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THE DEVELOPMENT OF DISCOVERY LEARNING MODEL TO IMPROVE STUDENTS' SCIENCE LITERACY FOR XI GRADE STUDENTS OF SMK-SPP NEGERI SAMARINDA

Rosdiana✉, Didimus Tanah Boleng, Susilo Susilo

Master of Biology Education Program,
Faculty of Teaching and Education
Universitas Mulawarman, Indonesia

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Abstract

This research was proposed on the problems of: a) the learning process of biology which lack of intergration to: context, knowledge, competence, and scientific behavior. It affects students' learning outcome, where 59.6 % still did not pass the passing grade. b) lack of students' activeness in learning process. In fact, not all students give questions in the learning process. Students were also unable to identify and know the key concepts of the materials. And c) teacher had difficulty and limited time to develop the learning process. This research aimed to produce valid and effective learning tools based on discovery learning. It referred to the stage of research of 4D, by Thiagarajan (1974) consisted of Define, Design, Develop, and Disseminate. The made products were syllabus, lesson plam, handout, students' worksheet, and scoring instrument. From the research, it can be concluded that the tools were valid with average score of 87.49 %. It was considered as very practice with positive responses of students in 84.33 %. Discovery learning model intergrated with science literacy can improve the effectiveness of learning process based on the balue of Normalized gain (N-gain) in the experiment class in 0.74 (high) while the control class got 0.30 (medium).

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✉Corresponding Author:
Rosdiana
Master of Biology Education of Teaching and Education Faculty
Universitas Mulawarman
Jl. Muara Pahu Kampus Gng. Kelua Telp/Fax: (0541) 743651/743929
e-mail: rosdiana.smkspp@gmail.com

INTRODUCTION

Learning process is not separated from learning tools as the important preparation of it. Rohli, M., *et al* (2015:58) states that learning tools are the tools in the forms of a set of media or infrastructure used by teachers and students for their guidance in the learning process, thereby, it will be executed effectively and reach the learning objective well. According to Devi, P.K., *et al* (2009:1), every teacher should prepare a lesson plan which contains an interactive, inspirative, joyful, and motivating activities for students.

Zuriyani (2012:2) explains that learning with an emphasis to science will improve their ability to observe, experiment, and inquire. It is relevant to the curriculum of science education for middle school which emphasizes on science literacy (BSNP, 2006; Depdiknas, 2007) in Ridwan, S., *et al* (2013:179).

Science literacy is the ability to use science to draw conclusion based on scientific facts. Meanwhile, based on Gbamanja (1999) in Adolphus, Telima, Arokoyu (2012:444), science literacy can be defined as the "knowledge and understanding of the event and phenomenon in the environment ".

PISA defines science literacy as the ability to use scientific knowledge, identify questions, and concluding something based on facts in order to understand and make decision regarding the nature and its changes from human activity (Zuriyani, 2012:1). PISA (*Programme for International Student Assessment*) is an institution of literacy which aims to research the ability of 15-year-old learners in reading literacy, matemathics literacy, and scientific literacy. PISA's assessment to OECD (*Organization Economic Cooperation* and *Development*) country in 2012 placed Indonesia in the 64th rank from 65th country with 382 out of 500 score in science. The data from National Research and Development Institution (2015) also showed the similar thing, Indonesia is still in the lower position. This position reflects Indonesia's educational system (Zuriyani, 2012:11). As the responsible actor of education, teacher shoul get the knowledge and understanding regarding the measurement of science literacy (Pantiwati and Husamah, 2015:1234).

PISA's definition of science literacy in OECD (2012:130) can be characterized in four aspects: 1) Context: directing learners to acknowledge situation which involves science and technology. 2) Knowledge: directing learners to understand the nature based on scientific knowledge. 3) Competences: able to identity scientific issues, able to explain scientific phenomena, and able to use scientific evidences. 4) Scientific behavior: showing interest in science as a support for scientific investigation and motivated to directly act responsibly.

An initial observation was done to know how far the science literacy of the students in biology is. In this case, the literaciy was reflected in four aspects: context, knowledge, competences, and process. The result showed that in the context, the learning process which directs the students to know living situations which involve science and technology were 45.2%. The aspect of knowledge obtained 12.3% of students understanding regarding science. The competence is related to students' literacy in identifying scientific issues, explaining scientific phenomena, and using scientific evidences which obtained 35%. Scientific behavior of the students for scientific investigation and motivation to act responsibly was 7.6 %. In conclusion, the students used science theoretically with minimum application of it for their daily life. It is also influential to the low understanding of science, competence, and behavior. Generally, it was reflected that there were still 59.6% students who did not pass the passing grade.

The mastery of science literacy is higly relevant to learning process. In fact, there were not many students who gave questions in the learning process. Specifically, the exploration, giving opinion in facts, or providing solution to certain problems were still rarely done by students. Pantiwati and Husamah (2015:1233) opines that those problems are caused by minimum students' involvement and teachers' emphases to the relation of biological concepts and real environment.

The facts above show that the application of learning strategies which can increase the science literacy level of students is highly important. An alternative to solve the problem is through applying the correct learning model. This statement is relevant to Kemendikbud (2013:2) that learning with discovery learning model can push the students to be active in discovering a new concept. This model motivates the students to learn by themselves independently. The use of this model changes the passive learning to the active

and creative ones. Changing the model from teacher oriented to student oriented through discovery can make the students find the information by themselves.

Based on this background, the researcher tried to integrate science literacy in biology education by applying discovery learning. It is relevant to the initiation of the government in 2017 to develop National Literacy Movement through the Ministry of Education and Culture. To realize this, school as an institution of education has important position. Research and development to the learning process will be initiated to XI grade students in SMK-SPP Negeri Samarinda focusing on the chapter of ecosystem. By the support of the environmental potentials of the farming school, it is hoped that the learning process eases the students to observe the ecosystem. Since, essentially, learning object gives students real experience. Thus, this research aimed to produce the valid, practical, and effective learning tools for XI grade students of SMK-SPP Negeri Samarinda.

METHODS

This research referred to the Research and Development model. It is explained by Thiagarajan *et al.* (1974:1-6). This model consists of 4 steps: define, design, develop, and diseminate. The procedure of the development consisted of define, which contains the analyses from the students, teachers, concept, and learning stages. The next phase is the design, which was done to produce the prototype of development. The prototypes in this development were syllabus, lesson plan, handout, media, students' worksheet, and instruments for evaluation and scoring. The next step was develop. This step included the validation of learning process by experts, revision I, trials, try out analysis, revision II, the measurement, and results' interpretation. The fourth step was disseminate. This process is the spreading of the tools to teachers of biology for Vocational High School in Samarinda. The subjects of the research were 75 students which consisted of 15 students in limited trial and 60 students in wide trial. The object of this research was the properness of discovery learning model to improve the science literacy model for XI students of SMK-SPP Negeri Samarinda.

The data analysis was done to value the validity, practicality, and effectiveness of learning process. The scoring of the learning tools was done starting from the validation by material experts, teaching experts, media experts, and language experts. This data used four scales of scoring which were very valid, valid, less valid, and not valid. Then, the result was converted by table of qualitative criteria to the validity of the tools.

Table 1. Qualitative Criteria to the Validity of the Tools

Range of Percentage	Qualitative Criteria
82 - 100 %	Very Valid
63 - 81 %	Valid
44 - 62 %	Less Valid
25 - 43 %	Not Valid

Source: Adaptated from Sudjana (2005) in Rosginasari (2014)

The score of learning tools' practicality was obtained from the questionnaires for students to the development of learning process in three media: student worksheet, hand out, and learning media. Students' responses were divided into: Very Practical, Practical, Less Practical, and Not Practical. The score was converted to become the criteria of qualitative practicality of the tools.

Table 2. Criteria of Qualitative Practicality of the Tools

Range of Percentage	Qualitative Criteria
81 - 90 %	Very Practical
71 - 80 %	Practical
61 - 70 %	Less Practical
50 - 60 %	Not Practical

Source: Adapted from Sudjana (2005) in Rosginasari (2014)

The effectiveness of the learning process was obtained from the students' cognitive score from the pre-test and post-test. Then, the Normalized gain (N-gain) was obtained by the measurement from the criteria in this following table.

Table 3. Criteria of Learning Tools' Effectiveness

No.	Score	Criteria
1.	$g \geq 0.7$	Tinggi
2.	$0,3 \leq 0.7$	Sedang
3.	$g \leq 0.3$	Rendah

RESULT AND DISCUSSION

The products of this research were the syllabus, lesson plan, handout, media, and scoring instrument. These products were validated by 3 validators as the experts of materials, technology, and language. The validation will be the guidance for the revision of the materials. (The result of the revision can be seen in table 4).

Source: Hayke (1999) in Nor Annisa et al (2017)

Table 4. The Revision of the Learning Tools

Tools	Source of Revision	Before Revision	After Revision
Lesson Plan	Material Expert	Lesson plan was made for four meetings	Lesson plan made for each meeting
Students Worksheet	Language Expert	The picture of the ecosystem destruction was unclear and less interesting	Picture of ecosystem was changed to another picture
Hand Out	Language Expert	The Handout was not interesting and has no direction, exercises, and glossary. The writing in the handout was grammatically incorrect according to the EYD. It was suggested to use times new roman. There was no reference from journals	The interface of the handout was changed to be more interesting, with clear direction. There where additions of exercises and glossary. The writing was proofread and changed to the correct ones. The font was changed to times new roman. The references from journals were added
Learning Video	Learning Technology (Media) Experts	The video had no reference. The mp4 video were converted to autorun. The cover of the video was added with the Basic Competence and Learning materials' indicator.	The video was added with source link from YouTube The video was played in autorun The cover of the video was added in the basic competence and the indicator

The validation showed that the developed products have fulfilled the requirement of validity in three aspects: materials, learning technology (media), and language with the average score of 87.49 %. It is showed that the tools were valid and proper to be used. (The validation result can be seen in table 4).

Table 5. The Validation of Learning Tools

Experts Validation	Total	Criteria
Materials	90.73 %	Very Valid
Learning Technology	89.47 %	Very Valid
Language	82.26 %	Very Valid
Average	87.49 %	Very Valid

Source: Primary Data (2017)

Then, the learning tools were experimented to limited object. In this step, there were minimum parts which should be revised. After in the revision II, the experiment was done in wider trial using the discovery learning model in the experiment class, while a control class was used with conventional learning model. Teacher explains the material throough teacher center model in the control class. After that, the learning process was ended with a post-test. Based on the pretest and posttest, the effectiveness of learning model can be seen through Normalized gain (N-gain) score. The result of the N-gain can be seen in Table 6.

Table 6. The analysis of Normalized gain (N-gain) score

Stages	N-Gain score	Category
Limited Trial	0.74	High
Wider Trial (Experiment Class)	0.74	High
Wider Trial (Control Class)	0.30	Medium

Source: Primary Data (2017)

The score of practicality of the learning process was obtained from 15 students in the limited trial. The score was 81.08 %. In wider trial, the score was 84.33 %. Based on the qualitative criteria, the tool was considered practical as a set of learning tools.

Table 7. Students Scoring and Evaluation

Stages	Average Responses	Criteria
Limited Trial	81.17 %	Very Practical
Wider Trial	84.33 %	Very Practical

Source: Primary Data (2017)

The discovery learning motivates the students to be literate in science. In this case, the literacy contains four aspects: concept, knowledge, competences, and science behavior. These are the stages in the learning process of ecosystem included with the aspects of science literacy in Table 8.

Table 8. The Activities in the learning of ecosystem including the four aspects of science literacy

No	Aspect	Criteria	Activities
1.	Context	Direct the students to know situations involving science and technology.	Students were asked to observe the ecosystem quantitatively by measuring the temperature with thermometer, soil humidity with soiltester, and measuring the temperature and humidity of the air using higrotermometer.
2.	Knowledge	Direct the students to understand the environment scientifically.	The students observed the ecosystem in their school, showed abiotic and biotic component, and determine interaction between components.
3.	Competences	Direct the stduents to identify scientific issues, explain scientific phenomena, and use scientific evidences.	The students observed the destruction of environment, explain the phenomena, and showed the scientific evidences with their sensing organs
4	Behavior	Direct students' interest to science, scientific investigation, and responsible action	The stduents observed many phenomena of ecosystem destruction due to human's activities as well as identified the causes and impacts. The motivation was given by asking the students to design a poster which themed as ecosystem protection

Source: Primary Data (2017)

Table 8 showed that the learning of ecosystem can be integrated with science literacy. The literacy f science can be seen through four aspects: concept, knowledge, competences, and science behavior. The activities were done outdoor and inside the classroom.

Activities in the school was observing the ecosystem. Students' involvement was using the practicum tools which were soiltester and higrotermometer to measure temperature and the humidity of soil and air.

Contextually, science literacy directs students to know the living activities involving science. In terms of knowledge, students were directed to observe the ecosystem. They were asked to show the biotic and abiotic component as well as the interaction between them.

In terms of competences, students were asked to identify scientific issues, phenomena, and use scientific evidences. Their involvement can be done by observing ecosystem destruction. Next, the students can describe the destruction and use the evidences through their senses. Students were asked to show their interest of science, scientific investigation, and responsible act to show their science behavior. It is applied in the learning process with their awareness to the destruction. To motivate them in the learning process, they were asked to design a poster regarding the preservation of the ecosystem.

The result of the learning process showed that the frequency of students who overcome the integration of science literacy were more than 20 % in all aspects. The limited trial obtained the data of 20% which were distributed as 24.57% in context, 26.65 % in knowledge, 23.84 % in competences, and 24.94% for behavior. Then, the wider scope of experiment obtained 25.05 % for context, 26.10 % for knowledge, 23.41 % for competences, and 24.44% behavior. The result showed that the distribution of science literacy integration were similar in all aspects.

This achievement was obtained due to the learning which included the environment as the learning object. It gave students real experience. From its farming environment, students were eased to observe the ecosystem. In fact, this activity made the students were high spirited to learn than before. As supported by Jalil, M. (2016) that "the effectiveness of discovery learning model in helping students came from its activities". Students were motivated to observe the environment around, active in collecting the data, and answered their worksheets easily". Students' involvement in showing biotic and abiotic component as well as their reaction was done well. Referring to Holbrook (1998) in Pantiwati, Y. and Husamah (2014), the level of science literacy was categorized as functional scientific literacy where students can explain a concept correctly with the limited knowledge that they have.

Based on the explanation above, the teacher should do more efforts in developing the strategies to boost students' literacy in higher level. It is relevant to Widiadnyana, *et al* (2014) that Discovery Learning influences students' understanding to science and students' scientific behavior.

CONCLUSION

Based on the result of the research, it can be concluded that: (1) Discovery Learning to improve the science literacy of SMK-SPP Negeri Samarinda students were very valid with the average score of 87.49% from validators (materials, learning technology, and language), (2) Discovery Learning was proved very practical for SMK-SPP Negeri Samarinda students with students' responses of 81.17% in limited trial and 84.33% in wider trial. (3) the learning tools of Discovery Learning to improve the science literacy of SMK-SPP Negeri Samarinda students has high effectiveness to be used from the N-gain of 0.74 in the experiment class (high) while the control class got only 0.30 (medium).

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