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Abstract. *The formulation of the problem in this research is how to develop a valid molecular genetics practicum guide with the aim of testing the validity of the practicum guide in molecular genetics courses for undergraduate biology study program students. This type of research is Research and Development (R&D) with the ADDIE development model which consists of five stages, namely analysis, design, development, implementation and evaluation. The instrument used is a validation sheet filled out by a validator expert. Data was collected through analysis of validation sheets that had been filled in by expert validators and analyzed descriptively in order to obtain data in the form of a validity score. The results showed that practicum guides had an average validity score in the range of $4.5 \leq Va = 5$, in this case it met the very valid criteria.*

Keywords: *ADDIE development model, practicum guide, molecular genetics*

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Validity of Practicum Guide in Molecular Genetics Course for Bachelor's Student of Biology Study Program of Mathematic and Science Faculty in Universitas Negeri Makassar

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Introduction

The development of biology on average comes from a concept of genetics, in other words, genetics is a biological science that covers all life sciences. Genetics is not just about the inheritance of traits but a branch of biology that studies genetic material, its structure, expression, and presence in populations and their engineering (Corebima, 2009). Genetics can also be said to be a study that discusses or studies genes and all aspects of them. Broadly speaking, the branches of genetics include; cell genetics, molecular genetics, developmental genetics, and quantitative and population genetics. Genetics is an example of a course that must be followed and studied by learners in pursuing higher education, especially in the biology department (Lauren, et al., 2016). Molecular genetics is a compulsory subject of the Bachelor's Degree Study Program of the Department of Biology, Mathematics and Science Faculty, Universitas Negeri Makassar which weighs 3 credits. The general purpose of this course is for students to master the theory of Biotechnology obtained in class and to prove the theory obtained in the laboratory. The theoretical lecture process is carried out with a cooperative learning approach and practicum in the laboratory is carried out through experiments. The problem obtained by researchers when making observations is that there is no molecular genetics practicum guide because there is no practicum guide during the molecular genetics lecture process. The result arises is that students have not been able to prove the concepts/theories they have obtained directly in the laboratory, so their mastery of theories about molecular genetics courses is very lacking. The existence of practicum activities is important in learning biotechnology because it can help improve student skills both in the fields of science and education. In line with Abu, et al. (2019) that one of the skills that must be possessed by biology graduates is expertise and skills in practicum activities. Practicum

the molecular genetics lecture process. The result arises is that students have not been able to prove the concepts/theories they have obtained directly in the laboratory, so their mastery of theories about molecular genetics courses is very lacking. The existence of practicum activities is important in learning biotechnology because it can help improve student skills both in the fields of science and education. In line with Abu, et al. (2019) that one of the skills that must be possessed by biology graduates is expertise and skills in practicum activities. Practicum activities are carried out as an effort to provide a real experience to students in implementing theoretical studies and to prove existing theories.

Practicum activities can run and achieve learning competencies if equipped with the right practicum tools and practicum guidelines. Practicum guides are used as instructions for conducting an experiment, observation sheets to write down observation data and as discussion sheets to get conclusions and how to maintain tools (Qorimah, 2019). This is in line with the research of Abu, et al., (2019) that practicum using guidelines is more effective than conventional practicum without using practicum guidelines..

The practicum guide is designed using Microsoft Word and Canva Software. Practicum guidelines developed based on guided inquiry to increase understanding of learning concepts related to DNA isolation, PCR, and electrophoresis. According to Sukma et al. (2016), guided inquiry learning is a learning model with independent concept discovery by students which plays a more dominant role. The guided inquiry-based practicum guide is prepared based on the components of a good practicum guide. A good practicum guide must contain several important components such as the title of the practicum, the purpose of the practicum, the theoretical basis, tools and materials, how it works, and evaluation. This is following the opinion of Budiarti & Oka (2014) that the guide has several components, namely titles, tools and materials, work steps, and questions that will reveal student knowledge.

From the results of observations and in-depth studies on the importance of procuring molecular genetics practicum guides in helping students understand the theories taught in class, therefore the purpose of this study is this research aims to produce practicum guides in molecular genetics courses for students of the S1 biology study program who meet the validity criteria. With the development of the molecular genetics practicum guide, it is hoped that students will get material that is following competency standards and can optimize the potential and skills of biology education students who will later become educators in Formal Education Institutions. Based on the above background, it is considered very important to research the development of practicum guidelines for the Molecular Genetics course for bachelor's students of Biology Study Program.

Research Method

The type of research used is Research and Development (R&D) which refers to the ADDIE development model which consists of five stages, those are; Analysis, Design, Development, Implementation, and Evaluations. Data collection techniques in this study include validity analysis through the assessment of expert validators using practicum guide validation sheets. The data analysis refers to Hobri (2010).

Table 1. Validity Level Criteria

Score	Information	Information
$4,5 \leq Va = 5$	Highly Valid	No Revision Required
$3,5 \leq Va < 4,5$	Valid	No Revision Required
$2,5 \leq Va < 3,5$	Less Valid	Partial Revision
$1,5 \leq Va < 2,5$	Invalid	Partial Revision
$Va < 1,5$	Highly Invalid	Total Revision

Source: Hobri (2010)

Result and Discussion

The results of testing the validity of the Practicum Guide in the Molecular Genetics Course for the Bachelor's Student of Biology Study Program based on various aspects can be seen in the following table.

Table 2. Results of Practicum Guide Product Validation Analysis

No	Aspect Indicators Valuation	\bar{X}	Category
1	Didactic terms	4,25	Valid
2	Construction requirements	4,87	Highly Valid
3	Technical terms	4,62	Highly Valid
4	Content laidness requirements	4,75	Highly Valid
Rata-rata		4.62	Highly Valid

Based on the table in the validation analysis of the practicum guide, an average score of 4.62 was obtained. This value is in the range of $4.5 \leq Va = 5$ with the category "highly valid". This means that the practicum guide developed has met the requirements of a guide and can be used in practicum activities. After validating the guide, then validation will be carried out on the lecturer response questionnaire instrument to find out the practicality of the guide developed. Furthermore, the results of the validation of the lecturer's response questionnaire as a whole can be seen in the following table.

Table 3. Results of Validation of Lecturer Response Questionnaire Instrument

No	Aspect Indicators Valuation	\bar{X}	Category
1	Hint aspect	4,90	Highly Valid
2	Content Eligibility	4,50	Valid
3	Display	4,50	Valid
4	Serving	4,50	Valid
5	Language	4,50	Valid
6	Benefit	4,50	Valid
Average		4.56	Highly Valid

Based on the table in the validation analysis of the lecturer response questionnaire instrument, an average score of 4.56 was obtained. This value is in the range of $4.5 \leq Va = 5$ with the category "Very Valid". This means that the lecturer's response questionnaire to the practicum guide developed has met the validity requirements and can be used in the field by researchers. Furthermore, the results of the validation of the overall student response questionnaire can be seen in the following table.

Table 4. Results of Student Response Questionnaire Instrument Validation

No	Aspect Indicators Valuation	\bar{X}	Category
1	Attraction	4,75	Valid
2	Ease of Use	4,50	Valid
3	Language	4,50	Valid
4	Benefit	4,50	Valid
Average		4.56	Highly Valid

Based on the table in the validation analysis of the student response questionnaire instrument, an average score of 4.56 was obtained. This value is in the range of $4.5 \leq Va = 5$ with the category "Highly Valid". This means that the student response questionnaire to the practicum guide developed has met the validity requirements and can be used in the field by researchers. Furthermore, an analysis of product validation instruments is carried out which can be seen in the following table.

Table 5. Product Validation Instrument Analysis Results

No	Assessment Aspect	\bar{X}	Category
1	The title of the questionnaire is clearly stated	5,00	Highly Valid
2	Completeness of components (identity for respondents, filling instructions, and tables to be filled)	4,50	Highly Valid
3	Clarity of the purpose of the questionnaire	5,00	Highly Valid
4	Clarity of statements of research product validation instruments	5,00	Valid
5	Writing questionnaire statement items in accordance with the provisions	5,00	Valid
6	Accuracy of using grammar and spelling terms (terms, grammar, and Enhanced Spelling in accordance with good and correct Indonesian language rules)	4,00	Valid
Aspect Average		4,75	Highly Valid

The assessment aspect of the product validation instrument consists of 6 indicators validated by expert validators. After analyzing the validation value of each expert validator, an average value of 4.75 or in the valid category was obtained. Furthermore, validation of the product implementation instrument is carried out to assess the practicality of the guide developed. The results of product implementation instrument validation can be seen in the following table.

Tabel 6. Results of Product Implementation Validation Instrument Analysis

No	Assessment Aspect	\bar{X}	Category
1	The title of the questionnaire is clearly stated	5,00	Sangat Valid
2	Completeness of components (identity for respondents, filling instructions, and tables to be filled)	5,00	Sangat Valid
3	Clarity of the purpose of the questionnaire	4,50	Sangat Valid
4	Clarity of statements of research product validation instruments	5,00	Valid
5	Writing questionnaire statement items in accordance with the provisions	5,00	Valid
6	Accuracy of using grammar and spelling terms (terms, grammar, and Enhanced Spelling in accordance with good and correct Indonesian language rules)	4,00	Valid
Aspect Average		4,75	Highly Valid

The assessment aspect of the product validation instrument consists of 6 indicators validated by expert validators. After analyzing the validation value of each expert validator, an average value of 4.75 or in the very valid category was obtained. Based on these results, the product implementation observation instrument is valid for use in the field. Furthermore, the analysis of the validation of student learning outcomes as a whole can be seen in the following table.

Table 7. Validation Analysis of Student Learning Outcomes

No	Aspect Indicators Valuation	\bar{X}	Category
1	Material	4,66	Highly Valid
2	Construction	4,75	Highly Valid
3	Language	4,75	Highly Valid
Average		4, 72	Highly Valid

After analyzing all aspects of learning outcome assessment, an average score of 4.72 was obtained which shows that all aspects are in the category of "very valid" so that this instrument can be used as a measurement tool for learning outcomes to determine the effectiveness of the practicum guide developed.

Conclusion

The inquiry-based practicum guide in the Molecular Genetics course developed refers to the ADDIE development model, these are; Analyze, Design, Develop, Implement, and Evaluate. This research only reaches the development stage. The results of the product validity test, student questionnaire, lecturer questionnaire, and product implementation show that the practicum guide is in the category of "highly valid" or can be implemented in the learning process.

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