IOP Conf. Series: Materials Science and Engineering **296** (2018) 012002 doi:10.1088/1757-899X/296/1/012002

The development of guided inquiry-based learning devices on photosynthesis and respiration matter to train science literacy skills

Choirunnisak[1], M Ibrahim [2] and Yuliani[2]

[1]Student of Science Education Program, Graduate Program of Universitas Negeri Surabaya
[2]Lecturer of Department of Biology Universitas Negeri Surabaya

choirunnisakchoirunnisak@mhs.unesa.ac.id

Abstract. The purpose of this research was to develop a guided inquiry-based learning devices on photosynthesis and respiration matter that are feasible (valid, practical, and effective) to train students' science literacy. This research used 4D development model and tested on 15 students of biology education 2016 the State University of Surabaya with using one group pretest-posttest design. Learning devices developed include (a) Semester Lesson Plan (b) Lecture Schedule, (c) Student Activity Sheet, (d) Student Textbook, and (e) testability of science literacy. Research data obtained through validation method, observation, test, and questionnaire. The results were analyzed descriptively quantitative and qualitative. The ability of science literacy was analyzed by n-gain. The results of this research showed that (a) learning devices that developed was categorically very valid, (b) learning activities performed very well, (c) student's science literacy skills improved that was a category as moderate, and (d) students responses were very positively to the learning that already held. Based on the results of the analysis and discussion, it is concluded that the development of guided inquiry-based learning devices on photosynthesis and respiration matter was feasible to train students literacy science skills.

1. Introduction

Science literacy becomes a must for everyone. Science literacy becomes very important for a person because the reverse of a nation one of them is determined by the quality of human that has the science literacy and technology skills [1].

The results of the 1988-2008 survey show that the increase in science literacy among college students in America is insignificant, only 10% -15% [2] and the science literacy of prospective teachers in Turkey is also low [3]. The average scientific skills of Indonesian learners has only come to the ability to recognize a number of basic facts, but they have not been able to communicate and link these abilities to various topics of science, let alone up to the application of concepts [4]. The main problems in the lectures in Indonesia in general due to the existence of some lecturers who are less understanding or less concerned about learning achievements, strategies and methods of learning, and how to appraise the right. The lessons dominated by lectures make it difficult for students to understand the essence of learning materials, so that their activities are limited to making notes and tend to be less able to listen due to the dependence on the photocopy of the presentation material from

the lecturers, as well as the opportunity to uncover the learning material obtained in the real world/society is very limited [5].

With the release of Permendikbud No. 49 of 2014 on National Standards of Higher Education which emphasizes the characteristics of the learning process in universities must be interactive, scientific, contextual, collaborative, and student-centred, the Study Program is required to produce graduates in accordance with the curriculum of Indonesia National Qualification Framework (KKNI). Therefore, the development of science literacy is needed to help prospective teachers understand the content of science literacy and the elements of science literacy, and be able to use appropriate teaching methods as the key mechanism that will lead students to develop their science literacy through the process of learning in the classroom [6]. Indicators of prospective teachers who understand science literacy are aware of and understand the impact of science and technology in everyday life, making personal decisions about things including science, health, the use of energy resources, reading and understanding important matters of media reports about science materials, critiquing information automatically , participating in discussions with full confidence about science issues [2].

Universitas Negeri Surabaya (Unesa) has committed itself to a national literacy centre, with plans and pilot programs in and out. Unesa acts as a centre for literacy studies to emerge as an institution that deepens and develops literacy from conceptual and theoretical realms, through various research, discussions, seminars, and so on. Unesa also acts as a centre of literacy movement. In this context, Unesa will cultivate literacy internally in advance, including cultivating reading-writing for lecturers, students, and (if necessary) employees. Programs with measurable performance targets are being matured, so that achievement is satisfactory. Proverbially, Unesa residents must educate themselves before launching the literacy culture movement for the wider community. The principle of exemplary is expected to accelerate the realization of the dream of literacy [7].

The development of literacy from the conceptual and theoretical realms is still lacking. This can be seen from the analysis of tasks and interviews that have been done with lecturers of general biology course which is one of the prestigious programs of plant physiology course in the biology department of Unesa. The results of study shown by students on the midterm exam which includes photosynthesis and respiration are still low. The values range from 44 to 74 with an average value of 53.4. The low learning outcomes of students indicate that students have difficulties in photosynthesis and respiration study, besides that based on the result of a practical report on plant physiology course shows that students do not have the ability of science literacy. Students are still less able to assemble the problem of the two variables they specify (variable manipulation and response variables), identify variables, design experimental design, create table titles and tables of experimental results, analyze data and discuss problems that arise and relate them to theory which is relevant, and concludes the results of the experiment even though the skill has actually been trained since the basic biology course.

Seen from the base of the problem it turns out to be prepared prospective teachers who have the ability of science literacy so that when students become educators can teach students how to use the ability of science literacy to face the demands of the 21st century and global competition. The ability of science literacy can be taught through guided inquiry method. According to Piaget's cognitive development theory, children of 18 years old to adulthood have achieved formal operational development. This is in line with the stage of cognitive development of students majoring in biology is the formal operational stage. The main characteristic of development at this stage is the child is able to think abstractly and logically by using the pattern of "possible" thinking. Scientific thinking models with hypothetico-deductive and inductive types have begun to possess children, with the ability to draw conclusions, interpret and develop hypotheses [8]. The learning device for scientific literacy on photosynthesis and respiration material is designed using guided inquiry model and is a practicum worksheet that train the science literacy skills. Based on the above description, one of the efforts that need to be done is by arranging a device that can guide the lecturers and students in the learning process, so it is necessary to do a research development about learning devices in the form of "The Development of Guided Inquiry-Based Learning Devices on Photosynthesis and Respiration Matter to Train Science Literacy Skills".

2. Methods

This type of this research was research development, namely the development of guided inquiry-based learning device to facilitate student's science literacy. The development that will be carried out refers to the 4-D development model (four-D models). Testing of learning devices on photosynthesis and respiration matter was used one-group pretest-posttest design study. Learning devices are arranged in the form of Semester Lesson Plan, Lecture Schedule, Student Activity Sheet, Student Textbook and science literacy skills test. Learning devices are then validated by experts before implemented in the classroom. Subjects in this study were 15 Biology Education students in 2016 Department of Biology, Universitas Negeri Surabaya.

The Instruments that used in data collection consist of learning device validation sheet, lesson plan implementation observation sheet, student activity observation sheet, student response questionnaire, and science literacy skill test. Data from learning device validation, observation of lesson plan implementation, student activity, student response, and literacy test of student's science literacy were analyzed quantitatively

3. Results and Discussion

3.1 Learning Device Validity

Validation of learning devices as a whole is categorized as excellent. Thus the learning device developed feasible to use in learning.

3.2 SAP Implementation

The observation of lesson implementation in learning is done by two observers. Observations were made at three meetings, meeting I on photosynthesis, meeting II differences in plants C3, C4 and CAM and III respiration meetings. Average assessment of attendees at meetings I, II, and III amounted to 4.00 with the percentage of compliance between observers of 100%. Implementation of all activities is also accompanied by the management of the time and atmosphere of a class well conditioned.

3.3 Student Activity

Recording of student activities at the time of learning will provide an overview of student activities at the time of learning with guided inquiry. Students activities during learning will affect students opportunities in learning. Broophy and Good (in Muijs & David, 2008) [9] argue that the important factor that affects the opportunity to learn is time on tasks, that is, the number of time students spend on learning and not with other activities such as walking in the classroom.

Student activity that most students do during the learning with guided inquiry-based is doing the experiment At least students do activities that are not relevant to the percentage 1.8%.). The average student activity at each meeting as shown in Figure 1 below.

Figure 1. Percentage of student activity in learning activities

High student activity during learning shows that learning is student-centred. Students are able to find their own concept as in Ausubel's meaningful learning theory which emphasizes the importance of students associating experiences, phenomena, and new facts into the student's sense system. Student-centered teaching enables important concepts in learning to be retained in the minds of students. This is in accordance with the information processing theory that student involvement actively in learning leads to the storage of information into long-term memory [10].

3.4 Student responses

Student responses include interest in the use of the device, the newness of the device, the ease of the device, the continuation of the use of the device, the role of the lecturer in teaching as well as the ease of test questions. The students responded positively to the components.

The student's interest response using guided inquiry-based learning devices on the next material scored 80%. This means that students support, feel happy, and are interested in learning by using guided inquiry-based development devices on photosynthesis and respiration matter to train science literacy skills. Students are very enthusiastic when doing student activities worksheets, this is evidenced by 100% student activity related to guided inquiry-based learning. According to Maher and Zuhro (2009) [11], some students have learning goal orientation, these students are internally motivated such as satisfaction to learn something new [12]. Students feel interested in guided inquiry learning because inquiry learning still feels new.

3.5 Students Science literacy skills

The student's science literacy test refers to the student science literacy skills score indicator. Indicator of science literacy skills used as a reference in preparing the test, which is to identify scientific opinion; Conducting an effective scientific search; Designing the elements of the research design and how it impacts the findings/conclusions; Make a precise graph of the data; Solving problems using quantitative skills including basic statistics; Interpret basic statistical data; Conducting inferences and predictions based on quantitative data; Making conclusions based on quantitative data [13]. The result of science literacy skills test analysis seen from scores obtained for each indicator of science literacy ability can be seen in Figure 2.

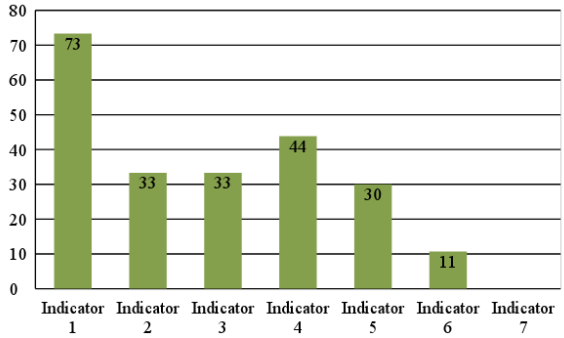

Figure 2. percentage of increasing in scores of each science literacy indicator

The highest increase indicator is the problem-solving indicator using quantitative skills, including the basic statistic of 73% while the indicators make the exact graph of the data still does not increase. This is because the teaching-learning process with guided inquiry will involve students in an investigation, helping them identify conceptual or inquiry issues, helping them identify conceptual or methodological problems in research and engaging them by designing ways to manganate the problems all of which can be done well if students trained critical thinking [14].

4. Conclusions and suggestions

Based on the results of the analysis, and discussion, it can be concluded that the devices based on guided inquiry learning on photosynthesis and respiration mater that has been developed were valid, practical, and effective to train students science literacy so it feasible to use in learning.

References

[1] UNESCO. (2008). *Science Education Policy-Making* Eleven *Emerging issues.* s.l. : UNESCO
[2] Impey, C. (2013). *Science literacy of undergraduates in the United States*. Organizations People and Strategies in Astronomy 2 (OPSA 2). Department of Astronomy, University of Arizona.
[3] Akenngi, H & Sirin, A. (2013). A Comparative study upon determination of scientific literacy level of teacher candidates. *Academic journals, Vol. 8(19), 1882-1886.*
[4] Toharuddin, Uus., Hendrawati, Sri dan Rustaman, Andrian. (2011). *Membangun Literasi Peserta didik.* Bandung: Humaniora.
[5] Sunarti, T.,(2015). Pemahaman Literasi Sains Mahasiswa Calon Guru Fisika Universitas Negeri Surabaya. Seminar Nasional Fisika Dan Pembelajarannya 2015 Universitas Negeri Malang
[6] Udompong, L., Traiwicitkhun, D. And Wongwanich, S. (2014). *Causal model of research competency via scientific literacy of teacher and student*. Procedia-Social and Behavioral Sciences, Vol. 116, 1581-1586.
[7] Khoiri. (2015). Unesa Sebagai Pusat Literasi oleh Much. Khoiri. Kompasiana.com.htm
[8] Budiningsih, Asri. (2004). *Belajar dan Pembelajaran*. Yogyakarta: Rineka Cipta.
[9] Muijs, Daniel and David Reynold. (2008). *Effective Teaching Evidence and Practice.* London: Sage Publication Ltd London
[10] Slavin, E. R. (2011). *Educational psychology.theory and practice.*USA: Pearson.
[11] Maher,A. Dan Zuhro.(2009). Learning Outcomes in Higher Education: Implementation of Curriculum Design and Student Learning. Journal of
[12] Hospital,Leisure,Sport and Tourism Education. 3(2): 47 Arrends, Richard I. (2012). *Learning to Teach Ninth Edition.* New York: McGraw-Hill.
[13] Gorrmally, Cara., Bricman, Peggy., and Lutz, Marry. (2012). " Developing a Test of Scientific Literacy Skill (TSOSL): Measuring Undergraduates' Evaluation of Scientific Information and Arguments". *CBE- Life Sciences Education.* Vol. 11, pp. 364-377
[14] Kardi, S. (2013). *Pengantar Pengembangan Kurikulum & Rencana Pelaksanaan Pembelajaran.* Surabaya: Universitas Negeri Surabaya