

## Development of Supplementary Science Teaching Materials with Ethnoscience Contained to Foster Students' Critical Thinking

Lina Kumalasari<sup>1✉</sup>, Sudarmin<sup>2</sup> & Sri Sulistyorini<sup>3</sup>

<sup>1</sup> Public Elementary School 1 Pendowo, Temanggung, Jawa Tengah, Indonesia

<sup>2</sup> Chemistry Education, Universitas Negeri Semarang, Indonesia

<sup>3</sup> Primary Teacher Education Universitas Negeri Semarang, Indonesia

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### Abstract

The purpose of this study is to develop teaching materials containing ethnoscience as well as the feasibility and effectiveness of natural science teaching materials supplement containing ethnoscience to foster students' critical thinking. This study applied development technique of ADDIE that consists of five stages: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation (ADDIE). The subjects of this study were grade IV elementary school students in Temanggung. The research instruments were observation, questionnaire, test, and documentation as data collection instruments. Analysis of the data from the N-gain test and t-test were used to find out the improvement in learning outcomes and critical thinking. The results show that the supplement of science teaching materials was appropriate to be used based on the expert validation test. The results of the product trial, natural science teaching materials supplement show an improvement in learning outcomes based on an N-gain value of 0.648. The effectiveness test of supplementary science teaching materials with ethnoscience contained show that it is effective in fostering critical thinking skills of student.

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✉ Correspondence address:

Pendowo RT. 01/RW. 16 Kranggan, Temanggung,  
Jawa Tengah, 56271  
E-mail: [linakumala29@gmail.com](mailto:linakumala29@gmail.com)

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## INTRODUCTION

The 2013 curriculum is a student-centered curriculum and its learning in the surrounding environment. Students can solve learning problems because they integrate knowledge with they experience in everyday life. The learning process can directly foster new knowledge, therefore, the students will better understand and can apply it in everyday life. Seroto (2012) states science refers to daily activities. Thus students can think scientifically about a situation around them. Learning is not just a theoretical rote but also expected is meaningful.

In the learning process that uses the concept of culture as a source of learning, it can improve the ability of students to use knowledge. Ethnoscience is a cultural knowledge possessed by a society. Sudarmin (2014) ethnoscience can be defined as a set of knowledge of a society or ethnic group that is obtained by a particular method in which the knowledge contains the concept of “science”. The learning approach through ethnoscience is a strategy of creating a learning environment and planning a learning experience that integrates culture as part of a learning process according to Sardjiyo & Pannen (2005).

Currently, the teaching materials used have not utilized culture as a source of learning. The results of observations made, the limited teaching material used in learning the 2013 Curriculum which is not in accordance with the environmental and cultural characteristics of students. Khoerunnisa (2016) learning has not been linked with culture. Therefore, students need to understand the culture that exists in society.

According to Piaget's theory, students at elementary school age enter the stage of concrete operational thinking and have not been able to deal with abstract material, the child is still focused on real objects or events that he has experienced. Ethnoscience is original knowledge acquired in language and culture obtained by someone who can be tested for its truth and this can be innovated in science-based learning in the classroom (Abonyi *et al.* 2014). Through

ethnoscience based learning, the students can make direct observations so they can identify scientific questions and explain phenomena scientifically.

In the teaching and learning process that does not pay attention to the environment, it will not produce maximum learning outcomes. This is in accordance with the 2013 Curriculum, learning that is close to the environment so that in the learning process, teaching materials are needed to achieve learning objectives. Teaching materials are all materials, which have been arranged systematically and can display a complete figure of the competencies that are mastered by students through an active and fun learning process (Prastowo, 2016). Development of teaching materials based on culture can improve students' critical thinking skills, learning ethnoscience can improve students' cognitive abilities (Afrianawati, 2016).

The objective of this study is to develop teaching materials containing ethnoscience and to determine the feasibility and effectiveness of natural science teaching materials supplement containing ethnoscience to foster students' critical thinking. The development of natural science teaching material supplements took the theme of “The Area Where I live” by linking it with the Temanggung community activities namely tobacco plants.

## METHODS

This research was development research that develops natural science teaching materials supplement containing ethnoscience The development process consisted of five stages, this research used ADDIE instructional design. There were five stages in this research development, namely (1) analysis, (2) design, (3) development, (4) implementation and (5) evaluation.

The subjects of this study were elementary school students in grade IV of Temanggung. The research instruments were observation, questionnaire, test, and documentation as data collection instruments. Analysis of the data from the n-gain test and t-test to find out the

improvement in learning outcomes and critical thinking.

## RESULTS AND DISCUSSION

The research and development that is implemented is a development that produces a product in the form of a natural science teaching materials supplement containing ethnoscience in the theme of the area where I live in IV grade of elementary school. Teaching material developed is teaching material in the form of supplements in the form of books. Prastowo (2016) teaching materials are “all materials (both information, tools, and texts) that are arranged systematically to be used in the learning process so that it achieves the competencies to be achieved”

Teaching materials play an important role in the learning process, namely as a medium in the delivery of information (Paramita, 2016). Therefore we need good and appropriate teaching

materials so that it can achieve the maximum learning objectives. So that teaching materials need to be developed because the existing teaching materials currently are less attractive to students to have independent learning initiatives (Khairoh, 2014). The following is a description of the results of research that has been carried out.

Natural science teaching materials supplement containing ethnoscience based on National Curriculum and Book Center assessment instrument Guidelines for Evaluating Teaching Materials 2018. In the validation of natural science teaching materials supplement is carried out by six validators consisting of three lecturers as validators of material experts, and three validators as expert practitioners. The following is a recapitulation of the results of the validation of the six validators which can be seen in Table 1.

**Table 1.** Recapitulation of Teaching Material Validation Test

| Feasibility components   | Average score | Mean (%) | Criteria         |
|--------------------------|---------------|----------|------------------|
| Content feasibility      | 3.7           | 93       | Very appropriate |
| Presentation feasibility | 3.6           | 90       | Very appropriate |
| Language feasibility     | 3.8           | 94       | Very appropriate |
| Ethnoscience component   | 3.7           | 92       | Very appropriate |
| Graphic feasibility      | 3.9           | 97       | Very appropriate |

The assessment results show that the validation of teaching material supplement products shows that teaching material supplements are very appropriate for use in learning. Teaching materials developed include aspects of content, presentation, language, and graphics (Pusparani *et al.* 2017). Even though

they have reached a very valid category, the researchers still carry out revisions based on input from the validators. The following experts provide input on the draft science teaching materials. The following is a result of revision of teaching which can be seen in Table 2.

**Table 2.** Results of Revision of Teaching Material Design

| Based on validator suggestions                              | Revision  |
|---|---|
| The front page of the introduction                          | Replace the front page of the book with larger letters to make it clearer, cartoon images of women for hijab, and the addition of institutions at the bottom of the front page                              |
| Add a book instructions page                                | Adds page instructions page for the book after the table of contents page   |
| Literacy page critical thinking                             | Add questions after reading critical thinking literacy to foster students' critical thinking  |
| Let's think critically ( <i>mari berpikir kritis</i> ) page | Add illustrative questions in each of the sub-chapters of Let's Think Critically and the picture descriptions in each picture presented to make it easier for students to understand commands and pictures. |

Inputs to the improvement of the draft of teaching materials are carried out so that the draft natural science teaching materials supplement containing ethnoscience can be presented in full and supported with an attractive appearance for students. Interesting teaching materials will be more effective in achieving these learning goals (Azimi, 2017). The results of the revised natural science teaching materials supplement can be seen in Figure 1.



**Figure 1.** (a) The Front Page After The Revision, (b) The Material Let's Think Critically After Revision

Besides, the revision of the draft teaching material, the test instrument used in the evaluation is improved before the questioned validity is tested. Siallagan *et al.* (2016) state that good types of questions are questions that guide students to find their answers, so between one

child and another child can have different answers. The test questions instrument refers to questions of critical thinking and ethnoscience. The following improvements can be seen in Table 3.

**Table 3.** The Improvement of Test Instruments

| Feedback                                   | Improvement  |
|--|--|
| Displays pictures on the test instrument   | Add pictures and information on each of the 4 items. Write a full explanation before asking questions. |
| Complete explanation on each item          | Use question words "why" and "how".  |
| Questions of critical thinking orientation |  |

Test instruments that have been carried out improvements then tested its validity to students. The validity test of the test instrument was carried out on 20 students. Furthermore, natural science teaching materials supplement is tested on a limited and broad scale. The trial is conducted on 12 students consisting of six male students and six female students. The feasibility of teaching material supplements is also determined by the students' responses after using science teaching material supplements. Based on the results of these responses, it is known that students respond positively to the modules that have been developed (Sudarmin, 2017). The average response of students to natural science teaching materials supplement containing ethnoscience is 97.2%. The results of student responses at the trial stage can be seen in Table 4.

**Table 4.** Recapitulation of Student Responses

| Aspect       | Percentage (%) | Criteria  |
|--------------|----------------|-----------|
| Feasibility  | 98             | Very good |
| Readability  | 100            | Very good |
| Presentation | 100            | Very good |
| Graphics     | 87.5           | Very good |

The results of the recapitulation of students' responses show that natural science teaching materials supplement containing ethnoscience in the reading and presentation aspects of teaching materials is very good, it can be seen during the learning, students' enthusiasm is very high. Readability test can find out whether teaching material developed is easily understood by students or not (Lukito *et al.* 2015).

Learning by linking with the culture around students has a higher curiosity. Kasmaienezhadfad (2015) states that there are

two factors encourage the realization of creativity, they are encouragement within oneself and encouragement from the environment. Hence, through learning ethnoscience students can learn directly.

According to Suastra as cited by Maherdrani (2015) ethnoscience studies the knowledge of the surrounding culture. The ethnoscience approach is a strategy in learning with learning experiences that integrate culture as part of the learning process carried out (Ristanti, 2018). Therefore ethnoscience learning makes learning more meaningful.

In the development of ethnoscience – learning, students’ critical thinking skills improve by using a natural science teaching materials supplement. In the learning process, it is used practical methods based on problem-based learning (PBL).

Problem-based learning has a high effect on improving scientific literacy in science learning (Eviani *et al.* 2014). PBL with this lab work method is conducted to allow students to practice improving critical thinking as an application after using natural science teaching materials supplement.

Natural science teaching materials supplement containing ethnoscience are very compatible with students' daily lives. Student lab work activities carried out by elementary school student activities to plant tobacco that is associated with force material. Cahyana (2017) in the process of learning science must be emphasized by providing a direct experience so students can develop competencies by exploring and understanding the environment scientifically. In line with Khoerunnisa (2016) student activities through practice can encourage students to know the relationship between knowledge possessed and can apply in life. So this will encourage students to be able to more easily remember and understand so that it can foster critical thinking.

Problem-based learning with lab work methods will encourage students to solve problems experienced through activities. Besides, by using ethnocentric integrated teaching materials with problem-based learning students

are directly involved and active in scientific activities and gain direct experience (Nisa, 2015).

In large scale trials, it can be seen from the results of student learning that has improved, it can be measured by the pre-test and post-test of the product trial assessment. In the implementation of large-scale trials in two elementary schools, data obtained in the form of pre-test and post-test scores as follows. Student learning outcomes which can be seen in Table 5.

**Table 5.** Student Learning Outcomes

| Description                    | Pre-test | Post-test |
|--------------------------------|----------|-----------|
| The number of students         | 54       | 54        |
| Average                        | 63,43    | 86,78     |
| The highest score              | 85       | 100       |
| The lowest score               | 35       | 65        |
| ∑ students who complete        | 22       | 52        |
| Proficient percentage          | 41%      | 96%       |
| ∑ students who do not complete | 32       | 2         |
| Unproficient percentage        | 59%      | 4%        |

Student learning outcomes can be concluded to have an improvement in post-test scores compared with the pre-test scores. Students are said to be complete when reaching the Minimum Mastery Criteria (KKM), in this study is 70. The improvement in student learning outcomes based on the Minimum Mastery Criteria increased by 55% from before after the use of natural science teaching materials supplement containing ethnoscience.

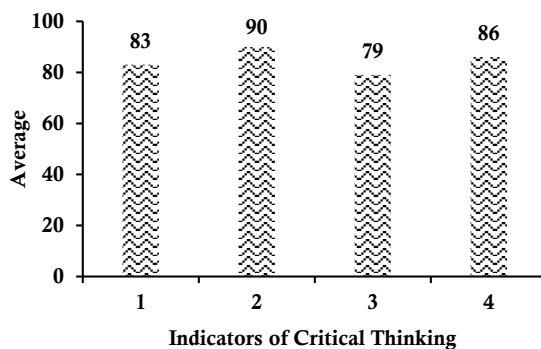
The results of the analysis of the gain test show that the gain score obtained is 0.648 with moderate criteria. So it can be interpreted that an improvement in the results of the students’ average score of the pre-test and post-test after implementing natural science teaching materials supplement containing ethnoscience in the theme of the area where I live. In this gain score, it indicates that the success indicator of the teaching material supplements development is fulfilled, the gain score  $\geq 0.3$ , so that this development research is successful.

Okebukola as cited by Sudarmin (2014) states that through learning that is integrated with scientific science, it can improve students’ understanding and can create more meaningful learning.

In this study, the measurement of students’ critical thinking is through pre-test and post-test

learning outcomes using valid instruments and observations. The calculation of the improvement in learning outcomes from the aspect of knowledge is then analyzed using the t test in the trial product with  $t_{count}$  amount is 10.82. Hence, it is consulted with a  $t_{table}$  with df 54 and  $\alpha = 5\%$ . With  $t_{table}$  is 1.65, it can be seen that the score of  $t_{count} > t_{table}$ , then the difference between pre-test results and post-test is significant. Therefore, it can be concluded through the use of natural science teaching materials supplement containing ethnosience can foster students' critical thinking skills.

Furthermore, an assessment of students' critical thinking skills is carried out during the problem-based learning process conducted by researches and teachers. There are four indicators used in the assessment, they are formulating the problem, designing the experiment, analyzing the data, and concluding. The average score of students' critical thinking skills can be seen in Figure 3.



**Figure 3.** Assessment of students' critical thinking (1: formulating the problem, 2: designing experiment, 3: analyzing data, 4: making conclusions)

The results of the assessment of all critical thinking indicators obtained total average of 85.2. Designing an experiment is an indicator with the highest average grade where the activity is a problem-based learning activity. Students have excellent ability in designing experiments, this is because students can understand the material that has been learned for knowledge and then directly design experiments to grow tobacco. Rusman

(2017) children more easily solve problems by trying activities (direct experience).

Formulating the problem at the basic stage that fosters critical thinking by asking questions. Through the environment or experiments will stimulate students' curiosity, make observations and ask questions (Wiyanto, 2017). So students can actively answer and ask questions related to the material, but there are still some students who are still passive in learning. Overall student knowledge improves because students become active in the learning process.

Analyzing ideas and information obtained from observations, experiences, common sense, and communication (Wahyuni, 2015). In analyzing data, students still have limitations in processing data when implementing problem-based learning, so the teacher's role is needed to guide in processing the experimental data. Mulnix (2012) critical thinking consists of obtaining, developing, and processing the skill to understand conclusions in a statement. Students are also good at making conclusions based on problem-based learning, but they need to improve in choosing the right vocabulary.

So it was concluded that through the use of natural science teaching materials supplement containing ethnosience is effective, it can foster students' critical thinking skills. Through new experiences and wide opportunities to express ideas and opinions, students can explore their creative thinking skills (Damayanti, 2017).

Learning by using a natural science teaching materials supplement containing ethnosience can improve students' skill in science knowledge and can train students to think critically. Afrianawati (2016) states that through the application of ethnographic-based learning, it can improve students' critical thinking skills. So that the effectiveness of natural science teaching materials supplement containing ethnosience can foster students' critical thinking skills measured by student learning outcomes.

The natural science teaching materials supplement containing ethnosience products, the Area where I live themes for grade IV of Elementary School are arranged in accordance with the Basic Competencies associated with the

activities of farmers in tobacco cultivation in Temanggung. In accordance with Fitriani's research (2017) which states that the evaluation aspect is one of the critical thinking students must have.

Sutrisno (2012) states that students who can think critically can not only master the content in each subject that has been studied but can also apply to everyday life. The use of natural science teaching materials supplement products fosters students' critical thinking skills. Besides, students can also apply in everyday life. The level of development of a nation is determined by human resource awareness of science and technology (Jurecki & Wander, 2012). One of the skills needed so that someone can contribute to society is the skill to think critically (Facione, 2015). So that ethnoscience learning will bring students closer to the environment and be able to foster critical thinking.

## CONCLUSION

Based on the results of research conducted on the development of natural science teaching materials supplement containing ethnoscience, it can be concluded that natural science teaching materials supplement containing ethnoscience is declared valid based on National Curriculum and Book Center assessment so that it is appropriate to be used in the learning. The use of natural science teaching materials supplement containing ethnoscience influences the skill to think critically toward elementary school students.

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## REFERENCES

- Abonyi., Okechukwu, S., Lawrence, A., & Njoku. 2014. Innovations in Science and Technology Education: A Case for Ethnoscience Based Science Classrooms. *International Journal of Scientific dan Engineering Research*, 5(1): 52-56
- Afriawanati, S, Sudarmin, & Sumarni, W. (2016). Model Pembelajaran Kimia Berbasis Etnosains Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Pengajaran MIPA*, 21 (1): 46-51
- Azimi, Rusilowati, A., & Sulhadi. 2017. "Pengembangan Media Pembelajaran IPA Berbasis Literasi Sains untuk Siswa Sekolah Dasar". *Pancasakti Science Education Journal*, 2 (2): 145-157
- Cahyana, U., Kadir, A., & Gherardini, M. 2017. "Relasi Kemampuan Berpikir Kritis dalam Kemampuan Literasi Sains pada Siswa Kelas IV Sekolah Dasar". *Jurnal Sekolah Dasar*. 26 (1):14-22
- Damayanti, C., Rusilowati, A., & Linuwih, S. (2017). Pengembangan Model Pembelajaran IPA Terintegrasi Etnosains untuk Meningkatkan Hasil Belajar dan Kemampuan Berpikir Kritis. *Journal of Innovative Science Education*, 6(1), 116-128
- Eviani, S. Utami, & T. Sabri,. 2014. Pengaruh Model Pembelajaran Berbasis Masalah Terhadap Kemampuan Literasi Sains IPA Kelas V SD. *Jurnal Pendidikan dan Pembelajaran*. 3 (7): 1-13
- Facione, P.A., 2015. *Critical Thinking: What It Is and Why it Counts*. Hermosa Beach: Measured Reasons LCC
- Fitriani, N, & Setiawan, B. 2017. Efektivitas Modul IPA Berbasis Etnosains Terhadap Peningkatan Keterampilan Berpikir Kritis Siswa. *Jurnal Penelitian Pendidikan IPA*. 2 (2) : 71-76
- Jurecki, K., & Wander, M. C. (2012). Science literacy, critical thinking, and scientific literature: Guidelines for evaluating scientific literature in the classroom. *Journal of Geoscience Education*, 60(2): 100-105
- Kasmaiezhadfad, S., Talebo, B., Roustae, R. & Pourrajab, M. (2015). Student's Learning Through Teaching Creativity: Teacher's Perception. *Journal of Education, Health and Community Psychology*, 4(1): 1-13
- Khairoh, L., Rusilowati, A., & Nurhayati, S. (2014). Pengembangan Buku Cerita IPA Terpadu Bermuatan Pendidikan Karakter Peduli Lingkungan Pada Tema Pencemaran Lingkungan. *Unnes Science Education Journal*, 3(2): 519-527
- Khoerunnisa, R. F., Murbangun, N., & Sudarmin. (2016). Pengembangan Modul IPA Terpadu Etnosains untuk Menumbuhkan Minat Kewirausahaan. *Journal of Innovative Science Education*, 1 (1): 1-9

- Lukito, A., Rusilowati, & S., Linuwih. 2015. Pengembangan Bahan Ajar Ipa Terpadu Berbasis Literasi Sains Bertema Perpindahan Kalor Dalam Kehidupan. *Unnes Physics Education Journal*, 4 (3): 25-32
- Mahendrani, K. & Sudarmin.(2015). Pengembangan Booklet Etnosains Fotografi Tema Ekosistem untuk Meningkatkan Hasil Belajar pada Siswa SMP. *Unnes Science Education Journal*, 4(2), 865-872
- Mulnix, J.W., 2012. Thinking Critically about Critical Thinking. *Educational Philosophy and Theory*, 44 (55): 464-479
- Nisa, A., Sudarmin., & Samini. 2015. Efektivitas Penggunaan Modul Terintegrasi Etnosains Dalam Pembelajaran Berbasis Masalah Untuk Meningkatkan Literasi Sains Siswa. *Unnes Science Education Journal*. 4(3), 1049-1056
- Paramita & Rusilowati. 2016. Pengembangan Bahan Ajar Berbasis Literasi Sains Materi Suhu dan Kalor. *Jurnal Pendidikan MIPA*, 7 (1): 58-67
- Prastowo, A. (2016). *Pengembangan Bahan Ajar Tematik*. Jakarta: Kencana
- Pusparani, H., Samsudi, S., & Haryadi, H. (2017). The Analysis of Requirements Developing Teaching Materials in Writing Folklore with Javanese Language Based on Local Wisdom. *Journal of Primary Education*, 6(2): 94-102
- Ristanti, A, & Rachmadiarti, F. 2018. Kelayakan Buku Ajar Berbasis Etnosains Pada Materi Pencemaran Lingkungan Untuk Melatihkan Berpikir Kritis Siswa SMP. *e-jurnal pensa*. 6 (02): 151-155
- Rusman. 2017. *Belajar dan Pembelajaran Berorientasi Standar Proses Pendidikan*. Jakarta. PT Kharisma Putra Utama
- Sardjiyo & Panen, P. 2005. Pembelajaran Berbasis Budaya Model Inovasi Pembelajaran dan Implementasi Kurikulum Berbasis Kompetensi. *Jurnal Pendidikan*. 6(2): 83-98
- Seroto, J. 2012. Student Teachers Presentations of Science Lessons in South African Primary School: Ideal and Practice. *International Journal Education Science*. 4(2): 107-115
- Siallagan, T.D., Syamsurizal & Hariyadi, B. 2016. “Pengembangan Instrumen Penilaian Autentik Berbasis PBL Pada Materi Dampak Pencemaran Bagi Kehidupan Di Sekolah Menengah Pertama”. *Edusains*, 5 (2): 40-51
- Sudarmin. 2015. *Pendidikan Karakter, Etnosains dan Kearifan Lokal ( Konsep dan Penerapannya dalam Penelitian dan Pembelajaran Sains*. Semarang: Fakultas MIPA UNNES
- Sudarmin, R Febu, & M Nuswowati. 2017. *Development of Ethnoscience Approach in The Module Theme Substance Additives to Improve the Cognitive Learning Outcome and Student's entrepreneurship*. The 3rd International Conference on Mathematics, Science and Education. Semarang
- Sutrisno.2012. *Kreatif Mengembangkan Aktivitas Pembelajaran Berbasis TIK*. Jakarta: Referensi
- Suprijono, A. 2013. *Cooperative Learning Teori dan Aplikasi PAIKEM*. Yogyakarta: Pustaka Pelajar
- Wahyuni. 2015. Pengembangan Bahan Ajar IPA Untuk Meningkatkan kemampuan Berpikir Kritis Siswa. *Jurnal Materi dan Pembelajaran Fisika*, 5 (2): 51-58
- Wiyanto, Nugroho, & Hartono. (2017). The scientific Approach Learning: How prospective science teachers understand about questioning. *Journal of Physics*, 824(1): 22-26.