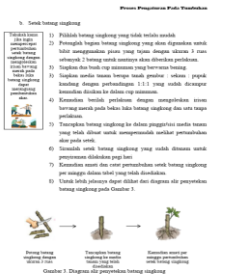


Design of onboarding stages

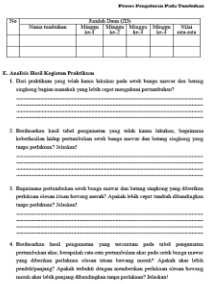
Design stages of problem formulation and hypothesis



Data collection design



Design of practicum result table



practicum result analysis design

Inference design and competency test

Figure 2. Snapshot of the prototype of the practicum guide for regulatory processes in plants integrated with modified free inquiry

The content of reproductive material in plants in the practicum guide is highly valid (88%) due to the fact that the material presented in the guide has been prepared in accordance with learning competencies. As reported by Fitriani and Sari, (2020), the material should be in accordance with learning objectives, indicators, and outcomes. The material extracted from each source has been cited by providing the author's name and listed in the bibliography. The material presented as learning information at the orientation, observation, theory review, data analysis, and evaluation questions has been customised to align with the learning needs and curriculum. In order to ensure that the material provided to students is of the highest quality, teachers are required to conduct a study of the material, as stated in the report by Robin et al. (2017). The theoretical review and work flow diagram have both provided students with supporting images that have facilitated their comprehension of the material and have directed the learning process to be more effective. It is in line with Latifah and Isnaini (2015) that material that includes images is an attempt to cultivate student understanding, particularly in terms of improving student learning outcomes.

The practicum guide has been designed with a plain and easy-to-understand information language that is influenced by linguistic aspects. The practicum guide can provide information and be interpreted correctly through the use of introductory language, material language, and learning language in Indonesian, Latin, foreign languages, and plant reproduction terms. In accordance with the report by Amelia and Fitrihidajati, (2018), teaching materials must be consistent in their use of terminology, and the organised use of terminology should be well-organised to prevent confusion.

The practicum guide has received a favourable evaluation due to its effective and efficient information delivery, which is facilitated by the sentence structure that adheres to the correct Indonesian language standards. This is in line with Saputra et al. (2022) that the practicum guide can be readily understood by students if the language used is clear and appropriate for the target audience, and if short, concise, and clear sentences are used.

In general, the practicum guide for reproduction material in plants, which is integrated with the modified free inquiry approach that has been devised, is highly valid in terms of didactics. The learning objectives are derived in greater detail in each practicum activity and are organised in a systematic manner to ensure that the sequence of practicum activities is executed correctly. The report by Robin et al. (2017) stipulates that teaching materials must satisfy a variety of criteria, such as the content being in alignment with the curriculum, the presentation being systematic, and the ability to assist students in achieving their learning objectives. The learning instruction in the practicum guide have been adapted to the students' level of ability, and the editorial and cognitive level of the questions presented at the problem formulation, data analysis, and evaluation stages have been adapted to the learning needs and the curriculum. Ulandari et al. (2022) reported that the practicum guide must motivate students to gather information in accordance with the hypothesis of the problem to be discussed, and can also instruct them on how to analyse the results of the practicum activities they have completed.

The test results of the graphical aspects of the practicum guide for reproduction material in plants, which were conducted using a modified free inquiry approach, are highly valid. This asserts that the practicum guide display's design is visually appealing, with regard to its size, font, content layout, image display, spacing, and design consistency.

The images displayed in the practicum guide are easy to comprehend. A photograph is employed to illustrate the reproduction of a plant, while clipart is employed to illustrate the work process in the form of a flow diagram. In order to elucidate the concepts that are being practiced, these images have been evaluated. The material should be presented in a manner that encourages students' imaginations to comprehend the teaching material, as advocated by Kusuma (2018). Students' comprehension of the paragraphs in the practicum guide may be enhanced by the inclusion of accompanying images or illustrations.

This is consistent with the opinion of Fitriani and Sari (2020) and Ulandari et al. (2022) that the design of the practicum guide must be in accordance with the format of the practicum guide. The preparation of material and images must be arranged systematically, and the combination of colours, images, shapes, and sizes of letters on the cover of the practicum guide should be harmonious and attractive. The shape and size of the letters on the practicum guide should be easily readable.

The feasibility test of the practicum guide in terms of legibility is conducted subsequent to the validation and revision values. The readability aspect comprises

six indicators and ten questions. Table 3 and Table 4 contain the results of the feasibility test of practicum guides conducted by small groups and individuals.

Table 3. Results of Individual Feasibility Test of Practicum Guides

Aspects	Eligibility score			JSP	JSM	NL (%)	Criteria
	P1	P2	P3				
Image display and image color	19	20	20	59	60	98,34	Very Feasible
Font type and size	9	9	8	26	30	86,67	Very Feasible
Layout	4	4	4	12	15	80	Feasible
Presentation of material	4	4	4	12	15	80	Feasible
Language	4	4	5	13	15	86,67	Very Feasible
Practicum guide display	4	4	5	13	15	86,67	Very Feasible
					Average	85,83	Very Feasible

Notes: P1= student 1, P2= student 2, P3= student 3, JS = Total Score Acquisition, JSM = Total Maximum Score, NL = Feasibility Value

Table 4. Results of the Feasibility Test of Practicum Guides by Small Groups

Aspects	Eligibility score						JSP	JSM	NL (%)	Criteria
	P1	P2	P3	P4	P5	P6				
Image display and image color	17	19	18	19	19	16	108	120	90	Very Feasible
Font type and size	9	9	8	9	8	9	52	60	86,67	Very Feasible
Layout	4	5	4	3	3	5	24	30	80	Worth
Presentation of material	3	5	4	5	4	4	25	30	83,33	Very Feasible
Language	3	5	4	5	4	5	26	30	86,67	Very Feasible
Practicum guide display	4	4	4	5	5	3	25	30	83,33	Very Feasible
								Average	85	Very Feasible

Notes: P1= student 1, P2= student 2, P3= student 3, P4= student 4, P5= student 5, P6= student 6, JSP = Total Score Acquisition, JSM = Total Maximum Score, NL = Feasibility Value

Tables 3 and 4 illustrate the feasibility test results, which yielded criteria that were highly feasible, with an assessment range of 80-98.34%. This evaluation indicates that the practicum guide that has been created is highly feasible. This demonstrates that the practicum guide for reproduction material in plants is user-friendly and can be utilised by students to acquire knowledge. According to Adelia et al. (2023), students' interest and learning outcomes will be amplified by books that are easily readable.

The feasibility questionnaire analysis results show that the practicum guide with a modified free inquiry approach to plant reproduction material that was tested by individuals received an average score of 85.83% (very feasible), and it was also tested by small groups and received an average score of 85% (very feasible). The feasibility test of teaching materials in the form of a practicum guide with a free inquiry approach modified reproductive material in plants encompasses the appearance of images and image colours, the type and size of letters, the layout, the presentation of the material, the language, and the physical appearance of the practicum guide. According to Saputra et al. (2022), the overall aesthetic appeal of the practicum guide will be enhanced by the presence of a design that is consistent and organised in its image placement.

The practicum guide's font type and size are both suitable and pleasant to read. Sonia and Yuliani (2023) reported that font selection is crucial in media development, particularly in the selection of fonts and their size. Students will find the practicum guide is easily readable due to the formatting design and sequence of material, practicum activities, and scientific work methods that were designed neatly. Sonia and Yuliani (2023) also reported that the layout design criteria for excellent teaching materials are that the pages of the teaching material must be neatly arranged with page numbers and the colours that are visually appealing are

selected in accordance with the composition to prevent students from becoming disinterested during their studies.

The material presented in the practicum guide is readily identifiable upon both reading and visual inspection, as it is consistent with the subject matter, which is the reproduction of plants. Nurmutia et al. (2013) reported that the presentation of material with language and expressions, as well as the use of images, tables, and flow charts that are organised in a systematic manner facilitate student comprehension.

The language used in the practicum guide must be informative and readily comprehensible to ensure that students can follow each stage of the practicum activities. Febriana et al. (2022) concluded that students may more readily comprehend the discourse's content by employing sentences and terminology that are not overly complex. Learning activities can be facilitated by the selection of discourse that is appropriate for the grade level, as indicated by the report of Febriana et al. According to Zidatunnur and Rusilowati (2021), effective learning materials must be of high quality in order to be readily comprehensible and readable.

CONCLUSION

The practicum guide with a modified free inquiry approach to plant reproduction material can assist and facilitate the process of practicum activities in terms of validity, feasibility, and practicality of use, as indicated by the results of this study. The practicum guide is highly valid, highly feasible, and highly practical in its application to practicum activities.

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