The Relevance and Use of Biology Laboratory Practice towards Biology Teacher Competencies

Nurhasanah

Department of Biology Education, Universitas Terbuka, Indonesia

Received October 19, 2019; Revised January 27, 2020; Accepted March 24, 2020

Copyright©2020 by authors, all rights reserved. Authors agree that this article remains permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

Abstract This research aimed to determine the extent of the relevance of 2nd Biology laboratory practice subject matter with biology material. Laboratory practice is part of learning to test and apply a concept in the form of learning activities or in high school. The method used is descriptive. Data was obtained from Biology Education students who have taken 2nd Biology Laboratory practice courses towards students. Instrument used is questionnaire, and analyze data used is descriptive. The results obtained on the relevance of the experimental substance to improve the competence of practicing laboratory practice in schools are that 44.21% strongly agree, 42.41% agree, and 10.96% disagree. The usefulness of the substance of the experiment in improving the competence of carrying out biology laboratory practice in schools is that on average as much as 55.04% strongly agree, and as much as 43.84% agree. The conclusions and suggestions from this study need to include other alternative materials for the experiment, bearing in mind that not all laboratories in the schools have complete laboratory tools and materials.

Keywords 2nd Biology Laboratory Practice, Competence of Biology Teachers, Relevance Laboratory Practice

1. Introduction

Laboratory practice is a part of learning that is intended to be discussed and proposed by the theory in real situations. In a more specific sense, a laboratory practice is a form of learning activity intended to strengthen student knowledge of course material through an application, analysis, synthesis, and evaluation of theories applied in laboratories through the field [1–3]. Laboratory practice is an activity that requires students to make observations, experiments, or testing a concept or principle of course material that is conducted inside or outside the laboratory

[4,5]. Practical activities are carried out under the guidance of the instructor/supervisor. 2nd Biology Laboratory practice must be taken by all students from various inputs ranging from senior high school equivalents to Non-Biology Education, constituting the main course and also as a prerequisite for taking the Final Examination Program.

In accordance with the explanation above, the laboratory practice courses in the Biology Education Study Program are the application courses of the concept of Biology Education Study courses. Based on the concepts that have been learned in each course in the Biology Education Study program, students should be able to apply the concepts/materials that have been learned and their relevance to the curriculum in junior and senior high schools, because for developing their profession as a teacher it is expected to be able to apply the skills of practicing laboratory practice to conduct learning and design laboratory practice activities at school [6,7].

Along with the development and demands of the Biology curriculum in junior and senior high schools, teachers are expected to be skilled in presenting learning by including laboratory practice. In this condition laboratory practice becomes student learning activities in schools [8,9]. To find out the implementation of laboratory practice in schools and curriculum demands, it is necessary to study the relevance and usefulness of 2nd Biology laboratory practice material on improving the ability of teachers or the competence of middle and high school teachers. In the implementation of learning, Biology Education students have taken laboratory practice courses in Biology at various to support their performance in the implementation of Biology Learning in Schools.

Science and technology, both as the substance of teaching materials and tools for organizing learning, continue to develop [10,11]. This dynamic requires teachers to always improve and adjust their competencies to be able to develop and present the actual subject matter using various approaches, methods, and the latest learning

technology [12,13]. Only in that way is the teacher able to organize learning that successfully leads students into the world of life in accordance with the needs and challenges of his day. Conversely, the unwillingness and inability of teachers to adjust their insights and competencies to the demands of the development of their professional environment will actually be one of the factors inhibiting the achievement of educational and learning goals.

Biology learning should involve students actively in practicing. The role of laboratory practice in learning is that it can support students to develop thinking skills and abilities. Laboratory practice implementation can stimulate students to be active in solving problems, think critically in analyzing existing problems and facts, and discover concepts and principles, so as to create more meaningful learning activities with a conducive learning atmosphere. The ability to solve problems, think critically and think creatively is the essence of educational goals and becomes the need for students to face the real world [14,15].

Until now, both in fact and in perception, there are still many people who doubt the competence of teachers both in the field of study being taught and other fields that support especially the didactic and methodical areas of learning. This doubt is reasonable because it is supported by the results of the competency test which shows that there are still many teachers who have not yet reached the competency standard set. This competency test also shows that there are still many teachers who do not master the use of information and communication technology (ICT). Trial video studies of a number of teachers in several sample locations complement the evidence of that doubt. Another conclusion is that learning in the classroom is more dominated by one-way lectures from the teacher and questions and answers are very rare. This reflects how many teachers still do not try to improve and update their professionalism [16,17].

The laboratory practice method is a way of presenting learning by using experiments [18,19]. In the implementation of this method, students carry out activities that include controlling variables, observing, involving comparison or control, and using practical tools. In the learning process using laboratory practice methods, students are given the opportunity to experience it themselves or do it themselves. By doing laboratory practice students will become more confident about one thing or concept rather than just accepting explanations from the teacher and books, which can enrich experiences, develop scientific attitudes so that learning outcomes will last longer in students' memories.

The purpose of this study was to determine the extent of the relevance of 2nd Biology laboratory practice subject matter with biology material. The relevance of the titles of laboratory practice subject matter with laboratory practice of biology. Then, Meaning/usefulness of practical laboratory practice subject matters for 2nd Biology Laboratory practice in carrying out laboratory practice in

Schools, the Meaning of laboratory practice material in supporting the enrichment and insight of teachers in providing learning in schools.

2. Methods

This research uses a descriptive method. The instrument used was in the form of a questionnaire divided into 3 components according to the problem that raised and an interview sheet for undergraduate students of Biology Education Universitas Terbuka who had become a Biology teacher and had taken 2nd Biology Laboratory practice. The location was used as a research data sample namely students from Jakarta, Bogor, Serang, and Bandung to find out the extent of relevance and application of 2nd Biology Laboratory practice. Design flows in the implementation of data collection, namely the Biology Practical Book, Biology Learning Materials. Biology Teacher Competencies in Schools, Relevance and Use / Benefits by students. Data processing uses calculations based on the amount of data obtained from items using the percentage table questions, while for the items of experience, proposals, and suggestions/interviews the data is grouped according to the issue and then analyzed qualitatively.

3. Result and Discussion

Based on the data acquisition of 46 respondents in the 3 items above, the results of data acquisition in points 1 and 2 after calculating the average will be presented in tabular form; while for item 3 on experiences, proposals and suggestions which are grouped according to the module will be analyzed descriptively and qualitatively. The average results obtained for each module on the relevance of the substance of the experiment in increasing the competence of conducting Biology Laboratory practice in Schools can be seen in Figure 1 below.

Figure1. The relevance of Biology Experiment material in junior/ senior high schools

Based on the data in table 1 and the description from

the table above, the results of the acquisition of respondents' opinion about the relevance of the substance of the experiment to improve the competence of practicing laboratory practice in the school are that 44.21% strongly agree, and as much as 42.41% agree and only 10.96% disagree. So 44.21% of students agreed that the substance of the experiment was relevant to improve the competence of laboratory practice in school. The average results obtained for each module on the usefulness of the substance of the experiment in increasing the competence of conducting Biology Laboratory practice in Schools can be seen in Figure2 below.

Figure2. Use of Biology Experiment material in junior/ senior high schools

Based on the results of the opinion of respondents in diagram 2 about the usefulness of the substance of the experiment in improving the competence of carrying out biology laboratory practice in schools, then on average 55.04% strongly agree, and as much as 43.84% agree. This means that as much as 55.04% of respondents strongly agree that the substance of the experiment in improving the competence of conducting practical work in schools is very useful. Overall all laboratory practice material presented is very useful, but it would be nice in every experiment to include other alternative materials/tools to be used. This is because not all schools have adequate laboratory facilities, there are even schools that do not have laboratories, including tools/materials, so teachers are required to be more creative in finding alternative materials / simple tools that will be used in laboratory practice [5,20,21].

As a whole, the subject matter of this course is relevant and has its uses with the implementation of Biology laboratory practice in schools, but the conditions in school laboratories are sometimes complete equipment or limited material is still often found [8,22]. Experiments on food testing and the results of excretion of ingredients are incomplete and there is no description of how to make a solution and obtain a solution. The notes are that the visualization of the laboratory practice process is very necessary for this condition, such as the stages of division in frogs or in mice, or the stages of cutting plants by stem cuttings. Not only being explained in the description but

also with visualization/picture, so it is easy to understand. If possible VCDs can be equipped as in the blood type test laboratory practice, Plant Development on vegetative propagation. The module is equipped with a CD, but not for all experiments, only for those that are considered difficult.

Module 1 material for gram staining is rather difficult to find the bacteria and at school, there are no or rare experiments done at school. It is rather difficult to implement and bacteria must already be in the finished form which must be purchased. Experiments in module 7 are rather difficult to find ingredients such as specimens preserved for parasitic worms. Schools must look for material from learning sources such as those in higher education institutions that have complete laboratories or to find places to procure materials that are somehow difficult to obtain, so as to obtain appropriate information, and experimental material that is not relevant to middle/ high school material such as counting the number of microorganisms, identification of microorganisms, and gram staining. Material with characters like these is indeed quite difficult because it is to add students' insights in applying the theory learned [23–25].

Science learning activities can be carried out through various activities such as observation, testing/research, discussion, independent information gathering through reading assignments, interviewing resource persons, simulations/role playing, singing, demonstration/modeling demonstrations, and relating to the Environment, Technology and Society [26–28]. Learning activities are directed more at direct learning experiences than teaching (teaching). The teacher acts as a facilitator so students are more active in the learning process. The teacher is accustomed to providing the broadest opportunities so that students can learn more meaningfully by giving responses that activate all students positively. The Biology teacher can provide project assignments that need to be worked on and reviewed to continually improve results. The task of this project is expected to involve Science, Environment, Technology, and Society in real terms in the context of simple technological development, research and testing, making reading literature, making clippings, writing scientific ideas or the like. Learning objectives for each subject and expected educational competence are determined.

The direct learning experience is emphasized through the use and development of scientific process skills and attitudes in order to understand concepts and be able to solve problems. To make it easier for teachers to do scientific work, basic competencies and indicators of scientific work are presented and integrated into their subject matter. In a learning activity such as scientific research, not all indicators of scientific work must be done. The teacher can choose according to the needs of the availability of tools/materials, student abilities, availability of time allocation, and the ability of teachers.

The approach used in Biology learning is student-oriented. The teacher's role shifts from determining "what will be learned" to "how to provide and enrich student learning experiences". Learning experiences are obtained through a series of activities to explore the environment through active interaction with friends, the environment, and other resource persons. Learning methods must be analytical, tangible objects. The laboratory approach is commonly used in the presentation of science learning through the methods of experimentation and demonstration [29-32].

4. Conclusions

Based on the results of the study it can be concluded that the relevance of the substance of the experiment to improve the competence of practicing laboratory practice in the average school is that 44.21% strongly agree, and as much as 42.41% agree and only 10.96% disagree. So 44.21% of students agreed that the substance of the experiment was relevant to improve the competence of laboratory practice in school. The usefulness of the substance of the experiment in improving the competence of carrying out biology laboratory practice in schools is that on average as much as 55.04% strongly agree, and as much as 43.84% agree. Through this research, according to the study and input obtained it is necessary to review the practical points that need to be adapted to the application of learning in schools both in middle and high school.

Acknowledgements

Thank you to all the participants in this research.

REFERENCES

- [1] Ichsan, I. Z., Sigit, D. V., Miasryah, M., Ali, A., Arif, W. P., & Prayitno, T. A. (2019). HOTS-AEP: Higher order thinking skills from elementary to master students in environmental learning. *European Journal of Educational Research*, 8(4), 935–942. <https://doi.org/10.12973/eu-jer.8.4.935>
- [2] Pouyanfar, S., Tao, Y., Tian, H., Chen, S. C., & Shyu, M. L. (2019). Multimodal deep learning based on multiple correspondence analysis for disaster management. *World Wide Web*, 22(5), 1893–1911. <https://doi.org/10.1007/s11280-018-0636-4>
- [3] Palonnikau, A., Karol, D., Kalachikova, O., Volkova, Z., & Solonenko, A. (2015). Educational Research in Changing University. *Procedia - Social and Behavioral Sciences*, 214, 684–692. <https://doi.org/10.1016/j.sbspro.2015.11.675>
- [4] Ali, A., & Arif, W. P. (2019). Developing of guidance for laboratory practice of islamic science-integrated plant anatomy-physiology. *Biosfer: Jurnal Pendidikan Biologi*, 12(1), 70–82. <https://doi.org/10.21009/biosferjpb.v12n1.70-82>
- [5] Kipnis, M., & Hofstein, A. (2008). The inquiry laboratory as a source for development of metacognitive skills. *International Journal of Science and Mathematics Education*, 6(3), 601–627.
- [6] Talmi, I., Hazzan, O., & Katz, R. (2018). Intrinsic Motivation and 21st-Century Skills in an Undergraduate Engineering Project: The Formula Student Project. *Higher Education Studies*, 8(4), 46. <https://doi.org/10.5539/hes.v8n4p46>
- [7] Anagün, Ş. S. (2018). Teachers' Perceptions about the Relationship between 21st Century Skills and Managing Constructivist Learning Environments. *International Journal of Instruction*, 11(4), 825–840. <https://doi.org/10.12973/iji.2018.11452a>
- [8] Bahtiar, B., & Dukomalomo, N. (2019). Basic science process skills of biology laboratory practice: improving through discovery learning. *Biosfer: Jurnal Pendidikan Biologi*, 12(1), 83–93. <https://doi.org/10.21009/biosferjpb.v12n1.83-93>
- [9] Surpless, B., Bushey, M., & Halx, M. (2014). Developing scientific literacy in introductory laboratory courses: A model for course design and assessment. *Journal of Geoscience Education*, 62(2), 244–263. <https://doi.org/10.5408/13-073.1>
- [10] Cheung, A. C. K., & Slavin, R. E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review*, 9, 88–113. <https://doi.org/10.1016/j.edurev.2013.01.001>
- [11] Miasryah, M., Rusdi, R., Aryani, N. D., & Ichsan, I. Z. (2019). MEBA: Development Android-based Ecosystem Module for Senior High School Students. *Indian Journal of Public Health Research and Development*, 10(8), 2114–2118. <https://doi.org/10.5958/0976-5506.2019.02168.5>
- [12] Sigit, D. V., Azrai, E. P., Heryanti, E., Ichsan, I. Z., Jajomi, Y. P., & Fadrikal, R. (2019). Development Green Consumerism E-Book for Undergraduate Students (GC-EBUS) as Learning Media in Environmental Learning. *Indian Journal of Public Health Research and Development*, 10(8), 2026–2031. <https://doi.org/10.5958/0976-5506.2019.02152.1>
- [13] Evans, C. (2014). Twitter for teaching: Can social media be used to enhance the process of learning? *British Journal of Educational Technology*, 45(5), 902–915. <https://doi.org/10.1111/bjet.12099>
- [14] Farisi, M. I. (2016). Developing the 21 st-century social studies skills through technology integration. *Turkish Online Journal of Distance Education-TOJDE*, 17(1), 16–30. <https://doi.org/10.17718/tojde.47374>
- [15] Sharif, A., & Cho, S. (2015). 21st-Century Instructional Designers: Bridging the Perceptual Gaps between Identity, Practice, Impact and Professional Development. *RUSC. Universities and Knowledge Society Journal*, 12(3), 72–85. <https://doi.org/10.7238/rusc.v12i3.2176>

- [16] Sultan, A. Al, Henson, H., & Fadde, P. J. (2018). Pre-Service Elementary Teachers' Scientific Literacy and Self-Efficacy in Teaching Science. *IAFOR Journal of Education Journal of Education*, 6(6), 25–41. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1172004.pdf>
- [17] Widjaja, W., Vale, C., Groves, S., & Doig, B. (2017). Teachers' professional growth through engagement with lesson study. *Journal of Mathematics Teacher Education*, 20(4), 357–383. <https://doi.org/10.1007/s10857-015-9341-8>
- [18] Ristanto, R. H., Miarsyah, M., Muharomah, D.R., Astuti, T.A., Aini, S., & Prihatin., A.I (2019). Light-Board: simple media to learn photosynthesis concepts. *International Journal of Advanced Trends in Computer Science and Engineering*, 9(1), 299–303. <https://doi.org/10.30534/ijatcse/2020/45912020>
- [19] Merry, S., Skingsley, D., Mitchell, P., & Orsmond, P. (2015). Biology students' perceptions of learning from video exemplars of practical techniques: some lessons for teaching strategies. *Innovative Practice in Higher Education*, 2(2), 1–14.
- [20] Ristanto, R. H., Zubaidah, S., Amin, M., & Rohman, F. (2018). From a reader to a scientist: developing cirgi learning to empower scientific literacy and mastery of biology concept. *Biosfer: Jurnal Pendidikan Biologi*, 11(2), 90–100.
- [21] Nugraini, S. H., Choo, K. A., Hin, H. S., & Hoon, T. S. (2013). Impact of E-Av Biology Website for Learning About Renewable Energy. *TOJET: The Turkish Online Journal of Educational Technology*, 12(2), 376–386.
- [22] Ningsih, L. R., Rusdi, R., & Miarsyah, M. (2019). Exploring respiratory system to improve biological learning motivation: resysmart media application. *Biosfer: Jurnal Pendidikan Biologi*, 12(2), 211–222. <https://doi.org/10.21009/biosferjpb.v12n2.211-222>
- [23] Khoiriyah, A. J., & Husamah, H. (2018). Problem-based learning: creative thinking skills, problem-solving skills, and learning outcome of seventh grade students. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 4(2), 151–160. <https://doi.org/10.22219/jpbi.v4i2.5804>
- [24] Khan, F. M. A., & Masood, M. (2015). The Effectiveness of an Interactive Multimedia Courseware with Cooperative Mastery Approach in Enhancing Higher Order Thinking Skills in Learning Cellular Respiration. *Procedia - Social and Behavioral Sciences*, 176, 977–984. <https://doi.org/10.1016/j.sbspro.2015.01.567>
- [25] Hsiao, C. C., Tiao, M. M., & Chen, C. C. (2016). Using interactive multimedia e-Books for learning blood cell morphology in pediatric hematology. *BMC Medical Education*, 16(1), 290. <https://doi.org/10.1186/s12909-016-0816-9>
- [26] Ichsan, I. Z., Sigit, D. V., Miarsyah, M., Ali, A., Suwandi, T., & Titin, T. (2020). Implementation supplementary book of green consumerism: improving students' hotspots in environmental learning. *European Journal of Educational Research*, 9(1), 227–237. <https://doi.org/10.12973/eu-jer.9.1.227>
- [27] Hacıeminoglu, E. (2016). Elementary school students' attitude toward science and related variables. *International Journal of Environmental and Science Education*, 11(2), 35–52. <https://doi.org/10.12973/ijese.2016.288a>
- [28] Miarsyah, M., Ristanto, R.H., Nurhayati, Mufida, S.N., Suparini, Zharroh, A.E. (2020). Development of adobe flash media integrated into hotspots on circulation system (af-hotspots bicycle media). *International Journal of Advanced Trends in Computer Science and Engineering*, 9(1), 896–903. <https://doi.org/10.30534/ijatcse/2020/128912020>
- [29] Turnip, B., Wahyuni, I., & Tanjung, Y. I. (2016). The Effect of Inquiry Training Learning Model Based on Just in Time Teaching for Problem Solving Skill. *Journal of Education and Practice*, 7(15), 177–181.
- [30] Hwang, G. J., Lai, C. L., Liang, J. C., Chu, H. C., & Tsai, C. C. (2018). A long-term experiment to investigate the relationships between high school students' perceptions of mobile learning and peer interaction and higher-order thinking tendencies. *Educational Technology Research and Development*, 66(1), 75–93. <https://doi.org/10.1007/s11423-017-9540-3>
- [31] Sigit, D. V., Miarsyah, M., Komala, R., Suryanda, A., Ichsan, I. Z., & Fadrikal, R. (2020). EECN: Analysis, potency, benefit for students' knowledge and attitude to conserve mangroves and coral reefs. *International Journal of Instruction*, 13(1), 125–138. <https://doi.org/10.29333/iji.2020.1318a>
- [32] Miarsyah, M., Sigit, D. V., Ichsan, I. Z., Fadrikal, R., & Suprpto, M. (2019). Lektur multimedia: Improving Indonesian students' environmental responsibility using multimedia in environmental learning. *International Journal of Scientific and Technology Research*, 8(12), 1639–1643.