



Development of Biology Practicum Guide to the Concept of the Digestive System in Developing Critical Thinking Students'

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Abstract

The aim of the study is to develop a biology practicum guide on the concept of the digestive system to develop students' critical thinking skills, to determine eligibility, and to determine student responses to the biology practicum guide. The research method is the research and development (R&D) method by using the Sugiyono model. The research was conducted in October 2021 at SMAN 2 Serang City. The population in the study was 10 students from class XI SMAN 2 at Serang City High School, school year 2021/2022. Data retrieval and collection techniques are carried out by spreading questionnaires and interviews, while data analysis techniques using guttman scales and likert scales are used to test the feasibility of the biology practical guides that have been created. The validity assessment from the material expert for the Biology Practicum Guide received a score of 85% and the score from the media expert got a score of 86%. Both values are very feasible in the category. The result of the students' response test was a 98.6% score, which was very feasible in the category. Thus, it can be concluded that the Biology Practicum Guide on the concept of the digestive system was very feasible to use to develop critical thinking skills in students.

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INTRODUCTION

Education is an important aspect to increase resources qualified human beings and able to build a better society. Education in Indonesia is still dominated by the view that knowledge as a set of facts to be memorized. The learning process is still focuses on the teacher as the main source of knowledge using the method lecture. This is not in accordance with the demands of the 2013 curriculum, which carried out must involve students more, so that students are actively involved in learning process.

Biological learning is a vehicle to increase knowledge, skills of attitude and values as well as responsibility to the environment. Biology related by finding out about nature systematically, so that biological learning not only the mastery of knowledge groups in the form of facts, concepts or principles only, but it is also a process of investigation and discovery. Hamidah (2014) stated that in learning biology in schools, including at the High School (SMA) level, it is carried out through the process of direct investigation and practice of certain or general subject matter known as practicum activities, even one of the requirements in learning biology in school is a practical activity.

Practicum is a learning activity that aims to present subjects to students in conducting experiments by experiencing and proving something learned (Ennis, 2011). The

implementation of the practicum focuses on developing certain skills, namely process skills, motor skills and the formation of scientific attitudes, both individually and in groups (Hyytinen *et al.*, 2009). The implementation of biology practicum requires a special place, namely a laboratory and special learning resources for optimizing the process and results of practicum learning in the form of a practicum guide. The practicum guide is a learning resource that is devoted to supporting the practicum learning process by prioritizing students' independence in exploring their understanding of the material they have learned during theoretical learning in class through direct practice.

Based on the results of the interview on the analysis of needs at SMA High School 2 City Serang falls into the category of being understood with a percentage of approximately 50%. However, in the practice used very minimal and inadequate, as well as the difficulty of the teacher board to explain other biological materials, seeing the development of technology and the circumstances of the pandemic that is being hit, the biology practicum manual which is not owned by SMA Negeri 2 Kota Serang is the basis for conducting research and development (*research and design*) to produce a product for developing a practicum guide with the hope that biology practicum activities will be more optimal. The hope is that there is the development of biology practicum guide based critical thinking that can facilitate practicum, support students in getting learning resources and improve critical thinking skills said biology teacher at SMA 2 City High School.

As explained above, this research aims to develop in of Development of Biology Practicum Guide to on the concept of the Digestive System in Developing Critical Thinking Student's. Many previous studies have discussed the development of biology practicum guide learning media on digestive system subject matter. However, the difference is that this development research is based on critical thinking, which is being hotly discussed in 21st century education. So that the material content in the biology practicum guide will prioritize critical thinking, which is combined with high school biology and practicum activity learning. More clearly, the difference between this study and other studies, namely, (Mislia, Qurbaniah, & Kahar, 2017). With the title development of guided inquiry-based biology practicum instructions on the material of the digestive system. the difference is that it is based on a critical thinking, print media and the material discussed is different.

This study seeks to develop learning media in the form of biology practicum guide to on the concept of the digestive system in developing critical thinking student's. The developed learning media is expected to educate students in learning activity practicum in high school. In addition, through this research, it is hoped that teachers can take advantage of the technology and facilities available at SMA 2 City Serang. Based on this, this study raised the title "Development of Biology Practicum Guide to on the concept of the Digestive System in Developing Critical Thinking Student's".

METHODS

This research was conducted in October 2021 at SMA 2 city serang. The subjects of this study were obtained based on data sources from small group trials, 10 students of class XI SMA 2 city serang, with 5 male students and 5 female students. The selection of the number of students was based on Arikunto (2012) opinion that the number of respondents for small group trials was between 4-14 people. The subject of this study is high school level XI students who follow the subjects of digestive system, data collection techniques used in this study, namely by document collection, interviews and observation results. This research is a type of research and development research and development (R&D), Research is used to produce a particular product and test the feasibility of a particular product using a development Borg and Gall (2003) research model modified by Sugiyono (2014), namely

problem analysis, material collection, product design, expert testing, limited trials, design revisions, usage trials, product revisions. The reasons for choosing the development model include: (a). This development model is specifically used for book development and for learning development (b). This development model is arranged sequentially and produce innovation and improvement products that change quality for the better. Based on suggestions and input from supervisors 1 and 2, this research was carried out only until the product revisions stage because for the undergraduate level the final product stage had to be carried out for a long time, it was also strengthened by Purwanto & Sasmita (2013) research which carried out research up to the revision product stage of his research with the title Development of a Biology Practicum Guidebook for Class XI Based on Guided Inquiry.

The instruments used research are instruments in the form of questionnaires addressed to learners to find out the respons dan needs of learners in learning, especially in practical activities and interviews to educators to find out the suitability of the use of in Biology Practicum Guide in high school students in class XI at SMA 2 City Serang High School, The validators involved in this research are 2 validators, namely 1 lecturer as a material expert test and 1 lecturer as a media expert test, then after the product is finished it will be tested by material expert validators and media expert validators with material expert qualifications from biology education lecturers and educational qualifications S2, Material expert validator assessed by Mr. Usman, M.Pd, and media expert validator from science education lecturer and qualified S2, Media expert validator assessed by Mr. Adi Nestiadi, M.Pd The instrument in this study used a material validation instrument covering aspects content, aspects of presentation, of language aspects, and aspects of critical thinking skills and media expert validation instruments consisting of book size aspects, design book aspects, content design aspects.

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The data processing techniques in this study use descriptive analysis techniques. Which provides a description of an object studied through existing sample or population data, processing data used in percentage form with the formula used, namely:

Information:

NP = Percentage number

R = score obtained

SM = expected maximum score

Then the instrument assessment is carried out by the validation of media experts and material experts, using the likert scale, the likert scale used is that we can see in table 2.1 below.

Table 2.1 Likert scale

Category	Value	Score
SB	Very good	3
B	Good	2
C	Enough	1

(Sugiyono, 2014 dengan modifikasi)

Then the students' responses to the biologi practicum guide were tested by students using a questionnaire instrument with a guttman scale with the following criteria:

Table 2.2 Scoring Respon Criteria

Alternative answer	Score
No	0
Yes	1

(Riduwan, 2010)

The results of the questionnaire data obtained are then presented using the interpretation criteria scale in table 2.3.

Table 2.3 Interpretation Scale

Percentage of Achievement	(%) Interpretation
0% - 20%	Tidak layak
21% - 40%	Kurang layak
41% - 60%	Cukup layak
61% - 80%	Layak
81% - 100%	Sangat layak

(Riduwan, 2010)

RESULTS AND DISCUSSION

A. Material expert validation results

Expert validation of material is intended to test the feasibility in terms of media from the biology practicum guide that has been made: the assessment of the material validator includes aspects content, aspects of presentation, of language aspects, and aspects of critical thinking skills with the following assessment details.

Table 3.1 Assessment of Expert Validator Material

No	Aspects	Number of values	Max score	%	Criterion
1	Content	57	72	79%	Decent
2	Presentation	65	72	90%	Very Decent
3	Language	59	66	89%	Very Decent
4	Critical Thinking	73	90	81%	Very Decent
Total Number		254			
Maximum score		300			

Percentage	85%
Criterion	Very Decent

Scale interprets of material expert tests:

- NP : $254/300 \times 100\%$
- : $0.85 \times 100\%$
- : 85%

Based on table 3.1, values are obtained for each aspect, namely aspects of content with a percentage of 79% with decent criteria, aspects of presentation coverage of 90% with very decent criteria, aspects of language with a value of 89% with very decent and aspects critical thinking with a value of 81% with very decent criteria. The presentation of material validation results is spelled out through the following graph:

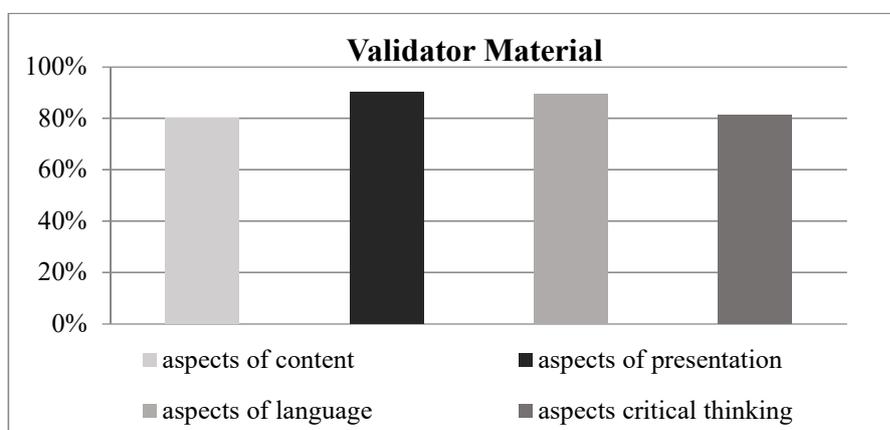


Figure 3.1 Graphs of Material Validator Results

From figure 3.1, it is known that the biology practicum guide in terms of material and aspects that are considered to meet the criteria is very decent. So that it can be tested to students with suggestions must be improved in advance biology practicum guide according to the repair advice submitted by the validator. The suggestions for improvement are given as follows:

Table 3.2 Improvements to Material Expert Validators

Repair Section	Repair Suggestions
Instructions for use guide practicum	1. The add of critical thinking indicators
Concept map	2. The addition of a concept map is a concept section that contains the content of the material, each section must be given a conjunction to explain the sub-topics of the material
Material	3. Content a book add word search game 4. The add articles in practicum activity
Language	5. The add use of communicative words in the bioinfo section of critical thinking skills 6. The question sentences are better related to practicum activity material

The appearance of the repair section on the biology practicum guide can be seen together as follows:

1. Revision 1

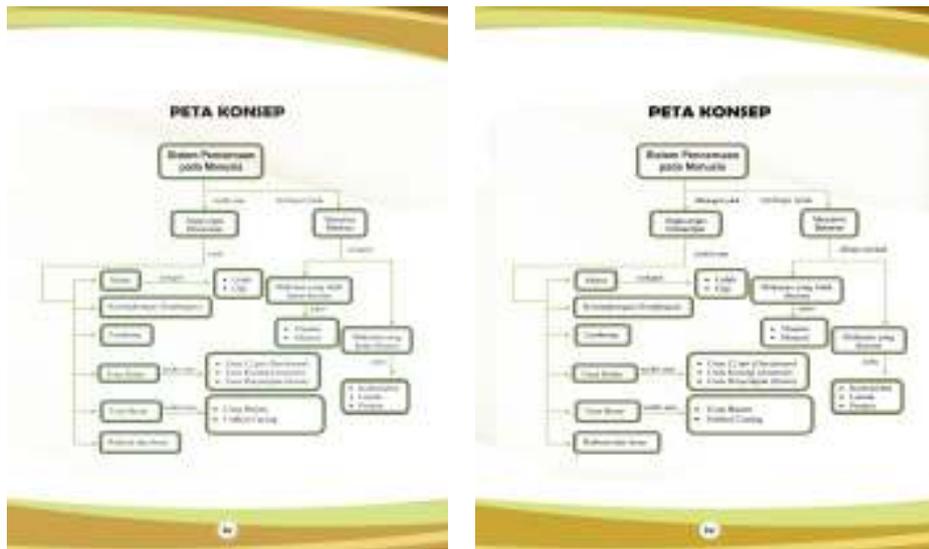


Before revision

After revision

Figure 3.2 Improvement of Material Expert Validator

2. Revision 2



Before revision

After revision

Figure 3.3 Improvements to the Material Expert Validator

3. Revision 3



Before revision After revision
Figure 3.4 Improvements to the Material Expert Validator

4. Revision 4



Before revision After revision
Figure 3.5 Improvements to the Material Expert Validator

5. Revision 5



Before revision

After revision

Figure 3.6 Improvements to the Material Expert Validator

6. Revision 6



Before revision

After revision

Figure 3.7 Improvements to the Material Expert Validator

The results of the validator's suggestions explain that researchers must improve the media before testing it on students.

B. Media Expert Validation Results

Expert media validation is intended to test the feasibility in terms of media from biology practicum guide that has been made, the assessment of media validators consisting of book size aspects, design book aspects, content design aspects with the following assessment details:

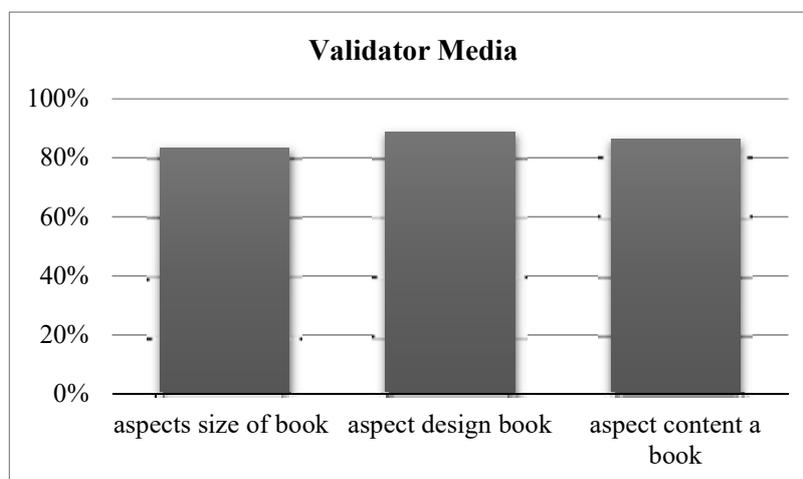
Table 3.3 Assessment of Expert Validator Media

No	Aspects	Number of values	Max score	%	Criterion
1	Size of book	15	18	83%	Very Decent
2	Design book	16	18	89%	Very Decent
3	Content	83	96	86%	Very Decent
Total Number		114			
Maximum score		132			
Percentage		86%			
Criterion		Very Decent			

Scale interprets of material expert tests:

NP : $114/132 \times 100\%$
 : $0.86 \times 100\%$
 : 86%

Based on table 3.3, the value for each aspect is obtained, namely the of book size aspects with a percentage of 83% with very decent criteria, the design book aspect of 89% with very decent criteria and aspect content a book with a value of 86% with very decent criteria. The presentation of media validation results is spelled out through the following graph:

**Figure 3.8 Graphs of Media Validator Results**

From figure 3.8, it is known that the biology practicum guide in terms of media and aspects that are considered to meet the criteria is very decent. So that it can be tested to students with suggestions must be improved in advance biology practicum guide according to the repair advice submitted by the validator. The suggestions for improvement are given as follows:

Table 3.4 Improvements to Media Expert Validators

Repair Section	Repair Suggestions
Design Cover	DNA images and microscope tools are converted into practicum materials and practicum activities Changes in critical thinking skills sentence at the top Add the author's full name dospem1, dospem2 and penguji
Description of biology practicum guide	Incomplete a book identity, font, page, etc.

The appearance of the repair section on the biology practicum guide can be seen together as follows:

1. Revision 1



Before revision

After revision

Figure 3.9 Improvements to the Media Expert Validator

2. Revision 2



Before revision

After revision

Figure 3.10 Improvements to the Media Expert Validator

The results of the validator's suggestions explain that researchers must improve the biology practicum guide before testing it on students.

C. Test the Response of students

The response test for biology students is a limited, intended to find out the responses from students about biology practicum guide that has been made to the Biology 10 students, namely 5 female students and 5 male students, to find out the attractiveness response students on the biology practicum guide that has been made, the student attractiveness test assessment is carried out on Tuesday 4 - 8 October 2021 face-to-face directly at school. Based on the results of the student respon test of 10 students of class XI obtained a percentage of 98,6 %, with the following calculations.

Scale interprets of student response tests:

NP : $296/300 \times 100\%$
 : 0,98/10 People
 : 98,6%

The respon stage in the study resulted in the assessment of limited test was conducted to 10 learners at High School 2 city serang to find out the student's study of biology practicum guidethat had been made. After the learners read and learn the biology practicum guide that has been made. The student then fills out the assessment sheet on the Instrument that has been shared with existing statements the results of the instrument are described as follows:

Table 3.5 Assessment of students Response Test

No	Aspects	Number of values	Max score	%	Criterion
1	Design	30	30	100%	Very Decent
2	Content	130	130	100%	Very Decent
4	Critical Thinking	136	140	97%	Very Decent
Total Number		254			
Maximum score		300			
Percentage		98,6%			
Criterion		Very Decent			

Data Source: Processed from Questionnaire Results Value of students SMA 2 city serang

The results of the analysis in table 3.5 obtained the results of the student response test with an assessment of 100%, with the very good criteria of the biology practicum guide has a very decent category, so it can be used as a biologic in High School 2 city serang Class XI, while the assessment is spelled out in graph form.

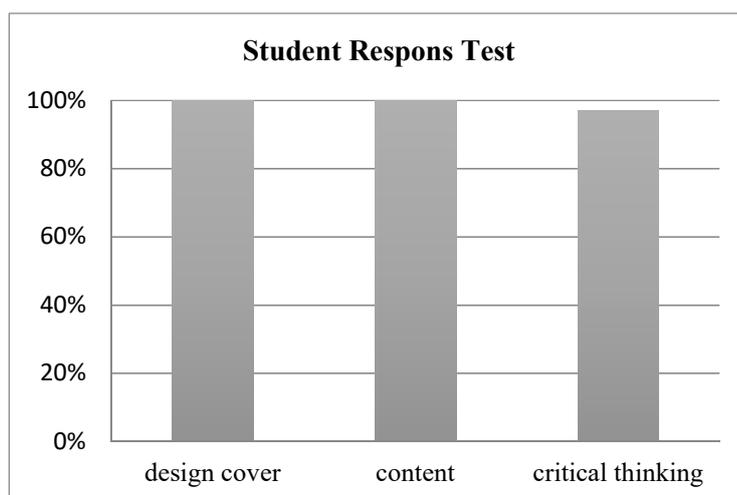


Figure 3.11 Graphs of Student Response Test Results

The development stage based on the evaluation results of material and media experts produces products that are suitable for use and then there will be limited tests to educators and 10 learners to find out the biology practicum guide response test that has been made, the results of the biology practicum guide obtained assessment with a percentage of 98,6% with very decent criteria. After conducting a limited test, it is known that biology practicum guide can be used as a learning device on digestive system materials for class XI SMA 2 city serang. The ministry of biology practicum of the digestive system for on critical thinking is with an interesting the preparation and appearance of many images so that it can facilitate in understanding the material. There is instructions for use of biology practicum that makes readers become more enthusiastic in reading biology practicum, as well as the application of critical thinking in case analysis and problems written based on problems in the the surrounding environment. Its use is easy and can be combined between text, and images so that it can make it easier for students to understand the practicum and not saturated or bored in following learning practicum.

Several biology practicum guide studies that have also been developed by Ruth (2019). With the title "Development of a biology practicum workbook based on guided inquiry for XI grade senior high school are concluded that (1). Development of a biology practicum workbook based on guided inquiry of design (various colors and interesting images). In terms of material, namely (clearer, accurate and detailed. Then in terms of language uses clear, straightforward, and easy to understand language). (2). Feasibility after being validated by validators from 2 expert teams, namely material experts: 84,5%, linguists 87.6% which means that biology practicum workbook based on guided inquiry media is "very feasible" to be developed. (3). Responses of biology practicum guide by students obtained the percentage of 93%. Which states "very decent"? Thus, student responses stated that biology practicum guide could attract students' attention and interest in learning to increase, the use of language was simpler, easier to understand and improve students' critical thinking skills (Rahmawati et al., 2016).

Biology practicum guide digestive system have several advantages including:

1. This biologi practicum guide is published in mold, making it easier for students to use it anywhere and anytime.
2. This biologi practicum guide are accompanied by picture, practical steps, and visuals to make it easier for students to understand the material.

3. This Biologi practicum guide is prepared based on problems in the community and how to solve them according to the problem solving stages and strengthened by expert opinions regarding the discussion of these problems, making it easier for students to understand the material.

CONCLUSION

Based on the results of the data analysis it can be concluded that:

1. Based on the expert test of media and material used a variety of biological practicum guide composed of picture, instructions for use, practice rules, material summaries and exercises on critical thinking is easy to understand clearly and includes practicum procedure information.
2. Media validation results obtained a value of 85% which belongs to the category of very decent and expert test material obtained a value of 86% which falls into the category of very feasible, based on biologi practicum guide data of critical thinking worth using.
3. Based on the response student with a score of 98,6% with very good criteria, based on the results of the data obtained it can be concluded that the biologi practicum guide of critical thinking is suitable for use in the biological learning process in school, and interesting so that it can help students in learning.

SUGGESTION

1. For educators
Hopefully this biology practicum guide can be used in schools in need, especially at SMA 2 City Serang.
2. For Students
Hopefully it can be used to increase knowledge and improve skill.
3. For researchers
 - a) The development of other biology practicum guide materials so as to enrich science.
 - b) It is hoped that there will be widespread publication of biology practicum guide critical thinking for the other school.

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REFERENCES

- Arikunto, S. (2012). *Dasar-Dasar Evaluasi Pendidikan Edisi 2*, Jakarta: Bumi Aksara.
- Borg, W. R. & Gall, M. D. (2003). *Educational research: an introduction 4th Edition*. New York: Longman Inc.
- Ennis, R. (2011). The Nature of Critical Thinking Disposition and Abilities. Diakses dari https://education.illinois.edu/docs/default-source/faculty_documents/robert-ennis/thenatureofcriticalthinking_51711_000.pdf, Pada tanggal 15 Desember 2021, pk 9.47.
- Hamidah, A., E. N. Sari & R. S. Budianingsih. (2014). "Persepsi Siswa Tentang Kegiatan Praktikum Biologi di Laboratorium SMA N Se-Kota Jambi". *Jurnal Sainmatika*, 1(8), 49-59.
- Hyytinen, H., Nissinen, K., Ursin, J., Toom, A., & Lindblom-Ylännö, S. (2015). "Problematising the equivalence of the test results of performance-based critical thinking tests for undergraduate students". *Studies in Educational Evaluation*, 4 (44) 1-8.
- Misliä, M. Qurbaniah & A. P. Kahar. (2017). "Pengembangan Petunjuk Praktikum Biologi Berbasis Inkuiri Terbimbing Pada Materi Sistem Pencernaan". *Jurnal Bioeducation*, 1 (4), 13-17.
- Purwanto, A. & R. Sasmita. (2013). "Pembelajaran Fisika Dengan Menerapkan Model Inkuiri Terbimbing Dalam Menumbuhkan Kemampuan Berfikir Logis Siswa di SMA Negeri 8 Bengkulu". *Jurnal Unnes Science Education*, 2 (1), 14.
- Rahmawati, I., Arif H., & Sri R. (2016). "Analisis Keterampilan Berpikir Kritis Siswa SMP Pada Materi Gaya dan Penerapannya". *Pros. Semnas Pend. IPA Pascasarjana UM*. 1, ISBN: 978-602-9288-21-2.
- Ruth Asgen, S., P. (2019). "Pengembangan Buku Panduan Praktikum Biologi SMA Kelas XII Berbasis Inkuiri Terbimbing." *Jurnal Pendidikan Dan Pembelajaran Kimia* 7(1), 129-141.
- Riduwan. (2010). *Skala Pengukuran Variabel – Variabel Penelitian*. Bandung: Alfabeta.
- Sugiyono. (2014). *Metode penelitian kuantitatif dan R & D*. Bandung: Alfabeta.