

Development of Learning Device based Ethnoscience for Heat Material in Kabupaten Tegal

Susilawati, Nizar Setiawan, Nur Khoiri

Department of Education Physics, Universitas PGRI Semarang, Jl Sidodadi Timur No. 24 Semarang, Indonesia

Article Info

Article history:

Received Aug 8, 2017

Revised Jan 10, 2018

Accepted Feb 14, 2018

Keywords:

Ethnoscience

Heat material

Learning set of physics

ABSTRACT

The purpose of this research is produce learning set equipment on heat material of ethnoscience based in Tegal district, The results showed that the feasibility of syllabus-based ethnoscience include into the category is very good because it has a percentage of 96,43%. The feasibility learning device of an ethnoscience-based into a very good category because it has a percentage of 91,37%. Ethnoscience-based learning tool able to improve student learning outcomes from the average value of 42,82 to 80,06 and the gains value 0,65. While the questionnaire of student's learning interest after the application of physics learning device on ethnoscience based heat material in Kabupaten tegal get the average value 3,01 with the high criteria.

Copyright © 2018 Institute of Advanced Engineering and Science.
All rights reserved.

Corresponding Author:

Susilawati,
Departement of Education Physics,
Universitas PGRI Semarang,
Jl Sidodadi Timur No. 24 Semarang, Indonesia.
Email: susilawati.physics@gmail.com

1. INTRODUCTION

The Ethnoscience is the activity of transforming between authentic science and scientific science. The original science knowledge consists of all the pertinent knowledge about the facts of society [1]. That knowledge comes from hereditary beliefs [2-5]. Central Java people when using traditional herbal medicine for the disease in the form of powder and herb extract of traditional plants. Society has applied original science knowledge about medicine, isolation and extraction of bioactive compounds of natural materials. But the original science is in established scientific science. Similarly, local wisdom in the Pegirikan Tegal area. The livelihood of some people in Pegirikan Village as a blacksmith.

Blacksmiths in the village Pegirikan mostly making kitchen tools and farming tools, is currently planting season so being a lot of reservations. The process of making hoes in Pegirikan Village is still using traditional tools. One of them is a furnace used for the heating process of iron before it is formed and during gilding. Knowledge and skills about making hoes both in the process of cutting the material until finishing obtained from generation to generation [6-10]. One form of local wisdom that can be applied in the learning of physics is the process of making hoes in the blacksmith industry, especially in the process of burning or heating iron [11].

In the process of iron heating in Pegirikan Tegal after the process of formation and cutting, iron is heated approximately five to ten minutes after iron red whitish. After that, the iron is forged by beating then The Ampel Mount that is useful to make the hoe is not easily broken when used. After installation of the next Ampel Mount of the gilding process, the gilding process is useful for sharpening the hoe by being burned and then inserted into the water.

The process of forming to the completion of the finishing process in the process of heating and gilding is what can be used in physics learning [12, 13]. On the subject of heat, there are sub subject of heat

transfer. The heat transfer consists of heat transfer by conduction, convection, and radiation. The variable contained in heat transfer is temperature, heat will move from high temperature to lower temperature.

Physics can be considered important to be taught as a separate subject with some consideration [14]. First provide the provision of knowledge to learners, physics is intended as a vehicle to foster thinking skills that are useful for solving problems in everyday life. Secondly, the subjects of physics need to be taught for a more specific purpose of equipping learners of knowledge, understanding and the number of abilities required to enter higher education and to develop science and technology. Therefore physics is closely related to the diversity of local wisdom.

The 2013 curriculum emphasizes the importance of character building in schools, especially in primary education. The competency standards of graduates formulated in the 2013 curriculum in general related to behavioral attitudes are a person of faith, noble character, confidence, and responsible in interacting effectively with the social environment, the natural environment, and the world and its civilization [15]. The competence should be formed in the learners when participating in teaching and learning activities in school as a learning effect as well as the effect of accompaniment or nurturant effect [16, 17].

Physics learning should be able to help the character develop in the learners themselves. However, in the execution of the delivery of physics lessons there are still shortcomings. The shortcomings in question, among others, most teachers only emphasize the ability of memory to know the ability of participants. Learning that is still based on rote theory and not based on experience [18]. This makes the learners difficult to improve learning outcomes cognitively, affectively and psychomotor. When viewed from the side of cognitive, learning by memorizing methods to make learners can only imitate and tend not to maximize the ability to analyze, in terms of affective learning using the method of memorization impact on learners who are less brave in expressing his opinion. In addition psychomotor learners become less creative in facing and finding solutions of a problem.

An ethnosocial based or attuned learning course will succeed if the teacher understands the insights of ethnosciences itself [19]. Weak understanding of ethnosciences can have an effect on concern for local cultural plurality. Meanwhile, the obstacles that arise when teachers do science learning and ethnosciences approach is the teacher has lack of skills, consequently learners have not maximized learning that appreciates the diversity of local culture and local wisdom [20].

The existence of instructional tools is important for teachers, because the tool is a learning scenario that will be implemented in the classroom during the lesson [21]. Learning tools serve as guidance for teachers in conducting learning in the classroom, in collaboration, or in the field for every basic competence. Therefore, teachers should be able to make learning tools worthy of use. The learning tools based on ethnosciences include excellent criteria and deserve to be used as learning tools and improve learners' learning outcomes.

Based on the explanation that has been presented, the researcher intends to develop the physics learning device on ethnoscience based heat material in Kabupaten Tegal. The purpose of this research is to develop physics learning device on ethnoscience based heat material in Kabupaten Tegal and to know the interest of student learning after application of physics learning device on ethnoscience based heat material in Kabupaten Tegal.

2. RESEARCH METHOD

The method use is Research and development. The location of this research was conducted in SMA Negeri 1 Pangkah. Address at Kalikangkung Village, Pangkah District, Kabupaten Tegal. This study was conducted in the academic year 2016/2017 even semester. Population in this research is all student of grade X SMA N 1 Pangkah academic year 2016/2017. The sampling technique is done by using purposive sampling. Purposive sampling is a technique of determining the sample with certain considerations. This sample is more suitable for qualitative research, or research that does not require generalization. The samples this study use amounted 33 students who are in grade X-A. Data collection in this study used observation, documentation, questionnaires and interviews [22]. Data analysis in this study include validation analysis of heat material, validation analysis of feasibility of learning tools and questionnaire analysis of student learning interest.

3. RESULTS AND ANALYSIS

The ethnoscience based learning tool on heat material in Kabupaten Tegal is a learning device that contains ethnosciences. Assessment of learning device validation was assessed by two experts in heat experts and learning device experts. Validation of this product is Suprpto, S.Pd., as the subject of physics teacher at

SMAN 1 Pangkah. The percentage of teaching device product by experts can be seen in Table 1, Table 2, and Table 3.

Tabel 1. Result of sillabus validation

No.	Aspect	Scor	Max	Recommendation	Category
1	Content	25	28	89.29	very good
2	Languange	4	4	100	very good
3	Time	4	4	100	very good
	Total	33	36	96.43	very good

Scores obtained validator results can be said very well. In the feasibility questionnaire each syllabus score of each aspect is from the aspect of the content to be presented obtained 25 from a maximum score of 28, the language aspect obtained 4 of the maximum score of 4, and the time allocation aspect obtained 4 of the maximum score 4.

Table 2 Results of the Lesson Plan Feasibility Questionnaire

No.	Aspect	Scor	Max	Recommendation (%)	Category
1	Lesson plan component	28	28	100	very good
2	Link component	24	28	85.71	very good
3	Eligibility of learning activities	12	12	100	very good
4	Selection of teaching materials	3	4	75.00	very good
5	Selection of media	7	8	87.50	very good
6	Selection of learning resources	8	8	100	very good
	Total	8	88	91.37	very good

The feasibility questionnaire of lesson plan score of each aspect is for the component of the lesson plan obtained score 28 from the maximum score 28, the aspect of the interrelationship between the components of the learning implementation plan obtained score 24 from the maximum score 28, the eligibility aspects of the learning activities obtained Score 12 of the maximum score of 12, the selection of teaching materials obtained a score of 3 from a maximum score of 4, the media selection aspect obtained a score of 7 from a maximum score of 8, and aspects of selection of learning resources to get a score of 8 from a maximum score of 8.

Table 3 Results of Material Feasibility Questionnaire

No.	Aspect	Scor	Max	Recommendation (%)	Category
1	Quality of content	8	8	100	very good
2	Quality of presentation method	16	20	80	very good
3	Language usage	8	8	100	very good
4	Use of illustrations	4	4	100	very good
5	Quality and completeness of supporting languages	4	4	100	very good
6	Quality of teaching materials physics	7	8	87.5	very good
7	Relevancy and credibility of the source book	4	4	100	very good
	Total	51	56	95.36	very good

In the feasibility questionnaire of each teaching material score of each aspect is from the aspect of the quality of the contents obtained 8 of the maximum score of 8, quality aspects of research methods obtained 16 of the maximum score 20, the use of language aspects obtained 8 of the maximum score 8, the use of illustration aspect obtained 4 Of the maximum score of 4, quality aspects and completeness of the supporting language obtained 4 of the maximum score 4, the quality aspects of teaching materials physics obtained 7 of the maximum score 8, and the relevance and credibility of the book source 4 of the maximum score 4.

Based on Table 1, Table 2, and Table 3 it can be seen that the validation result from the expert got the average percentage of Sillabus 96.43 percent, the feasibility of lesson plan 91.37%, and 95.36% of the learning material is categorized as excellent product. In addition to validators to assess this learning tool is also assessed by Sigit Ristanto, M.Sc., as a material expert. The results of the assessment percentage of material expert validation can be seen in Table 4.

Table 4 Results of Expert Assessment of Material Expert Validation

No.	Aspect	Scor	Max	Recommendation (%)	Category
1	Quality of material	21	24	87.5	very good
2	Presentation of material learning	12	16	75	good
3	Quality of technique	15	16	93.75	very good
4	Quality of interaction	16	20	80	very good
5	Presentation of visual media	4	4	100	very good
	Total	68	80	87.5	very good

Scores obtained from the validator results can be said very well. In the questionnaire validation of the material experts each score of each aspect is from the aspect of material quality 21 of the maximal score 24, the presentation aspects of learning materials 12 of the maximum score 16, the quality engineering aspects 15 of the maximum score 16, the interaction quality aspect 16 of the maximum score 20, Visual media presentation aspect 4 of maximum score 4. Based on Table 4, it can be seen that the validation by the material expert is average percentage of expert material valuation of 87.5 percent and categorized very well. The product validation is performed after the design of the ethnosciences based learning device in Kabupaten Tegal for SMA approved by the supervising lecturer to be validated by the expert.

The next step after the validation and revision process is a trial. Physics learning device on ethnosciences based heat material in Kabupaten Tegal is tested to learners. Validation of products in the form of teaching materials by students of grade XA SMA N 1 Pangkah consisting of 33 students. The score of the results of the questionnaire by the students can be seen in Table 5.

Table 5 Results of Student Learning Interest Questionnaire

No.	Statement	Average	Category
1	Fun learning modules	3.21	always
2	Fun learning	2.85	often
3	Physics material	3.18	always
4	Ethnosciences module	2.67	often
5	Examples in everyday life	3.09	always
6	Enthusiastic in reading modules	2.85	often
7	Questions I have not understood	2.79	often
8	Listen to a question	3.39	always
9	Grow students interest in learning	2.76	often
10	Insights on new information about heat	3.21	always

The initial phase of the study is a preliminary study which includes literature study and interview. After the draft learning device is completed then the researcher conducts guidance with the supervisor to ask other things less before implementing the expert validation. This expert's validation consists of validation of the feasibility of learning tools and material experts. Feasibility experts consist of a physics teacher is Suprpto, S.Pd while the material expert consists of a lecturer namely Sigit Ristanto, M.Sc. Percentage of Silabus eligibility to be tested is 96.43% and categorized very good. Because the syllabus based ethnosciences get percentage of each aspect that is on content aspect to be studied 82.29%, aspect of language 100%, aspect of time allocation 100%.

The lack of perfect syllabus is the depth and breadth of the material. The validation result of the feasibility of the lesson plans by experts is obtained by percentage of 91.37% and categorized very well. Because the percentage of each aspect is the aspect of lesson plan 100% component, the aspect of interrelationship between component of lesson plan 85.71%, 100% learning feasibility aspect, material resource selection aspect 87.5%, media selection aspect 75%, and selection aspect of learning resource 100%. Percentage of ethnosciences based resource to be tested is 95.36%. In detail the feasibility of teaching materials on the aspect of quality content 100%, quality aspects of presentation method 87.5%, language usage aspect 100%, illustration usage aspect 100%, quality aspect and 100% language support 100%, physical quality of teaching materials 80% and the relevance and relative aspects of the source book. Factors affecting the magnitude of the value of the feasibility is not optimal based on the assessment of the expert is less precise in the quality of the method of serving one of them on the placement of images and text.

According to expert learning validators, learning tools on ethnoscience based heat material in Kabupaten Tegal have advantages that have linked the material with daily life, the aspects contained in the learning tool on ethnosciences heat materials in Kabupaten Tegal is complete and the teaching materials Interactive. According to the experiment validator, the lack of learning tools on ethnosciences based heat material in Kabupaten Tegal is less interesting material packaging, the allocation of time is too long while the physics learning time in school is only three hours of lessons per week or just 135 minutes in a week, and the

lack of sheets Practicum in lesson plan contained in learning tools on ethnosciences based heat material in Kabupaten Tegal.

Based on these shortcomings, the validator provides suggestions to make the packaging of teaching materials more interesting, the allocation of time adjusted with the hours of physics learning contained in the school, and more plus the study of ethnosciences. The result of validation of the material content of the material expert is 87.5% on the content quality aspect, the presentation aspect is 75%, the quality of the technique is 93.75%, the interaction quality is 80%, and the presentation aspect is 100%. Validation of assessment sheet of all assessment indicators is 87.5% with very good category. Because the material contained in the class X physics teaching materials for ethnosciences based heat subjects in Kabupaten Tegal has the advantage of having linked the theory with the facts that exist in the community.

Based on the material inadequacies found in the class X physics teaching materials for ethnoscience based heat, subjects in Kabupaten Tegal is the lack of illustrative drawings to clarify the matter about heat transfer, the factual lack of numbers in sample 2, and no explanation of the process of making a hoe. So from the above deficiencies, the validator suggested to be corrected before doing the test in SMA N 1 Pangkah by adding illustration to the material of heat transfer, adding explanation to the illustration contained in the teaching materials, fixing example 2 with more factual number, and add an explanation of the hoe making process at the beginning of the instructional material page.

Range of percentages and qualitative data criteria, 76% -100% percentage is included in the criteria very well. So it can be concluded that the percentage of feasibility of learning tools both comes from syllabus expert, lesson plan, teaching materials, and material experts based on the results of research development of ethnoscience based learning tool on heat material in Kabupaten Tegal this study included in very good criteria or very worth to be tested. Limited trials of research on development of learning devices based on ethnosciences in heat material in Kabupaten Tegal conducted in class X-A SMA N 1 Pangkah as research subjects. In the first step of the test, the study provided a pretest. This pretest aims to determine the initial state of the learner before using an ethnoscience based learning tool on heat material in Kabupaten Tegal in learning activities. Then learners are conditioned form a discussion group and share the physicsbased learning module of ethnosciences in Kabupaten Tegal for the subject of heat to the learners. The researcher's subject in learning. The material in this research is heat material. Learners discuss with the group to discuss the issues on the group discussion sheet. After discuss problems to get a solution, learners forward to present the results of the discussion.

The second meeting of students to carry out practicum activities to determine the heat of iron fault type. During the implementation of practical activities students can work group well. This is accordance with the observer observation of the activities of learners in carrying out learning activities. The third meeting of learners review the material that has been studied, and ending with the researcher giving posttest. From the pretest and posttest values, the researcher can know the unrealized gain. After the posttest answer sheets were collected, the researcher provided several physics modules based on ethnosciences in Kabupaten Tegal for high school class X as a support for learning. The researcher gave a questionnaire of student's interest in learning to the subject of the researcher to give feedback about the interest of learning after using ethnoscience based physics module in Kabupaten Tegal for Grade X SMA. The average pretest result of the study subjects was 42.82 while the mean posttest of the subjects of this study was 80.06. Based on gain test analysis, the difference of pretest and posttest score shows improvement of learning result which is included in medium category because gain value obtained is 0.65. The value is categorized as being or not quite distant.

The results of this study support the results of several studies that have been done previously that is related to using learning-based ethnosains. There is an increase in learning outcomes between students in learning with ethnosciences approach [23,24]. This is science learning using ethnoscience approach, students are more interested and enthusiastic about learning because students feel the science learning approaches ethnosains more fun compared with conventional learning. Furthermore, students' ability in learning is influenced by the speed and accuracy of individual thinking, the ability to analyze concepts will train students to think [25].

Based on student questionnaires, ethnoscience based physics teaching materials in Kabupaten Tegal for high school grade X-A developed heat subject matter can attract students' learning interest to study it. This is seen from the first impression see developed teaching materials. Students are enthusiastic, this is also seen from the acquisition of percentage from student questionnaire that is ethics based physics teaching materials in Kabupaten Tegal for senior high school grade X developed on very good criteria and seen from increasing student learning outcomes. If the lesson learned is not in accordance with the interests of students, students will not learn well. If learning without interest, students will be lazy and will not get satisfaction in following the learning.

4. CONCLUSION

Based on the formulation of the problem, the development of learning tools, limited testing, data analysis and discussion of the problem. It can be concluded that the development of ethnosciences based learning devices on heat materials in Kabupaten Tegal has been developed successfully. Learning tools in the form of syllabus, lesson study, and teaching materials including the criteria so well worthy to use. Based on the questionnaire of student's interest in learning after the application of physics learning device on ethnoscience based heat material in Kabupaten Tegal get a total of 3.01 with the criteria always read.

ACKNOWLEDGEMENTS

Department of educational physics and SMAN 1 Pangkah Kabupaten Tegal, physics departement Universitas PGRI Semarang and KEMENRISTEK DIKTI are given support and facilities this research. Thanks for full opportunities this research.

REFERENCES

- [1] Battiste, M., "Indegenous Knowledge: Foundation for First Nations," Canada: University of Saskatchewan, 2013.
- [2] Kind, P.M. "Establishing Assessment Scales Using a Novel Disciplinary Rationale for Scientific Reasoning," *Journal of Research in Science Teaching*, vol. 50(5), pp. 530–560, 2013.
- [3] Ding, L., Wei, X. & Mollohan, K. "Does Higher Education Improve Student Scientific Reasoning Skills?" *International Journal of Science and Mathematics Education*, vol 10 (2), pp. 21–37, 2014.
- [4] Adams, W. K. & Wieman, C. E. "Analyzing the many skills involved in solving complex physics problems." *American Journal of Physics*, vol. 83 (5), pp. 459-467, 2015.
- [5] Alifuddin, M. "Non-Formal Education Policy on Life Skills and Its Implications on People Welfare," *Journal of Education and Learning*, vol. 11 (2), pp. 165-171, 2017.
- [6] Nazila, K. & Reza, B. M. "Eliciting Management Education Model of Teaching (M.E.M.T.) From a Decade Studies in Iran and Its Use for Teaching," *Procedia - Social and Behavioral Sciences*, vol. 29, pp. 1151-1160, 2011
- [7] Niss, M. "Obstacles Related to Structuring for Mathematization Encountered by Students when Solving Physics Problems," *International Journal of Science and Mathematics Education*, 2016.
- [8] Opitz, A., Heene, M. & Fischer, F.. "Measuring scientific reasoning – a review of test instruments," *Educational Research and Evaluation*, vol 4(1), pp. 63–74, 2017.
- [9] Pratama, Y, Sariyatun, & Joebagio, H. "The development of Means-Ends Analysis and Value Clarification Technique Integration Model to explore the local Wisdom in Historical Learning," *Journal of Education and Learning*, Vol. 11(2), pp. 179-187, 2017.
- [10] Alghamdi, A.K.H., Fadlelmula, F.K., & Hattami, A. "Evaluating Teaching Strategies in Higher Education from Students' Perspectives," *Journal of Education and Learning*, vol. 11(2), pp. 120-129, 2017.
- [11] Abonyi, OS, Achimugu, L, Njoku, & Adibe, MI. "Innovations in Science and Technology Education: A Case for Ethnoscience Based Science Classrooms", *International Journal of Scientific & Engineering Research*, vol. 5, (1), pp. 52-56, 2014.
- [12] Khabibah, E.N., Masykuri, M. & Maridi. "The Effectiveness of Module Based on Discovery Learning to Increase Generic Science Skills," *Journal of Education and Learning*, vol.11(2), pp.146-153, 2017.
- [13] Setyawan, D.N., Aminah, N.S., & Sarwanto. "The Using of Scientific Based Physics Module in Learning to Enhance High School Students Critical Thinking Skills on Rotation Dynamics and Equilibrium of Rigid Body," *Journal of Education and Learning*, vol.11(2): 213-218, 2017.
- [14] Mujiyati, N., Wardo, Agung, L. "The Strategies To Improve Social Solidarity of Senior High School Students Through History Module Based On Problems," *The Journal of Education and Learning*, vol. 11, (2), pp 130-137, 2017.
- [15] Susilawati, Huda, H., Linuwih, S. & Sudana, IM. "The use of poster on thermodynamics for concept mastery and attitude students in vocational high school," *Proceedings of the IConSSE FSM SWCU*, Salatiga, 1 Agustus 2015
- [16] Wang, Y. H. "The Multicultural Science Literacy of Science Teachers in Taiwan," *International Journal of Asian Social Science*, vol. 3(9), pp. 2052-2059, 2013
- [17] Rist, A., Dahdouh, F., & Guebas. "Ethnosciences a step towards the integration of scientific and indigenous forms of knowledge in the management of natural resources for the future," *Environ Dev Sustain*, vol. 8, pp. 467–493, 2006.
- [18] Susilawati, Wijayanto, Nur Khoiri. "The EMF Induction Experiment Set Trial for High School Students Productive Performance Skill," *International Conference on Mathematics, Science, and Education*, Semarang, 5 September 2015.
- [19] Sudarmin, Febu, R., Nuswawati, M. & Sumarni, W. "Development of Ethnoscience Approach in The Module Theme Substance Additives to Improve the Cognitive Learning Outcome and Student's entrepreneurship," *Journal of Physics: Conf. Series* 824, 2017.
- [20] Okwara, K.O. "Effects of Ethno Science Instructional Approach on Students' Achievement and Interest in Upper Basic Science and Technology in Benue State, Nigeria," *International Journal of Scientific Research in Education*, vol. 10 (1), pp. 69-78, 2017.

-
- [21] Susilawati, Ardhyani, S., Masturi, Wijayanto & Khoiri, N. "Project based Learning Multilifeskill for Collaborative Skills and Technological Skills of Senior High School Students," *Journal of Physics: Conference Series* 824: 012010, 2017.
- [22] Stiggins, R.G. "Student-Centered Classroom Assessment," New York: McMillan College Publishing Company, 1994.
- [23] Zhou, S. et al. "Assessment of scientific reasoning: The effects of task context, data, and design on student reasoning in control of variables," *Thinking Skills and Creativity*, vol 19(2), pp.175–187, 2016.
- [24] Waldrip, B. & Prain, V. "Engaging students in learning science through promoting creative reasoning," *International journal of science education*, 95(2), pp.1–22, 2017.
- [25] Dasgupta, D. "A study of scientific reasoning in a peripheral context: the discovey of the raman effect," *International Journal of Scientific Research in Education*, vol 13(2), pp.171–186, 2015.