



THE VALIDITY OF FLOWCHART-BASED MICROBIOLOGY PRACTICUM HANDBOOK FOR THE BIOLOGY STUDENTS OF FKIP ULM

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Abstract:

Microbiology is a branch of biology which studies about small microorganisms. Its practicum aims to support the learning materials, give the experiences and the basic skills of the students in the field of microbiology, especially the practicum itself. Before doing the practicum, the students have to master the easily understood working procedure in doing the practicum which is the flowchart-based working procedure. Because the problems that acquired by the researcher in the field are based on the observations and interviews with the practitioners, the working procedures are still in form of the description (the explanations of the procedure are in form of words and points) which are not making practicum becomes easier. This development research aims to describe the validity of a flowchart-based microbiology practicum handbook (the handbook). The method used in this research is Tessmer Model, but only until the stage of one-to-one (individual test/legibility). The result shows that the flowchart-based microbiology practicum handbook achieves the criteria of very valid based on the three experts with the average percentage of 84,55%. Meanwhile, the individual test of this book achieves the good criteria with the average percentage of 70,31%, so this book for the students of biology education at the Faculty of Teacher and Training Education in Lambung Mangkurat University Banjarmasin is reasonable to be tested to the next stage so it can be used on the learning process on the microbiology practicum, and make the students become easier in doing biology practicum.

Keywords: practicum handbook, microbiology, flowchart

1. Introduction

Microbiology is a branch of biology which studies microorganisms. The practicum of biology is given to support directly the learning materials in the lectures and give the

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experiences and basic skills for the students about basic techniques which are widely used in microbiology. Before doing microbiology practicum, the students have to master the working procedures of the practicum topic so it can make them easier to do it (Prayitno, 2017). Easy-to-understand practicum working procedure means practical and effective working procedure. The basic techniques of microbiology include the skills of using the tools, sterilization techniques, transfer techniques and aseptic microbial isolation, and painting technique. Those techniques are basic techniques which are widely used in microbiology practicum so the students are expected to achieve enough experiences and skills.

The existence of a microbiology laboratory in the science learning process is very important. The laboratory is the facility where the students can sharpen their skills in doing practice, demonstration, experiment, research, and developing the science. It is the place for them to implement the theories given in the classes by their lecturers so they have a deeper understanding towards the materials they have learned (Mustaji, 2009). The laboratory here is not only about a room or building used for the scientific experiments, for example in the science are: biology, microbiology, chemistry, physics, engineering, and so on; but also, the scientific activities places like the experiment, research, observation, demonstration that related to the learning activities.

The obstacles which are usually faced by the laboratory are the limited number and the complete equipment, the limited number of chemical materials because of the expensive price of microbiology materials. Other obstacles are the uneven skills of the students in using the equipment. One way to solve the issue and to improve the practicum effectiveness is by using some media in form of microbiology handbook (Prayitno, 2017).

The problem found by the researches in the field according to observation and researchers interview with the practitioners and their assistants is the practicum guidance which the working procedure is still in form of the description (the procedure explanation is in form of words and points) so it makes the practitioner a little bit confused and feel the difficulty in doing microbiology practicum. Meanwhile, the assistant also faced the same difficulty in explaining the working procedure which still in form of description, because it has to be very clear in explaining the description to the practitioner, a little less clear in explaining it will make the practitioner confuse in doing the practicum. This activity is also very important in microbiology learning because it gives the mastery through 'minds on' and 'hands-on' to the students. The solution of these issues is the necessity to develop the microbiology practicum guidance that based on flowchart so it makes the students easier to do the microbiology practicum. According to Kilinc (2007), practicum guidance is the facility given to the lecturers so the students can learn and work continually and guided.

The education field realizes that it needs something to connect the theory and practice which tend to be integrative, where theory and practice alternately and gradually filling each other, looking to each other base, and studying each other. According to the relations between theory and practice, the laboratory and other facilities in the learning process need attention (Mustaji, 2009). The existence of

microbiology practicum guidance can bridge the theory and practicum of microbiology. The most appropriate learning to be implemented is the learning through experiment. A way to improve the microbiology practicum guidance book is by developing a practical and effective book to do updates and provides to it.

The practicum guidance is a book that contains the topic, goals, basic theories, equipment and materials, procedures, observation worksheet, students' worksheet, and evaluation questions of the practicum, which is made according to the practicum goal (Musyarofah, 2006). Kilinc (2007) added that the guidance is the facility given by the lecturer so the students can learn and do it continually and guided (Arifah *et al*, 2014).

The expected competence after following microbiology practicum is the students understand about the flowchart-based working procedure before mastering microbiology practicum basic techniques. The importance of practicum guidance in the learning process is shown by Arifah *et al* (2014) which is the development of guided inquiry-based practicum guidance book optimized enough students' hands on. Muhajir (2005) in his research added that the biotechnology practicum guidance of 12th science class from Senior High School 1 Binamu, Jeneponto Regency which has been developed is stated to fulfill the criteria of validity, practicality, and effectivity so it helps the learning process. Based on existing research, so it is developed the learning resources in the form of flowchart-based microbiology practicum guidance book. It is expected that it can make the students become easier in the microbiology practicum at biology laboratory at the Faculty of Teacher and Training Education in Lambung Mangkurat University Banjarmasin.

2. Material and Methods

The type of this research is Research and Development (R&D). This research develops flowchart-based microbiology practicum handbook (the handbook) which is done through five stages using Tessmer Model (1998) that consists of 1) self-evaluation, 2) expert review, 3) one-to-one, 4) small group, and 5) field test. This development research only uses the model until stage 3 (one-to-one) (validity).

The stage of self-evaluation is a step used to study towards the analysis context, literature review, and the development of conceptual framework or theoretic. The activities on this stage are done through collecting information from the students who take microbiology class and follow its practicum to study the standard of competency of microbiology practicum at the Biology Education at the Faculty of Teacher and Training Education in Lambung Mangkurat University Banjarmasin. It is continued by studying towards the common issues on microbiology practicum, particularly on its working steps which still in form of descriptions. The next step is finding the solutions of the issues according to observation by the researchers.

According to the analysis of the problems, the best solution which can be done is by developing the flowchart-based microbiology practicum handbook. Before entering the developing stage, it passes through the preliminary research which aims to get the data of the problems and give the right solutions to the handbook development.

The handbook development is validated by three validators from the experts who are the lecturers of Master of Biology Education at the Faculty of Teacher and Training Education in Lambung Mangkurat University Banjarmasin. Meanwhile, the one-to-one test is done by three students of Biology Education at the Faculty of Teacher and Training Education who take microbiology practicum.

The result of validation to the handbook is analyzed through these steps:

- a. Determining the score from the experts using mean
- b. Calculating the means of all validation scores by the experts as follows:

$$X = \frac{\sum X}{n} \times 100\%$$

Notes:

X: Mean

$\sum X$: Total score of all validators

N: The numbers of validators

- c. The validation result which is known from the percentage can be matched with the validity criteria as follows:

Table 1: Validity Criteria

Percentage	Category	Notes
80,1 – 100%	Very valid	No revision needed
60,1 – 80%	Valid	Minor revision
40,1 – 60%	Quite valid	Minor revision
20,1 – 40%	Less valid	Major revision
0,0 – 20%	Not valid	Total revision

Source: Sugiyono, 2010

The one-to-one result towards the handbook is analyzed through these steps:

- a. The data is received from the students through the legibility sheet of the handbook, then, the data is analyzed using the formula:

$$\text{Percentage} = \frac{\text{Total Score}}{\text{Total Number}} \times 100\%$$

- b. The received students' legibility then being converted according to the criteria:

Table 2: The Validity Percentage Criteria

Percentage	Criteria
80,1%-100%	Very Good
60,1%-80%	Good
40,1%-60%	Average
20,1%-40%	Not Good
0,0%-20%	Very Not Good

Source: Sugiyono (2010)

3. Results and Discussion

The validity of the handbook is achieved on the stage of expert review which is done by doing validation of the Flowchart-based Microbiology Practicum Handbook using prepared validation format. This validation process is done by experts who have competences on microbiology, teaching capability, following scientific development, designing practicum learning, and producing the set of learning towards 22 indicators of scoring, for example, the cover of the handbook shows the taught materials. It does not use a lot of letter combinations so it can be easily read. The font size of the title and its position on the cover already fit perfectly. The physical appearance of the handbook can attract the students' attention. The components of the handbook are complete. The use of font variation for the content is not excessive and can be read. The language used is right according to the grammar rules, e.g. spelling. The word selection in the sentence does not cause ambiguity, makes it a clear sentence. It has presented the problem columns in the handbook to determine the hypothesis according to inquiry model steps. The explanation of the activities concepts in the handbook is already fitted with the students' level of knowledge. The practicum activities in the handbook already achieve the practicum goals. The use of the handbook is in line with the semester learning plan. The depth of the material in the handbook is in line with the students' level of thinking. The practicum in the handbook is easy to be implemented, in line with the time allocation, and creating a direct experience. The selected practicum activities are in line with the inquiry model. The presented working steps can be done in sequence and correctly. The steps in the flowchart are in line with the microbiology practicum; make the practitioners become easier in doing the practicum. The handbook is clear and systematic.

3.1 The Experts' Validation

The experts' validation is done by three validators of lecturers of Master of Biology Education at the Faculty of Teacher and Training Education in Lambung Mangkurat University Banjarmasin which aims to determine the validity of the handbook from the expert perspectives towards several aspects written in the validation sheet. This is in line with Sugiyono (2015) who stated that the valid data means it can be used to measure what should be measured. Thus, it can be categorized very well and proper to make practicum activities easier. This is also in line with Rustaman (2003) who stated that practicum handbook is one of the needed tools to smoothen the learning activities

in the laboratory so the practicum goals can be achieved and reducing the accident risks.

The experts' validation result toward the handbook can be seen on the table 3:

Table 3: The Validation Result of the Handbook

No	Aspects/Indicators	Average Score
1	The cover background of the handbook presents the content /materials	4,33
2	The cover of the handbook does not use too much letter combination so it can be easily read	4,67
3	The font size and its placement on the cover is already correct	5
4	The overall physical appearance of the handbook can attract the students' attention	4,67
5	The components in the handbook is already complete	4
6	The use of letter variation for the content in the handbook is not excessive and easy to read	4,67
7	The language used in the handbook is communicative and interactive	4
8	The use of language in the handbook is according to the grammar rules	4
9	The word selection in the sentences is not ambiguous so it is clear	4
10	The problem column is presented in the handbook to determine the hypothesis according to the steps on inquiry model	3,33
11	The explanation of activities concept in the handbook is in line with the students' level of knowledge	4,33
12	The practicum activities in the handbook achieve the learning goals	4,33
13	The use of the handbook is in line with the semester learning plan	3,67
14	The depth of the material in the handbook is in line with the students' maturity of thinking	4,67
15	The practicum in the handbook is easy to be implemented	4,33
16	The practicum activities in the handbook is in line with the practicum time allocation	3,67
17	The practicum activities in the handbook create direct experiences	4,33
18	The selected practicum activities in the handbook is in line with the inquiry model	3,67
19	The working steps presented in the handbook can be done in sequence and correctly	4
20	The steps of the flowchart is in line with the microbiology practicum steps	4,33
21	The steps of the flowchart make the practitioner becomes easier to do practicum	4,67
22	The handbook is clear and systemic	4,33
Total Score		93
Average		4,23
Percentage (%)		84,50
Category		Very Valid

Source: Processed data

According to Table 3, the handbook validity result by three validators shows the score of 4,23 which is categorized as good. According to Picture 1 below, it can be seen that the handbook average result is 83,33%. It means that the developed handbook is categorized as very valid, thus this book can be used in the practicum.

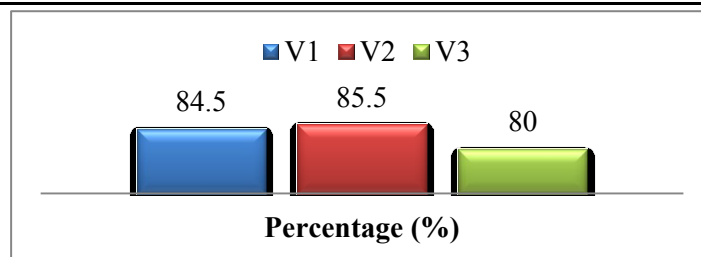


Figure 1: The Result of Percentage Graphic of the Handbook

The importance of the handbook is to activate the students and help to develop their skill through the developed handbook. This is in line with Savitri (2008) who stated that the goal of the handbook development has to include several things in order to activate the students so they not only receive theoretical knowledge but also able to manage their source of knowledge and their learning skills and helping them to develop their process skills through activities in the handbook. The comments or the weakness of the book had been revised. A good handbook, specifically this handbook, has to pay attention to the expert review from the three validators. The validity of the lesson set had been achieved, which is in line with the previous research (Akker et al, 2007). He explains that the validity as one of the high-quality interventions before analyzing the practicality and effectivity.

The validity result on this aspect received the criteria of very valid (can be used without any revision), which means that this handbook fulfills the requirements to be read by the students based on the age or the education. This match will make the students become easier to understand the materials in the handbook, which will improve their interests to the practicum that will lead to their score improvement on microbiology practicum and train the students' science process skill.

3.2 One-to-One

One-to-one test or legibility test is done by three students of Biology Education on Faculty of Teacher and Training Education ULM Banjarmasin who take microbiology practicum. The appointment to the students is done by the researchers based on their skills, knowledge, interest, representative, and independence. This test aims to get the scores given by the students who is the user of the handbook. The scoring is done through three aspects: the display, the material presentation, and the language aspect. This is according to Akbar (2013) who stated that the one-to-one test or audience validation can be used to score a book, including this handbook. The result of the one-to-one test can be seen in Table 4:

Table 4: The Score of One-to-One Test/Legibility by the Students

No	Scoring Aspects	Number of Students				Score Total	Score
		SS	S	KS	TS		
1	Display Aspects						
	a. The content is interesting	0	3	0		9	75
	b. The display is interesting	1	1	1		9	75

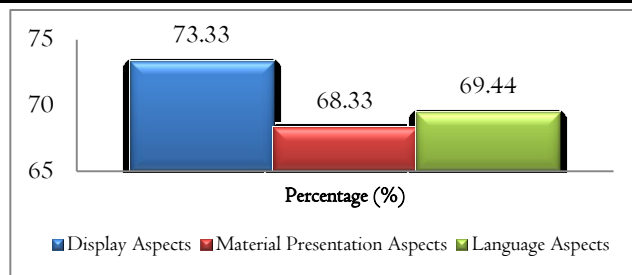
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No	Scoring Aspects	Number of Students				Score Total	Score
		SS	S	KS	TS		
c.	The pictures are clear and not blurred	0	1	2		7	58,33
d.	The information on each picture is in line with the presented picture	1	2	0		10	83,33
e.	The presented tables are clear and easy to read	1	1	1		9	75
2.	Material Presentation Aspects						
a.	The materials are presented are coherent and logical	1	2	0		10	83,33
b.	There are initial explanations before the material explanations	0	2	1		8	75
c.	There are material explanations to enrich the concepts	0	3	0		9	75
		0	0	3		6	50
d.	There are info bio to enrich the knowledge	0	2	1		8	66,67
e.	There are feedback to help me to know the material mastery						
3.	Language Aspects						
a.	The language used is in line with the students' age level	2	1	0		11	91,67
b.	The terms used in the handbook are right and can be understood	0	1	2		7	58,33
c.	Using communicative language	0	3	0		9	75
d.	Using effective language	0	1	2		7	58,33
e.	The easiness to understand the sentences in the book	0	2	1		8	66,77
f.	The quotations include clear citations	0	2	1		8	66,77
	The Total Score					135	70,31
	Category					Good	

Source: Processed data

According to the table 4, it is achieved the average score of 70,31. Generally, the legibility test by the students to the handbook shows the good/agree category to the reading on the handbook. The students are interested to read and use the handbook so it makes them easier in doing microbiology practicum.

The picture 2 below, shows that the average percentage is 73,33% which is categorized as good. It means that the handbook has a good and interesting display. The average percentage 68,33% categorized as good enough believe that the handbook shows a clear and easy to understand material presentation. The average percentage of 69,44% which is categorized as good enough believe that the handbook using good enough and easy enough language to understand. From all three aspects, the material presentation aspect achieved the lowest result comparing to the other aspects. It might be because the students are a little bit confused in understanding the materials since there are new practicum materials, so they are not yet familiar with the materials in the handbook.



Picture 2: The Graphic of Percentage Average of the Legibility Test

The student legibility test to the handbook has three aspects: the display, the material, and the legibility. From the all three aspects which is done by three students achieve the total average percentage of 70,31% for all aspects who stated good and interesting because it makes the students easier in understanding the coherent and clear flowchart-based working procedures. Besides that, the presented flowchart pictures are suitable with the presented materials so it makes the students easier in understanding the materials. The easy to understand handbook will improve the students' learning results. Similar with the findings, a research by Nugrahani (2007) who stated the readability of the message of a writing give the influences towards the students' learning result while doing the practicum. According to Asyhar (2012), the pictures in form of flowcharts can be used as interpretation objects in the practicum which motivates the students in doing the practicum. The undecorated pictures also help the students to study as they should, which is to encourage the students to pay attention to the meanings of the pictures. This is relevant to the statements by Istiningrum *et al.*, (2016) who said that the content designs, pictures, and colors on the handbook have to be clear and attract the students' attention. This is assessed by the students on the legibility test of the aspect of display, material presentation, and language. According to the legibility test by the students, overall, the developed handbook can be understood based on the level of education and interesting for the students, so the developed handbook can be used for small tests to evaluate the use of the handbook. This is supported by the research done by Himala *et al.* (2016) that the legibility test result shows the readability that matches with the level, so the developed book can be used for the practicum activities.

According to the explained results of the one-to-one test, it can be known that the Flowchart-based Microbiology Practicum Handbook which is being developed is achieved the criteria of good agree which means this handbook is easy to understand and the materials are easy to implement to the real life of the students as the reader. This one-to-one test is very important to be done so the developed handbook correlates with the students or readers conditions who will use this handbook in the real practicum. This explanation is in line with Achyani (2016) who explains that the practicum process in the college should accommodate the condition around the students, and it is expected that the students can seek the answers of the reality. So, the practicum is not only memorizing the theories.

On the one-to-one test is also obtained several comments and suggestions from the students who take the microbiology practicum at the Biology Education at Faculty

of Teacher and Training Education in Lambung Mangkurat University Banjarmasin. Thus, the researchers feel the needs to do revisions based on the comments and suggestions from the students as the user of the handbook to make it better.

4. Conclusion

The practicum handbook for the students of biology education at the Faculty of Teacher and Training Education in Lambung Mangkurat University is reasonable to be tested to the next stage so it can be used on the learning process on the microbiology practicum, and make the students become easier in doing biology practicum.

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