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Developing Laboratory guidance of islamic science-integrated plant anatomy-physiology

Ahmad Ali[1*] Wiwin Pramita Arif[2]

[1] Department of Biology Education, Universitas Islam Negeri Alauddin, Indonesia.
[2] Department of Biology Education, Universitas Muslim Maros, Indonesia.

*Corresponding Author: ahmad.ali@uin-alauddin.ac.id

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ABSTRACT

The research aims to develop a valid, effective, and practice guidance for laboratory practice of Islamic science-integrated plant anatomy-physiology. The study was development research of Plomp development model. The study consisted of five phases, namely the preliminary investigation phase, design phase, realization or construction phase, test, evaluation, revision phase, and implementation phase. Devices developed were tested to students of Biology Education Department, Universitas Islam Negeri (UIN) Alauddin, Makassar in the Even Semester 2017/2018 Academic Year. The research results indicated that the laboratory guidance developed has met valid criteria with content validation. Average of practice criteria with device applicability lied in category of three, means that most of the devices were implemented. Effective criteria with 92% of students who performed the laboratory practice gave positive responses to the overall item being questioned, and 100% assistants provided positive response on 93.33% items asked.

INTRODUCTION

The vision of Biology Education Department, UIN Alauddin Makassar is to be superior in education, research, and community service fields integrates with science. The vision is the manifestation of UIN Alauddin Makassar's vision as a center of enlightenment and transformation of Islamic civilization-based science and technology (Ali, 2014; 2017). The vision is the implementation of the level of integration of science and technology and IMTAK, faith and piety (Minarno, 2011; Muspiroh, 2013; 2014; Amri, 2017). While, at the operational level to achieve the vision, it is necessity for Biology Education to integrate general sciences and Islamic science in every activities including classroom learning, administrative services as well as laboratory practice (Rahmania, Sartono, & Miarsyah, 2015; Hanif, Ibrohim, & Rohman, 2016; Khasanah, 2016).

The paradigm of scientific integration in UIN Alauddin Makassar is an integration between Islamic science and science and technology. Implementation strategies and curriculum policies encourage all lecturers to conduct research of 50% products per year in Islamic integration, sciences, technologies, and arts as well as seek for an integration of Islamic values in scientific studies conducted by lecturers in general faculties (Ali, 2014; 2017). This number is enough considering that there is no standard guideline for scientific integration established by UIN Alauddin Makassar or by the Ministry of Religion. Therefore, the application of scientific integration in the learning process can be initiated by compiling a textbook package that contains scientific integration between general and Islamic sciences (Rifai, Fauzan, & Bahrissalim, 2014; Hanif, et al., 2016; Khasanah, 2016; Amri, 2017).

Efforts to achieve the vision is reflected in curriculum review activities to re-examine courses according to Indonesion Qualification Framework (KKNI) (Mas'ud, 2014; Fadilah., Amin., & Lestari, 2016; Desy Setyoko, 2017; Istiana & Awaludin, 2018). Curriculum in Biology Education Department of UIN Alauddin Makassar requires students to program Plant Anatomy-Physiology Courses with 4 credits. The course consists of 3 credits of face to face meeting, which is equal to 3x50 minutes and 1 credit of laboratory practice (120 minutes) (Ali, 2014; 2017).

The scope of the Plant Anatomy-Physiology based on the Curriculum of the Biology Education Department of UIN Alauddin Makassar includes Plant Anatomy (the cell, meristematic tissue, permanent tissue, the stem, the root, the leaf, anatomy of floral parts, fruit and seed) (Pandey & Chadha, 1993; Nuraeni., Redjeki., & Rahmat, 2017). Furthermore, Plant Physiology includes photosynthesis, respiration, metabolism, mineral nutrition, hormones and growth regulators, transport of water and minerals, plant motion, and dormancy (Salisbury & Ross, 1992; Hasnunidah & Suwandi, 2011; Damopolii., Hasan., & Kandowangko, 2015). The course is a combination of plant anatomy course with 3 credits and plant physiology with 3 credits. This is due to the curriculum of UIN Alauddin Makassar in addition to compulsory courses, there are compulsory courses in the University which contain courses in Islamic studies, including the science of Fiqh, Hadith, and Al-Qur'an so that the burden of general courses must be reduced to avoid students' excess credits/semester. Therefore, The combination of the two courses call for some changes in all course devices including laboratory practice guidance.

Laboratory practice is a learning strategy that allows students to empirically practice, demonstrate and simulate cognitive, psychomotor, and affective abilities in simultaneous way using laboratory equipments (Suryanda, Rusdi, & Kusumawati, 2017; Sari., Haviz., & Afwadi, 2017; Mustami, 2017). Increased psychomotor attitude expects abilities in using tools, working attitudes, analyzing problems, arranging sequences Activities, reading skills and describing images and also doing an activity quickly (Lauren, Harahap, & Gultom, 2016; Ristanto, 2017). Laboratory practice is an integral part of learning activities (Susantini & Lisdiana, 2012; Sari, et al., 2017). Real experience provides learners for meaningful knowledge. Meaningful learning occurs when students build the knowledge and cognitive processes needed through learning experiences to solve problems (Mayer, 2002; Ristanto, Zubaidah, Amin, & Rohman, 2018). Students are able to associate the information they have with new knowledge obtained during practicum (Susantini & Lisdiana, 2012; Refirman, Hasanah, & Sartono, 2016; Sari, et al., 2017).

Laboratory practice experience causes students to be able to integrate knowlege obtained from books with real experience through laboratory practice (Silawati, 2006). In addition, development of competency, self-confidence, and socialization is obtained most from practicum (Tuli, 2009). It indicates the importance of laboratory practice to achieve learning objectives. The achievement of laboratory practice objectives should be supported by excellent and proven quality device. The device is laboratory guidance. The guidance is essential in laboratory practice implementation. According to Handayani, Farida, & Anhar (2014), laboratory practice guidance intends to assist and guide learners

to work continuously and directly. The guidance is used as a guide in laboratory practice work steps for students as well as assistants/lecturers.

Incorporation of plant anatomy courses with plant physiology was started in the even semester 2015/2016. Based on the result of evaluation on Plant Anatomy-Physiology laboratory practice implementation in even semester of the 2016/2017 academic year, some improvements were required, namely: (1) the available guidance still combined two courses, Plant Anatomy and Plant Physiology, without Islamic science integration content, (2) the numerous research procedures in the guidance for every topic caused the laboratory practice cannot be completed on time, (3) the implementation of the laboratory practice was sometimes not in accordance with the procedures, (4) students were struggling in finding materials for the laboratory practice due to many practical courses so students were unable to prepare all practice fresh samples (plants), (5) the laboratory practice report couldn't be completed on time due to the number of laboratory practice course in the ongoing semester, (6) limited availability of laboratory practice tools, and (7) a standard and valid laboratory practice assessment was not available thus the assessment was not objective and measured (Ali, 2017). So, Laboratory guidline that has the content of Islamic scientific integration and in a package with report was neded to be developed. In will help the student to write lab reports is efficiently. In addition, the laboratory procedures must be made simple with clear steps so that the process will run according to the correct procedure.

METHOD

Development Model

The research was a research and development. The research subject consisted of students from Biology Education Department, UIN Alauddin Makassar. Device developed was a laboratory practice guidance of Islamic Science-integrated Plant Anatomy and Physiology. The research used research and development model of Plomp consisted of five phases, namely: 1) Preliminary Investigation phase, 2) Design phase, 3) Realization/Construction phase, 4) test, evaluation, and revision phase, and 5) Implementation phase (Plomp, 2013). The Plomp model was chosen because each stage of development was easier to understand and implement. The development of laboratory practice guidance can be summarized in a flow as presented in Figure 1.

Research Subject

The guidance was tested to students in the fourth semester of the 2017/2018 academic year of 35 students and 5 laboratory practice assistants.

Instrumen

The research instruments consisted of validation sheet, device applicability sheet, assistant response questionnaire, and questionnaire for students who performed laboratory practice (hereafter called students). The things assessed include; guiding format, language, construction of guiding contents, student learning motivation, implementation of guidance, student interaction, and Islamic scientific integration, Where as in this study validation was conducted by 2 lecturers of Plant Anatomy-Physiology. The expert assessment was analyzed using Gregory's content validation, as follows. Gregory formula was chosen because in this research only used 2 validators.

Content Validity Coefficient = $\frac{D}{(A+B+C+D)}$

D = Number of question items where both experts agree.
A = Number of question items where both experts disagree.
B = Number of question items where assessor I agrees but assessor II disagrees.
C = Number of question items where assessor I disagrees but assessor II agrees.

(Gregory, 2004)

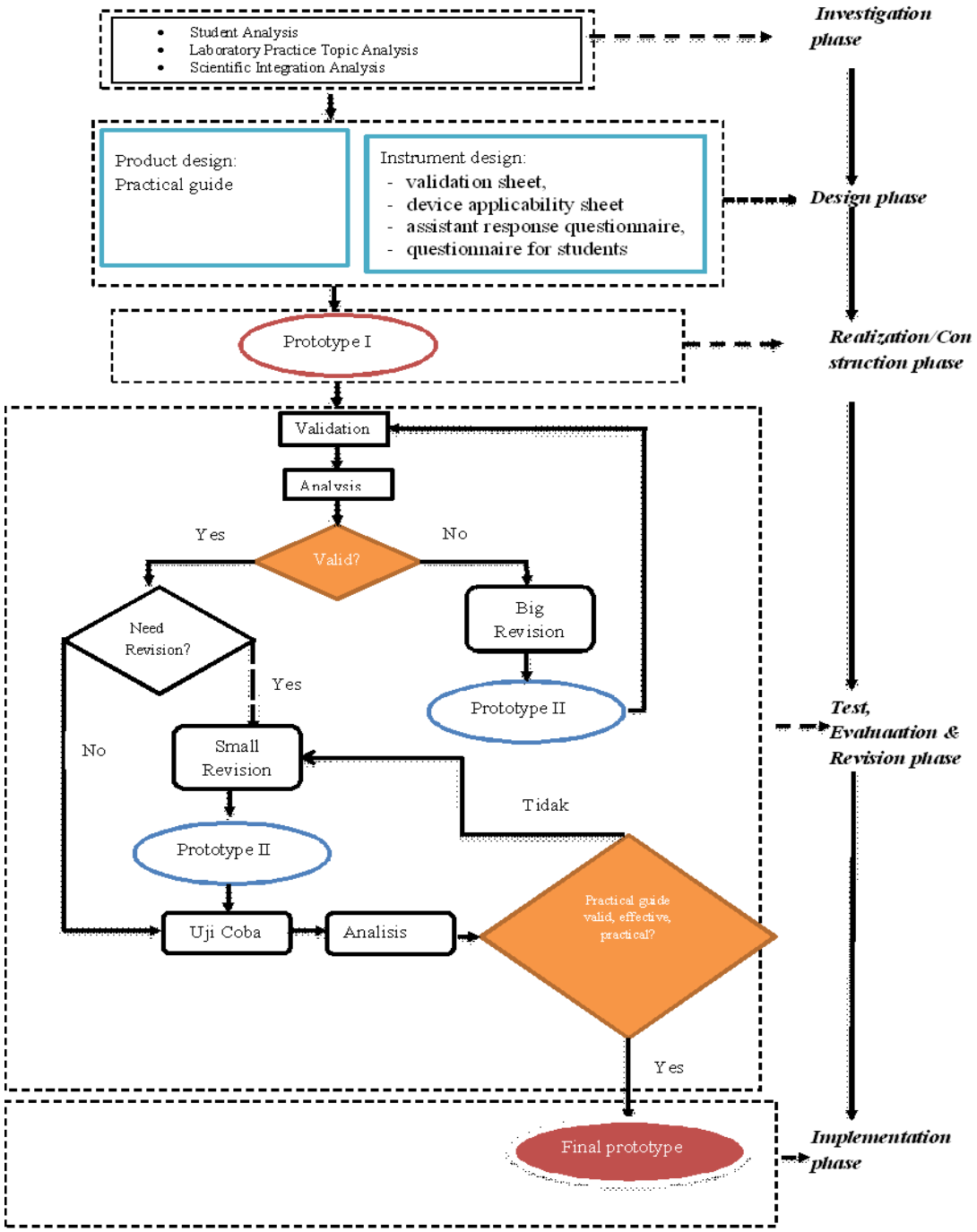

Figure 1. Flow of Plomp Model Modification Development.

Criteria to state that an assessment instrument has high validity level is when the assessment result from both validators has a strong relevance (3 or 4). If the validity score is high (75%) then it can be stated that the measurement or intervention conducted is valid. The device applicability sheet was given to observers to measure the device practicality. Based on the assessment result of the three observers, average T score was determined. T score was confirmed with intervals of assessment device applicability category:

$T \leq 1$ = Inapplicable
$1 < T \leq 2$ = Only small parts are applicable
$2 < T \leq 3$ = Most part are applicable
$3 < T \leq 4$ = All are applicable

Criteria used to decide whether or not the guidance has an adequate applicability was minimum T score is in the category of Most Part are Applicable. Effectiveness was measured by giving the response questionnaire to the assistants and students. Criteria set to determine that the students and assistants had positive response towards the assessment device was if 50% of them provide positive response on minimum 70% of aspect questioned.

RESULT AND DISCUSSION

Investigation Phase (*Preliminary Investigation*)

Student Analysis

Based on a study by Ali, (2017), there were some issues encountered by the students in the implementation of Plant Anatomy and Physiology laboratory practice. Those issues were: the numerous research procedures in the guidance for every topic caused the laboratory practice cannot be completed on time; the implementation of the laboratory practice was sometimes not in accordance with the procedures but as the assistants' instructions; students were struggling in finding materials for the laboratory practice; the laboratory practice report could not be completed on time; students were dissatisfied with the assessment given by the assistants since there were no standard and valid laboratory practice assessment available thus the assessment was not objective and measured.

Laboratory Practice Topic Analysis

In addition to analyze students' issues, the researcher also found issue in the laboratory practice implementation, as follows: the available guidance was still combined two courses, Plant Anatomy and Plant Physiology; some laboratory practice topics in the guidance could not be conducted since there were no equipment available; some laboratory practice topics were failed due to the less quality equipment; the laboratory practice topics required a series of difficult tools thus it took time for the laboratory practice and the tools were often failed to assemble.

Scientific Integration Analysis

Considering the vision and mission of Biology Education Department UIN Alauddin Makassar, the integration of Islamic science should be well implemented in classroom learning as well as in laboratory practice despite there was no standard of scientific integration guidelines (it was still a concept). Every learning activity, at minimum, should contain Islamic scientific integration content although it was merely quoting a theorem or hadits suitable with the learning topic. Based on the initial investigation, it was known that there was no single course has laboratory guindace applied with scientific integration in the Laboratory of Biology Education UIN Alauddin Makassar

Design Phase

Referring to the syllabus of Plant Anatomy and Physiology course, the laboratory practice guidance was compiled in IX topics or laboratory practice title as follows.

Chapter I : Ergastic Substances in Cells
Chapter II : Epidermal Tissues
Chapter III : Parenchyma, Collenchyma, and Sclerenchyma Tissues
Unit IV : Root, Stem, and Leaf Anatomy
Unit V : Water and Soil Relationship
Unit VI : Weight Loss during Respiration
Unit VII : Measurement of Plant Tissues' Water Potential
Unit VIII : Evaporation and Transpiration
Unit IX : Dormancy

Laboratory practice guidance developed should at least contain: 1) theoretical basis, 2) clear experiment objectives, 3) detail explanation on tools and materials used, 4) easy to implement activity

steps, and 5) laboratory practice-related questions to control students' knowledge. Based on this, topics in the laboratory practice guidance consisted of ten units.

The units were:
Objectives of the Laboratory Practice. It consisted of objectives to be achieved in each laboratory practice topics
Theoretical Basis. It consisted of brief theories that supported the laboratory practice topics.
Tools and Materials. It consisted of a list of tools and materials required during the laboratory practice activities. Tools were all available in Biology Laboratory and were confirmed in good condition, whereas materials were mostly prepared by the laboratory and the remaining materials were prepared by the students. Materials prepared by the students included fresh plants that easy to find.
Working Procedures. It consisted of the implementation steps of the laboratory practice in simple language
Observation Result. Students completed this part in form of images, tables or graphics according to the laboratory practice topics.
Discuss. This part consisted of questions related to the laboratory practice to answer facts found in observation result. In this part, students were asked to discuss with their group mate and the assistants.
Discussion. In this part, students were requested to elaborate the laboratory practice results, facts found during the activities and compared them with theories. The theories were at minimum from 10 (ten) relevant sources, from books or journals. This part should answer the objectives of the laboratory practice and questions containing in the discussion topics
Scientific integration. In this part, students were asked to quote verses from the Quran or hadith and connected them to the facts or phenomenon found during the laboratory practice. In addition, students were also expected to be able to express their gratitude and admiration for Allah SWT's creation
Conclusion. Students drawn conclusion of the laboratory practice based on objectives, observation results, and relevant theories.
References. It consisted of references quoted in the discussion part

Realization/Construction Phase

In this stage, a product basic form was resulted as an outcome of design phase realization. In addition, the laboratory practice guidance was created according to the planned design and called as **Prototype I**. The product was then presented to the validators before trial.

Test, Evaluation, and Revision Phase

The laboratory practice guidance produced was presented to the two validators for assessment prior to trial. The following Tabel 1.are the results of the assessment of the two validators.

Tabel 1. Result of validating.

		Validators I	
		Irrelevant Score (1 – 2)	Relevant Score (3 – 4)
Validators II	Irrelevant Score (1 – 2)	0	0
	Relevant Score (3 – 4)	0	17

Content Validity = $\frac{17}{(0+0+0+17)} = \frac{17}{17} = 1$

According to calculation, it can be inferred that content validation score was V = 1 or V = 100%. It can be interpreted that the assessment result from both validators had "strong relevance" since the content validation coefficient was more than 75%. Therefore, the content validation

coefficient produced was valid. Both validators provided conclusion that the Laboratory Practice Guidance of Plant Anatomy and Physiology can be applied with small revision. The suggestions of both validators presented in Table 2.

Table 2.
Suggestions of both validators

Validator Suggestion (Before Revision)	Follow-up (After Revision)
Validator 1	
1. Objectives and discussion topics should be set in left alignment.	1. Objectives and discussion topic had aligned left.
2. Object Glass and Deck Glass should be translated into Bahasa Indonesia.	2. Object Glass and Deck Glass had been translated into Bahasa Indonesia, which were *Gelas Benda* and *Gelas Penutup*.
3. There was no column for sweet potato image in table of Topic I observation result.	3. A column had been added for sweet potato image.
4. Title in topic II should include the word "*Jaringan*".	4. The word *"jaringan*" had been added and it becomes "*Jaringan Epidermis*".
5. Materials in Unit IV needed to clarify the type of its soil (it was stated as "yard soil").	5. Materials were clarified into *Tanah Humus* (top soil) and *Tanah Lempung* (clay).
6. There was not enough space to write conclusion.	6. More space added to write conclusion.
7. There were some typos in the guidance.	7. Some typos had been corrected in accordance with EBI.
Validator II	
1. There was no tool to grind rice.	1. Mortar and pestle had been added.
2. Objectives and discussion topics should be set in left alignment.	2. Objectives and discussion topic had aligned left.
3. There were no tables on observation results in Unit VI, Unit VIII, and Unit IX.	3. Observation result tables had been added.
4. Laboratory practice procedures on evaporation were separated from transpiration.	4. Laboratory practice procedures on evaporation and transpiration had been separated.

By considering suggestions from the validators, the laboratory practice guidance of Plant Anatomy and Physiology was re-revised. The result was called **Prototype II**. This Prototype was then tested to limited students of Biology Education Department to evaluate the effectiveness and practicality of the developed product. The practicality was observed from the applicability of both products, whereas effectiveness was observed from the response of the students and the assistants.

Practicality

Based on the implementation criteria of the device, it was known that the practicality of the laboratory practice guidance was in the Category of 3, which most of them were applicable. Therefore, it can be inferred that the developed product was practical to apply.

Effectiveness

The effectiveness of laboratory practice guidance of Plant Anatomy and Physiology could be observed from the response of the assistants and the students. Based on the analysis result of the students' response, it indicated that 92% of the students gave positive response on all items questioned and 8% provided negative responses. In measuring the effectiveness of laboratory practice guidance, the assistants' response should be also considered. According to the analysis result of the assistants' response questionnaire, 100% of the assistants provided positive response on 93.33% items questioned and 6.67% of the items were given negative response by the assistants. Therefore, it can be concluded that the developed product met the effective criteria.

Evaluation (FGD)

After the product trial, focus group discussion (FGD) was performed to listen directly to all responses and suggestions from all people involved in the research, consisted of researchers, validators, observers, assistants, and representatives of students who perform the laboratory practice. The result of FGD were as follows in Table 3.

Table 3. Resume result of FGD.

Response/Suggestion (Before Revision)	Follow up (After Revision)
Validator	
1. They suggested to add more pages in the report column. 2. They suggested to create a more interesting design for the guidance.	1. Added 3 pages in the report column for each topick. 2. Products were made attractive by designing the cover with related images.
Observer	
1. Some activities could not be conducted, for example the filling of tool bills. 2. Several assistants had less ability to lead a discussion. 3. The assistant provided less motivation to the students .	1. Efforts would be put to maximize the implementation phase.
Assistants	
1. The use of test tube in Unit V was not appropriate since it was too short. Therefore, the experiment ended before the determined time, which was 60 minutes. 2. Potato tubers submersion in Unit VII was too long, which was 2 hours; thus, it required more time.	1. The test tube would be replaced with a longer cylinder glass. 2. The submersion would be conducted for an hour.
Students who Performed the Laboratory Practice	
1. They suggested to add the laboratory tools, for example, analytic scale since there were only two units. 2. A minimum of 10 sources of reference was considered as difficult for students since they had numerous laboratory practices to be completed. 3. Students encountered some difficulties to find a proposition or verse suitable for the laboratory practice topics.	1. It has been discussed with the laboratory and the tool in question had been ordered. 2. Reduced the number of references to seven sources. 3. It did not have to be a preposition. Stating a gratitude and amazement for Allah's creation was sufficient.

After the revision based on suggestions from the practitioners, the product was considered as end product that met the valid, practical, and effective criteria.

Implementation Phase

The end product of the guidance that met the valid, practical, and effective criteria applied in the broader educational institution scope. The researchers, however, limited the use of the laboratory guidance in the scope Department of Biology Education UIN Alauddin Makassar.

The Product Validity of Islamic Scientific-Integrated Plant Anatomy and Physiology Laboratory Guidance

Product validation was performed by presenting the developed product to experts for assessment. The developed guidance had met the valid criteria based on the assessment of both

validators. Each developed product had content validity coefficient score of 1 and as previously set, a product is stated as valid if it has validity coefficient of > 0.75. Both validators concluded that the laboratory practice guidance can be applied with small revisions.

Product Practicality of the Islamic Scientific-Integrated Plant Anatomy and Physiology laboratory guidance

Based on the observation result by observers, it can be seen that the device of Plant Anatomy and Physiology Laboratory Practice Guidance was in the category of most of them are applicable with T value equal to 3. Activities that had not been conducted optimally included: a) the assistants did not coordinate the tool bills filling, b) the assistants had less ability to lead a discussion, c) the assistants provided less motivation to the students before the laboratory practice started. The three conditions will be improved when the developed product applied in the next laboratory practice.

The Effectiveness of the Islamic Scientific-Integrated Plant Anatomy and Physiology laboratory guidance

The laboratory practice procedures were the main element to be prepared, because all the needs of tools and materials, as well as practicum steps are all contained in the guide. Without guidance, practical activities will not work well. The guidance should be used optimally to obtain results in accordance with the laboratory practice objectives (Setyorini, Sukiswo, & Subali, 2011; Suryanda et al., 2017). All tools, materials and procedures on the guide must be available and carried out properly, not only following the instructions of the practicum assistant which are sometimes not in accordance with the procedures in the guide (Susantini & Lisdiana, 2012; Sari, et al., 2017). Further, Prasetyo (2016) stated that due to the existence of laboratory guidance, learning process in laboratory could be well managed and it would facilitate students to understand concept by providing a real experience during the practice. Product effectiveness in form of laboratory practice guidance was measured by considering response from assistants and students who performed the laboratory practice. This is needed to ensure that the assistant understands the things contained in the guide especially work procedures, so that errors and misunderstandings in guiding practicum can be minimized.

The analysis result indicated that 92% of students provided positive responses on all items questioned and 8% respondents provided negative responses. It was also known that all items received positive response (100%) with an average value of 3.4 in the agree category. The negative responses were in the following statements: a) working procedures in the laboratory practice guidance were easy to understand thus it could be implemented, b) materials in the laboratory practice guidance were easy to obtain, and c) I use an effective time to understand steps in the laboratory practice activities. In addition to the students' responses, the response questionnaire also presented to the assistants consisted of 15 question items. Based on the analysis result of assistant response questionnaire, all of the assistants provided positive responses to 93.3% items questioned and 6.67% received negative responses. Statements received negative response were: "according to me, the display of laboratory practice guidance is interesting" thus the guidance product will be revised by creating a more interesting display, because according to Isfaeni, Corebima, Suwono, & Rohman, (2018) & Mustami, (2017), Graphic characters both in writing (letters) and images, can make it easier for students to understand learning material. In addition, an attractive appearance can increase students' interest in learning (Fitriani, Amelia, & Marianingsih, 2017; Suryanda et al., 2017).

Guides that have been developed have the advantage of being integrated with laboratory reports so as to make time efficient for students to complete reports, since students must undergo six practical courses in the current semester (Fitriani, et al, 2017; Handayani et al,. 2018). The number of practicums that require students to complete 1 lab report every day plus other lecture assignments is feared to cause fatigue and stress in completing reports. According to (Sutjiato, 2015) stress can be caused by several factors (Syabilla, Suryanda, Sigit., 2018), one of which is that external demands

can be derived from lecture assignments and learning burdens. The effects of stress can affect a person's memory (Joëls, Pu, Wiegert, Oitzl, & Krugers, 2006)

This guide has a discussion topic that is able to activate cognitive and student communication skills (Fitriani, et al., 2017;. tudents must be stimulated to interact with each other because this interaction can positively influence learning (Dolmans, De Grave, Wolfhagen, & Van Der Vleuten, 2005). Discussions with group friends allow students to work together to improve critical thinking skills and problem solving skills (Gokhale, 2012; Wall, 2015). Collaboration between students, assistants, and lecturers in solving problems can help achieve deep and more meaningful learning (Stover & Ziswiler, 2017).

Most laboratory practices titles are very relevant to everyday life so students are expected to be more interested in learning. According to (Supriyatin & Ichsan, 2018) students can apply concepts from the latest research results to be applied in real life. Thus they will position themselves as parties who need provisions for their lives later (Suryanda, et al., 2017). There is a part of Islamic scientific integration so that the main goal of education is expected to shape Indonesian people who have faith and fear God can be achieved not only cognitive, but also moral values and messages from science (Bagir, 2005). Need to know that all sciences are originated from Allah and interpreted through spiritual soul and psychic. Sciences are gift from Allah to explore the world aiming for afterlife (Murtopo, 2008). Islam as a foundation of all knowledge has a significant implication in the quest of knowledge. If a person has knowledge but no religion then his knowledge will be useful for his own interest and it is quantitative in nature. Theology as a foundation for all human life aspects should be balanced with knowledge since Islam without general knowledge will be apathetic to life realities (Wathoni, 2018)

There needs to be an education system that is able to unite the values of Religion with science so that it can produce individuals who not only have skills in the scientific and technological fields but also have religious awareness so as not to fall prey to current global developments (Hamzah, 2015). The shortcomings of this guide are thicker because they have merged with the laboratory report. The obstacles faced in the laboratory practises process was that students still having trouble finding verses of the Qor'an or hadith that are in accordance with the topic of the practicum.

CONCLUSION

The developed laboratory practice guidance was based on a modification from Plump development model consisted of five phases: Preliminary Investigation, Design, Realization (Construction), test, evaluation, and revision, and Implementation phases. The laboratory practice guidance of Plant Anatomy and Physiology had met the valid, practical, and effective criteria.

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