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Developing Learning Tools for Environmental Change Material Using Problem Based Learning Model Based on Local Environmental Conditions in Wonosobo

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Abstract

Environmental change material is a material for Senior High Schools (SMA), especially for class X even / second semester. Preliminary documentation studies showed that Biology learning tools, especially material for environmental change, were not in accordance with the 2013 Curriculum. The purposes of this study are: 1) to test the validity, readability, practicality of the developed learning tools; 2) to test the effectiveness of learning tools that had been developed; 3) describe the characteristics of the learning tools development for environmental change material based on local environmental conditions in Wonosobo. This research is a Research and Development (R&D). The results showed that the learning tools that had been developed were very valid to be used in learning activities of environmental change material. The readability and practicality of learning devices was very good as indicated by the response of the students and the teachers to the learning tools that had been developed. The effectiveness of learning tools showed the results of learning aspects of knowledge achieved classical completeness. The attitude of caring for the environment and the skills of students on the subject of environmental change have reached very good criteria. The characteristics of the learning tools that had been developed provide the examples of environmental damage and lake pollution that occurred in the Dieng Plateau so that learning with PBL model can be done optimally.

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INTRODUCTION

The 2013 Curriculum in senior high school level is regulated by the government through the Minister of Education and Culture Regulation No. 24 of 2016 which contains core competencies and basic competencies in academic specialization subjects including Biology. The existence of core competence (KI) and basic competence (KD) is the basis for teachers to develop a learning syllabus. Syllabus becomes a guideline for teachers in developing learning tools.

Environmental change material is material for senior high schools (SMA), especially for class X even / second semester with Basic Competence 3.11. Analyze data on environmental changes, their causes and impacts on life 4.11. Formulating ideas for solving problems of environmental change that occur in the surrounding environment.

NU Kejajar Senior High School is one of the schools that implemented the 2013 Curriculum since the academic year 2013/2014. The results of preliminary study of documentation in Biology class X even semester at SMA NU Kejajar in the academic year 2017/2018 showed that Biology learning tools, especially on environmental change material, were not in line with the tools that had been expected by the 2013 Curriculum. It can be seen from the lesson plan (RPP) that was designed by the teacher. The learning activities specified in the syllabus had not been fully realized in the preparation of the lesson plan, especially in integrating the local environmental conditions of Wonosobo Regency. The incompatibility of these learning tools will have an impact on not achieving the learning objectives that was set by the government. Thus, the development of learning tools for environmental change material in accordance with the learning objectives of the syllabus needs to be developed.

The development of learning tools that make the environment as a source of learning is one of the principles that is in line with Minister of National Education and Culture Regulation number 103 of 2014. Local environmental conditions in the school environment can be utilized as an effective learning resource for learning. Local environmental conditions in learning will facilitate the student understanding so that the learning outcomes can improve.

Local environmental conditions in Wonosobo Regency are geographical conditions, culture, tourism and also the superiority of commodities namely *carica* fruit and *purwaceng*. The learning resources of environmental change material that can be used is the utilization of the surrounding natural environment. One environment that can be used as a learning resources is the environmental changes that occur in the Dieng Plateau area of Wonosobo.

Besides functioning as a protected forest area, the Dieng Plateau also functions as a water absorption area. Reducing forests to cultivated land has an effect on hydrological conditions in this area. It is become more serious by the improper cultivation techniques, which are the planting that is opposite to the contour, so that ecological damage is higher with the potential for land degradation to increase.

The results of interviews with the teacher of Biology subject in the early observation of the 2017/2018 academic year showed that the school had not fully utilized the local environmental conditions of Wonosobo Regency as a learning resource for environmental change material. The learning resources about environmental change material was still limited to the learning in the classroom by using power points and observing images of environmental damage in books. Minimum completeness criteria (KKM) environmental change material of 68 with the classical completeness of students obtained by 73% of students achieving KKM from 75% targeted. The development of learning devices by utilizing the local environmental conditions of Wonosobo Regency in learning can motivate

students to contribute in maintaining environmental sustainability. One learning model that has the potential to help students in learning is to use the Problem Based Learning (PBL) model.

Problem Based Learning is an approach in learning through problem solving that is found every day (Duch et al., 2001) so as to increase student interest in learning (Emlek & Akturk, 2017), PBL in the world of education is described as a learning environment where students are introduced to problems related to the learning material and are invited to find the solutions. Through this process students are directed at receiving new information and knowledge (Padmavathy & Mareesh, 2013). In addition, the PBL model in learning besides using a constructivist approach is also able to make students play an active role, analyze and solve problems even though their ability levels are varied (Fauzan *et al.*, 2017).

This study aims to examine the validity, readability, practicality, and effectiveness of learning tools for environmental change based on local environment in Wonosobo Regency, towards the learning outcomes of NU Kejajar Senior High School students, and describe the characteristics of the development of learning tools for environmental change materials based on the local environment in Wonosobo Regency.

METHOD

This research was a research and development (R&D). In this research, product development is carried out in the form of learning tools. The development of learning tools began with initial observations that was carried out in the even semester in the academic year 2017/2018, student learning outcomes in the aspects of knowledge reached 73% complete KKM, while aspects of skills in solving the problems and aspects of environmental care attitude was still lacking. The results of the initial interview with the teacher of Biology subject showed that one of the efforts to increase the value of knowledge, problem solving skills and care for the environment was the development of learning tools. The intended potential was the potential of the local environment in Wonosobo Regency that can support learning on Environmental Change material, namely environmental damage and lake pollution in the Dieng Plateau region that had not been overcome to the maximum. The tools developed were in the form of syllabus, lesson plans, and teaching materials.

The object of the research was the students of SMA NU Kejajar consisting of class X MIPA 1 20 students and class X MIPA 2 18 students.

The limited scale test took 10 students from Class X MIPA to find out the level of readability and ease of students in understanding the instructions contained in the learning tools (in this case the tool tested was in the form of teaching materials). Then a large-scale test was a test of the application of learning devices using 2 treated classes and then the results were observed.

Data Sources of the Research

Data and data sources in this study were presented in Table 1.

Table 1. Data and Data Sources

Data and Data Sources	Types of Data	Data Sources
The validity of learning tools (Syllabus, lesson plans, teaching materials)	Quantitative	Education and material experts
Readability of teaching materials	Quantitative	Students and teachers
Practicality of learning tools	Quantitative	Students and teachers
Learning outcomes	Quantitative	Students
a. Knowledge Aspects		
b. Attitude Aspects		
c. Skills Aspects		

Data Analysis Technique

The readability and practicality of the product were seen from the responses of students, teachers and the level of implementation of learning activities. The percentage of student, teacher responses and performance in learning was calculated using the modified formula from Sudijono in Listiani (2017) and the criteria for evaluating student attitudes can be seen in Table 2.

——————————— x 100%

Table 2. Criteria for evaluating student attitudes during learning

Percentage (%)	Criteria
85 - 100	Very good
70 - 84	Good
60 - 69	Fair
50 - 59	Poor
< 50	Very poor

Product effectiveness was seen from the completeness of learning outcomes aspects of students' knowledge, attitudes and skills. Knowledge aspects are carried out using tests. The completeness of student learning outcomes in a classical manner can be effective if more than 75% of students are able to reach KKM. Quantitative data processing is done using statistical tests on the results of the pretest, posttest, and *N-Gain* data from the experimental class to then determine the average score and standard deviation. Assessment of learning outcomes aspects of student attitudes and skills is calculated using a modified formula from Sudijono in Listiani (2017).

RESULTS AND DISCUSSION

Results

Validity of the Learning Tools

Product validity of learning tools for environmental change material with PBL model based on the local environmental conditions in Wonosobo Regency was carried out by material experts namely Dr Partaya, M.Sc and media expert Dr. Sigid Saptono, M.Pd. The results of the learning tools product validation can be seen in Table 3.

Table 3. The Recapitulation of Results of Learning Device Validation by Material Experts and Media Experts

No	Product Types	Total Score	Percentage (%)	Criteria
1	Syllabus	42	88	Very Valid
2	Lesson Plan	80	91	Very Valid
3	Teaching Materials (Material Experts)	68	89	Very Valid
4	Teaching Materials (Media Experts)	50	89	Very Valid
5	Questionnaire of Students' responses to the use of teaching materials	30	94	Very Valid
	Average		90	Very Valid

Validation of learning tools for environmental change material obtained an average of 90%, it means that the developed learning tools were very valid in use. Giving a score of 42 out of 48 in the development of syllabus was because there still needed to be improvement in the basis of the division of student groups and inventory of environmental damage. In the development of learning tools improvements were made to these aspects.

The results of the lesson plan validation that had been developed have a score of 80 out of 88 with very valid criteria by material experts. It means, the lesson plan material for environmental change with a PBL model based on local environmental conditions in Wonosobo District that had been developed was very valid for use. Giving a score of 80 due to the use of prefixes or prepositions that were not suitable yet. The lesson plan that was implemented had been corrected in accordance with the direction of the validator at several points above so that the learning activities can be carried out according to the learning objectives.

The results of the validation of teaching materials that was developed got a score of 68 (maximum score of 76) with valid criteria by the material experts. It means that teaching materials that had been developed were valid to use. Giving score 3 on the depth aspects of the material, the accuracy of facts and concepts, the accuracy of illustrations, conformity with the development of science, contextual, balance between sub-topics, variations in presentation, and bibliography. The teaching material that was used had been improved according to the directions of the validator on the aspects above.

The results of the validation of teaching materials by learning media experts obtained a score of 89% with very valid criteria. It means, the teaching materials on the environmental change with PBL model based on the local environmental conditions in Wonosobo Regency that had been developed were very valid and can be used in research.

The evaluation of instructional materials by media experts got the high scores, but there were still some aspects of teaching materials that still needed to be improved; the writing of titles must be enlarged and clarified, writing errors, pictures in teaching materials to be more focused on the context, there are no instructions for the use of teaching materials and table of contents. Therefore, the teaching materials were revised so that the writing of the font size was enlarged and clarified. The image size was more clarified so that it was more focused on the context, improvement in writing errors. Instructions for using instructional materials did not yet exist so it was necessary to include the following contents list in order to facilitate students in using teaching materials. Font sizes in teaching materials were more varied with a variety of background colors to make them more attractive to students.

The results of the developed student response questionnaire got the score of 94% with very valid criteria by the material experts. It means, the student response questionnaire

that had been developed was very valid to be used, but before the questionnaire was distributed, it was improved according to the direction of the material expert.

Readability and Practicality of Learning Tools

Learning tools that had been validated and revised were then tested on the limited scale to determine the level of readability and practicality in learning activities of environmental change material with PBL model based on the local environmental conditions in Wonosobo.

The results of recapitulation of student responses, teacher responses to the use of learning tools, and the level of feasibility of learning were presented in Table 4.

Table 4. Recapitulation of Student Responses, Teacher Responses to The Use of Learning Tools, Level of Implementation of Learning Material on Environmental Change Based on Local Environmental Conditions in Wonosobo

No	Types of Data	Percentage (%)	Criteria
1.	Limited scale Students' response	81	Good
2.	Large scale Studens' response	89	Very Good
3.	Teacher's response	85	Very Good
4.	Level of Learning Execution	86	Very Good
	Average	85	Very Good

Recapitulation of the students' response, teachers to the use of learning tools, the level of learning accomplishment got an average percentage of 85%, which means the learning device has very good criteria.

Students expressed interest in learning materials based on local environmental conditions in Wonosobo. The lowest assessment by students on a limited scale test of the learning device was the cover/cover of teaching material which scores 70%. Improvements and revisions to the cover were made to make teaching materials better and students become more interested in learning activities.

Students on the large-scale test responded very well to the learning tools developed with a score of 89%.

The Effectiveness of Learning Tools

The results of learning aspects of students' knowledge, attitudes and skills were presented in Table 5.

The teacher responded very well to all aspects of the assessment of the learning tools developed. Learning tools for environmental change materials based on local environmental conditions in Wonosobo were very helpful for teacher during the learning process. Learning activities about environmental change material became more interesting because students became more familiar with the conditions of the environment in which they live.

Student responses to the implementation of learning got an average score of 86% with very good criteria and the lowest score in the aspect of applying similar learning models to other materials scored 79%.

Table 5. Recapitulation of Learning Outcomes Aspects of Knowledge, Attitudes and Skills

No	Assessment Aspects	Percentage of completeness		Average	Criteria
		X MIPA 1	X MIPA 2		
1	Knowledge	90%	89%	90%	Very Good
2	Environmental care attitude	97%	98%	98%	Very Good
3	Skills	95%	92%	94%	Very Good

Learning aspects of knowledge aspects were taken using test questions before and after learning activities using the developed learning tools. Data was taken to measure the level of classical completeness of student learning outcomes.

The completeness of student learning outcomes has reached high completeness, class X MIPA 1 the percentage of completeness was 90% and class X MIPA 2 the percentage of completeness was 89%. The mastery of learning outcomes in the knowledge aspect reached an average of 90% of the provision of achieving a value of ≥ 68 on material changes in the environment.

Based on the recapitulation of the results of measurements of Normality gain (N-gain) the results of the assessment of aspects of knowledge were presented in Figure 1.

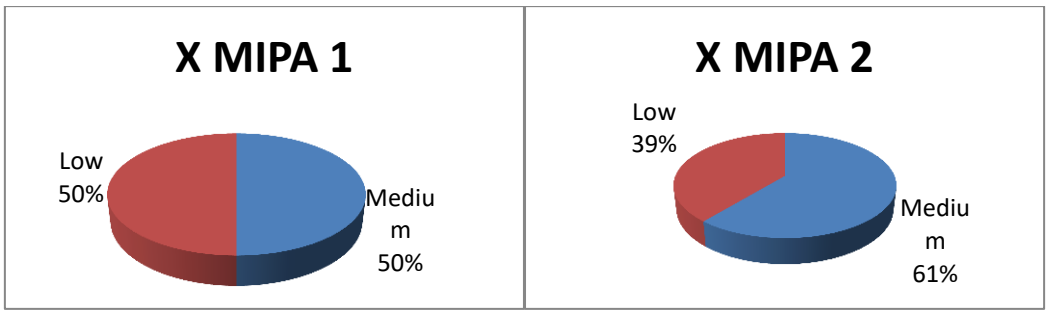

Figure 1. Recapitulation of Measurement Results for normality gain (N-gain)

Based on the results of the recapitulation of measurements of Normality gain (N-gain) in Graph 1, it can be seen that in class X MIPA 1 there were 50% of students who received N-gain with moderate criteria and 50% of students who received low N-gain, in class X MIPA 2 there are 61% of students who get N-gain with medium criteria and 39% of students who get low N-gain.

Learning outcomes of the aspects of caring for the environment were taken during the learning process as many as four meetings. The recapitulation of criteria for the value of environmental care attitudes gained a very good average of 98%.

Data was taken from observation sheets of students' environmental care attitudes. Assessment of learning outcomes aspects of student attitudes have reached very good criteria except in the aspect of environmental concern for others. The lowest score of environmental concern for fellow citizens only gained 89% with a very good category. Some students did not dare to reprimand friends who throw garbage not in place.

Learning outcomes aspects of student skills were carried out through observation as much as 2 meetings. Recapitulation of the value of student skills was presented in Figure 2.

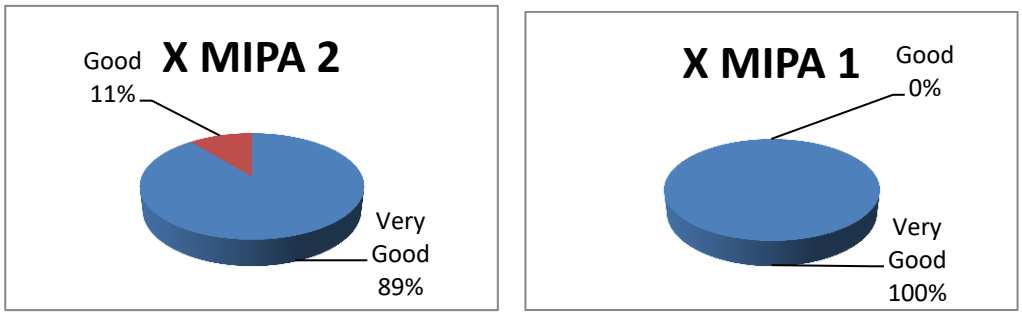

Figure 2. Recapitulation of Student Skill Values

Based on the value of student skills showed that all aspects assessed reach very good criteria. The lowest percentage was obtained 92% in preparing tools and materials. Preparation of learning activities that was carried out still required guidance from the teacher in preparing the tools and materials used. In some groups it was still incomplete in carrying the tools and materials needed for learning activities.

The Characteristics of Learning Tools Development Results

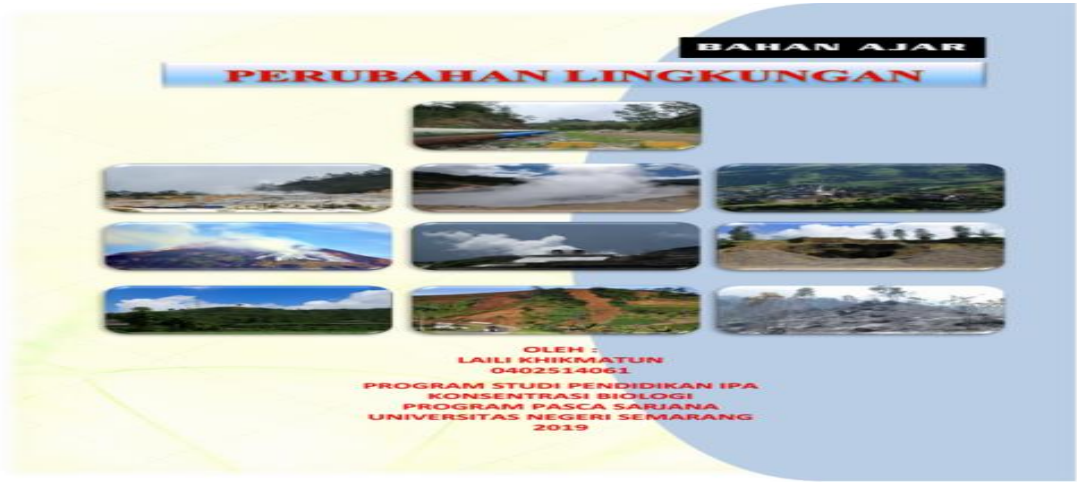

Figure 3. Cover of Teaching Materials

Learning tools for environmental change material were developed based on local environmental conditions in Wonosobo. The device that was developed consists of syllabus, lesson plans and teaching materials based on environmental damage, lake pollution and environmental preservation efforts in the Dieng Plateau region. Components in the syllabus were the subject matter presenting environmental damage and lake pollution in the Dieng Plateau region and its preservation efforts. Learning activities are designed in accordance with the syntax of Problem Based Learning (PBL) with learning resources in the form of photos and data on damage and lake pollution in the Dieng Plateau region arranged in the form of teaching material "ENVIRONMENTAL CHANGE" in addition to books from the Ministry of Education and Culture.

Lesson Plans were presented in 4 meetings, each meeting 3 lesson hours (3 X 45 minutes) with PBL models and discussion methods. The 1st and 2nd meeting of the discussion and presentation of environmental damage, lake pollution in the Dieng Plateau area and its conservation efforts. The 3rd and 4th meetings of the making and presentation of pamphlets containing ideas or efforts to preserve the environment.

The learning process used teaching materials which contain basic competencies and indicators of achievement of competencies, deepening of material containing theories and concepts of environmental change material equipped with photos, data on environmental damage and lake pollution in the Dieng Plateau region and environmental conservation efforts, student discussion sheets about damage environment and pollution of the lake in the Dieng Plateau area, and let's work which contains a description of pamphlet-making activities on environmental preservation efforts. Test questions contain evaluation questions on environmental change material to measure students' knowledge abilities.

Learning tools for environmental change materials based on local environmental conditions in Wonosobo District were developed to present data and photos of environmental damage and lake pollution in the Dieng Plateau area that were delivered with PBL models.

Discussion

The development of learning tools based on local environmental conditions in Wonosobo Regency through a validation process by media experts and material experts. This was done to determine the feasibility of the learning device developed.

Based on the results of the validation of learning tools by material experts and learning media experts developed an average percentage of 90%, which means it was very valid so it was suitable for use in learning. The validity was due to the learning tools that was developed had met the criteria for media and material development. According to Matondang (2009), validation was done aimed at knowing a product that is developed can be declared valid or not. That is, the measurement results from the measurement of high product validity is a quantity that reflects precisely the facts or the actual conditions of what is measured.

The process of developing learning devices needed to be revised, even though it has obtained very valid criteria. The revision of learning devices was carried out to produce products that were increasingly good in terms of media and material aspects. Revisions were made to inputs and suggestions obtained from media expert validators and material experts.

The components that need to be revised in the syllabus were in the distribution of student groups and inventory of environmental damage. The local environment of Wonosobo Regency where students live was a source of learning for students in research. According to Winarti *et al*. (2018) learning resources have an important role in the learning process because with the availability of adequate learning resources will help teachers and students in facilitating the learning process so that learning objectives that have been set can be achieved.

The components in the lesson plan that need to be revised include the use of prefixes in or prepositions that were not in accordance with the rules of Indonesian grammar.

Components in teaching materials according to experts of the material that need to be revised, that are the depth of the material, the accuracy of facts and concepts, the accuracy of illustrations, conformity with the development of science, contextual, balance between sub-topics, variations in presentation, and bibliography. According to media experts, the components that need to be revised were the cover of teaching materials, the size of the images contained in the teaching materials, and the usage instructions that do not yet exist. The improvements to these aspects were made so that teaching materials become more interesting and can motivate students in learning. In accordance with the statement of Ibrahim & Syaodih (2006) about the principle of learning that is the effort that teachers can make to arouse students 'learning by using various learning methods and media, choosing interesting material and according to students' needs and creating a pleasant learning atmosphere. Variation in presentation was very important so that teaching materials become more interesting to use. The choice of color in the display of teaching materials, text and color in the background must have criteria that are

easily seen. The colors in the text must contrast with the background color. Color selection must pay attention to the use of color.

The selection of the right image needs to be considered to attract attention and facilitate students in understanding the material. Samsudin (2016) explains that the selection of the right images on the learning media has a very big influence in attracting students' interests, so students easily understand the material presented. Images on instructional materials developed also have a function to clarify the information conveyed to students.

Clarity of instructions on the use of teaching materials needed to be clarified. It was done because students were not accustomed to learning using teaching materials based on local environmental conditions in Wonosobo Regency, so that a small number still experienced difficulties in understanding teaching materials. According to Kristanti *et al*. (2012) Students who are not familiar with teaching materials will have difficulty in understanding teaching materials.

Students and teacher responses were taken to find out the readability and implementation of learning activities using learning tools for environmental change based on local environments in Wonosobo Regency.

The results of student and teacher responses show that the learning tools developed have met the level of readability with very good criteria. The teacher also gave very good responses to the learning devices that had been developed. The learning tool applied was a learning device that has met the criteria both in terms of content and presentation material so that it was feasible to be applied in learning.

The enthusiasm of students in learning activities was increasingly apparent with the development of learning tools. Students are excited and interested in campaigning for environmental preservation. The results of research that was conducted by Sofnidar & Sabil (2012) stated that learning activities carried out in the environment around students can improve understanding of the learning material being taught. Students also actively build new knowledge from their initial knowledge. Adwiah *et al*. (2016) also described the use of media and learning resources as one of the keys to the development of learning activities in a school. Students' enthusiasm for learning material is caused by the presence of media in learning. Development of learning tools makes it easy for students to learn learning material. The material contained in it uses easy-to-understand language. Besides the photos and data on damage and environmental pollution that are displayed are the real conditions that exist in their living environment, so the development of learning devices attracts students' attention.

Learning outcomes that was obtained by students include the aspects of knowledge, the aspects of attitude to care for the environment and the aspects of skills. The results of learning aspects of knowledge showed the X grade of MIPA 1 achieved 90% completeness and class X MIPA 2 89%. The acquisition of high student learning outcomes showed that the enthusiasm of students was also high in learning activities.

The results of N-gain acquisition showed a slightly different class X MIPA 2 better than class X MIPA 1. and vice versa for the value aspects of class X MIPA 1 skills were better. However, the results of the t test are not significantly different.

The results of the research that was conducted by Haryadi *et al*. (2015) states that the acquisition of optimal learning outcomes showed the success of the quality of the learning process that was carried out with a variety of learning models. The application of PBL model learning has elements or characteristics that make students better understand the material. The teacher does not merely provide knowledge to students but rather facilitates students to build their own knowledge so that they have a better understanding of the material.

The results of the final evaluation indicate there were still students who got low grades (not yet completed). According to Hindasti *et al*. (2016) the cause of the low value of student evaluation was due to internal and

external factors of students. Internal factors that also influence other than enthusiastic learning and learning models applied include physiological aspects (health) and psychological aspects (learning styles) of students. Other external factors that also influence include parental support in achieving learning outcomes.

Learning outcomes aspects of environmental care attitude determines classical completeness by 98% with very good criteria. This achievement is excepted in the aspect of caring for fellow students, some students have not dared to reprimand their friends who throw garbage out of place. Each student has a different character. According to Setiawan *et al*. (2016), students are reluctant to reprimand friends who make mistakes because some students have shy characters.

The high score of environmental caring attitudes that was obtained after learning with PBL showed that the attitude of caring for students is evident. It is consistent with the results of Khanafiyah's (2013) research that learning that applies the PBL model can improve students' environmental care attitudes. Increased attitudes of environmental care can be seen from the habits of students who began to look like throwing trash in its place, more diligent in carrying out class pickets and maintaining a clean school environment.

The results obtained by the aspect of skills with very good criteria. Criteria for achievement of results the skills aspects of the students of Class X MIPA 1 were better than those of Class X MIPA 2, however the results of the t-test were not significantly different.

This is consistent with the study of Priadi *et al*. (2012) the use of PBL models provides students the opportunity to develop communication skills, representation, modeling and reasoning. The results of the same study by Kelly & Odilla (2007) stated that the PBL approach provides more scope for the development of skills and understanding of experimental concepts and processes.

CONCLUSION

The conclusion in this study was the validity of the learning tools for environmental change material with PBL models based on local environmental conditions in the Wonosobo Regency that were developed were declared to be very valid for use in the learning activities of environmental change material. The readability and practicality of learning tools was very good as indicated by the response of students and teachers to the

learning devices developed. The effectiveness of learning tools showed the results of learning aspects of knowledge achieved classical completeness. The attitude of caring for the environment and the skills of students on the subject of environmental change have reached very good criteria. The characteristics of the learning tools that was developed present the examples of lake damage and pollution in the Dieng Plateau region, so that learning with PBL model can be carried out optimally.

Teachers were advised to develop learning tools for environmental change materials with PBL models based on local conditions that were interesting and enjoyable as learning resources.

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