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Science Learning Based on Local Potential: Overview of the Nature of Science (NoS) Achieved

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Abstract. The research concerned here examined the effectiveness of science learning conducted with local potential as basis from the point of a review of the NoS (nature of science) achieved. It used the non equivalent control group design and took place in the regions of Magelang and Pati, Province of Central Java, and the regions of Bantul and Sleman, Province of the Special Region of Yogyakarta. The research population consisted of students of the first and second grades at each junior high school chosen with research subjects sampled by means of cluster sampling. The instruments used included: a) an observation sheet, b) a written test, and c) a questionnaire. The learning and research instruments had been declared valid and reliable according to previous developmental research. In conclusion, the science learning based on local potential was effective in terms of all the NoS aspects.

INTRODUCTION

Indonesia is a country of large and small islands lying between two continents and two oceans. In addition, Indonesia is a country possessing geological uniqueness, too, because the country also lies between two geological rings which could anytime cause an earthquake due to a shifting of the geological plates there. But the geological uniqueness also causes Indonesia to have a wealth of biological diversity, which is the second greatest in the world after that in Brasil, and to be rich with sources of natural gas, mine products, and fertile land.The biological diversity influences the social diversity and gives birth to the cultural diversity of the various ethnic groups in Indonesia [17].

The natural and cultural uniqueness of Indonesia is distributed into various regions as potential that could be developed for regional development of the nation. Each region has its own uniqueness of land, local knowledge, and culture. In the perspective of national education, variety in the regional potential becomes part of the considerations in planning educational policies. There is a demand that curriculum construction pay attention tothe variety in regional and environmental potential, as stated in an [15]. The message contained in the said UU provides a great opportunity for teachers as learning implementers to raise issues of local potential in the learning. The implementation of integrating local potential into the learning still undergoes several constraints. The main constraint is that teachers do not understand yet exactly the right way to integrate environmental potential into the learning process [1]. [16] states that several factors that cause teachers not to utilize local potential in the learning yet are teachers' very heavy teaching load, no adaptable model being available yet, and limited facilities, funding, and time.

The integration of local potential into the learning at school is highly needed and even more so in the situation at present in which the younger generationis in the process of under going a degradation in the respect that it has towards local potential and local culture. Most members of the younger generation are more interested in seeking work in the cities than developing the environmental potential in existence in the rural villages. There are many village youths who pursue higher education in the cities but could not be optimum in applying the sciences in their

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possession after they return to their villages. Most members of the present generation like products of cultures from outside better than the cultural products of their own people. The integration of regional potential into the learning would give students enlightenment related to regional potential. Their introduction to regional potential could improve their respect toward their region, get them to know the values related to local wisdom, and cause them to experience value internalization that could lead them to becoming personalities with character.

The integration of regional potential into the curriculum could be done through certain school subjects or independently as a local content school subject, according to [11]. Natural science, referred to else where as the natural sciences or natural science or, simply, science as a school subject is highly relevantas a means of implementing it. The curriculum referred to as Kurikulum 2013 desires a development of natural science learning at SMP, the first level in the two-level system of high school in use with the concept of integrated science, one of the characteristics of which is that it has the nature of being thematic. Local potentialis quite right to be chosen as basis of theme selection because it has the nature of being contextual, interesting, and connected to real life. Local potential contains the original concept for science that could be beneficial for the life of students and society in general [6].

The integration of local potential into science learning needs to be directed towards the achievement of a students' learning outcome which is, in line with the nature of science, whole and complete, namely, students' possession of science knowledge, skills, and scientific attitude and ability to apply science knowledge in daily life so that it could lead to them becoming individuals with scientific literacy. In achievement of scientific literacy, learners from Indonesia at presentare still left far behind those from other countries. Results of an achievement studyin the course of identifying TIMSS (Trends in International Mathematics and Science Study) in 2011 indicate that, for achievement in IPA, learners from Indonesia get a score of 406 [9]. Results that are relatively the same are shown in a study by PISA (Program for International Student Assessment) in 2012, which indicates that, for level of IPA literacy, learners from Indonesia get a mean score of only 382, far below the ideal mean score of 501 [11].

The students' low sience achievement indicates that the science learning process at school is not yet a success in training them in the mastery of the nature of science as an integrated whole. The tendency of IPA learning at presentis that it still puts emphasis onthe achievement of results which are cognitive in formand does not touch the science process, attitude, and critical thinking skills to the optimum yet [13]. That as the result of a study becomes the reason why it is difficult for students to get the meaningfulness of the science learning delivered. It results in students having difficulty in making connections betweenthe concepts in lesson materials and the applicationsin daily life in using IPA concepts to solve various problems that occur.

Efforts to solve the problem of degradation in the respect that the younger generation has towards regional potential and to actualize the formation of students with comprehension of the nature of science as an integrated whole could start with improvements in the science learning process in the classroom which is integrated with local potential. Improvement in science learning could be done by providing direct experience through explorations of the environmental potential and the local potential around students. It is in line with the IPA learning standard emphasizing the activity of inquiry and doingin order that it could aid students ingaining deeper understanding of the nature around them [7]. Science learning should provide students with opportunities to apply scientific concepts and methods in daily life. It has implications concerning the science learning at school, where science learning should contain the nature of science as scientific product, scientific process, and scientific attitude.

In view of the importance of integrating local potential into science learning which leans towards the achievement of the nature of science as an integrated whole and of some constraints that teachers are faced with in implementing the effort, then such research as that concerned here as a form of wide spread dissemination of the results of developing science learning sets with local potential as basis is quite necessary to be done. The learning sets specifically concerned here would be beneficial for teachers designing the integration of local potential into the learning. The learning sets that have been developed vary and represent the local content characteristics in various regions. The local potential integrated into the research consisted of (1) the onion farming in a Kabupaten Brebes,with the areal characteristic of low-lying flat land, (2) the industry of coconut sugar in a Kecamatan Paranggupito, Kabupaten Wonogiri, with the areal characteristic of coast land with many coconut trees, (3) the processing of clove leaves in Kecamatan Bumiayu, Kabupaten Brebes, with the areal characteristic of high land appropriate for growing clove plants, (4) the industryof furniture and pottery making in Kabupaten Jepara, with the city of Jepara known as city of wood carvingand the areal characteristic of simultaneously coast land and mountain slope with soil containing clay, and (5) the exploitation of the river as micro-hydroelectric power plant in Kecamatan Rampi, one of the isolated regions in Kabupaten Luwu Utara with the areal characteristic of mountain

forests. The research tested the effectiveness of the science learning sets with local potential as basis from the point of an overview of the NoS (Nature of Science) achieved as result of the research and development.

Science is related to the way to gain knowledge of nature systematically so that it is not only the mastery of an accumulation of knowledge in the form of facts, concepts, or principles but also a process of discoveries. Education in IPA could hopefully become the vehicle for students to study themselves, the nature around them, and the prospects for further development in applying the education in daily life. The learning process conducted puts emphasis on providing direct experience to develop competence in order to explore and comprehend the surrounding nature scientifically.

National Science Education Standard mentions that science is a way to understand the world in which we dwell and, though there are other ways to understand it, science is quite specific because it has standards and practices that could generate ideas to explain phenomena and predict their consequences without knowing how long the ideas would survive and remain useful because science theories could be rejected and abandoned with the occurrence of new discoveries [3] while [2] state that science consists of products, processes, andattitudes.

Science, as a term referring to science, should be viewed as a way of thinking in the pursuit of understanding nature, as a way of investigating claims about phenomena, and as a body of knowledge that has resulted from inquiry [3] Further [3] explain that the dimensions that should always be present in science learning are "science as a way of thinking, science as a way of investigating, and science as a body of knowledge". With that opinion as basis,it could be explained that IPA, as a science that studies natural phenomena, is, through the act of thinking, learned as accumulated knowledge coming from the results of inquiryand of a way of investigation tofigure out natural phenomena. Interpreted more expansively, the way IPA is acquired by thinking is with belief, curiosity, imagination, and reasoning. Further, IPA, referred to as science here, as a body of knowledge, covers facts, concepts, principles, theories, and models. Mean while, science, or, simply, science, as a way of investigating, covers the acts of observing, collecting data, developing a hypothesis, experimenting, and concluding.

METHOD

The research concerned here used the nonequivalent control group design. The format of the research design could be seen in Table 1.

TABLE 1. The Nonequivalent Control Group Research Design

Group	Pretest	Treatment	Posttest
EG	O_1	X	O_2
CG	O_3	-	O_4

where:

EG = Experimental Group
CG = Control Group
O_1 = Initial Competence of EG
O_2 = Final Competence of EG
O_3 = Initial Competence of CG
O_4 = Final Competence of CG

The research took place in Kabupaten Magelang and Kabupaten Pati in the Province of Central Java and Kabupaten Bantul and Kabupaten Sleman in the Province of DIY. The research population consisted of students of Grade VII and Grade VIII (the official terms referring to the first and second grades of high school) at each school selected. Cluster sampling was used. The instruments used included: a) an observation sheet, b) a written test, and e) a questionnaire. All the learning instruments and research instruments were already declared valid and reliable based on preceding research and development activity.

RESULTS AND DISCUSSION

Aspect of Skills in the NoS: Science Process Skills

From the results of the test of Science process skills, it is known that the mean score for the Science process skills of the experimental group is 69.77 in magnitude while that of the control group is 61.67 in magnitude. It indicates that the posttest mean score for the Science process skills of the experimental group is greater than that of the control group. The mean score for the science process skills of the experimental group being higher is also indicated by the mean gain score of 0.37 in magnitude obtained by the group. It is greater than the mean gain score of 0.22 in magnitude obtained by the control group. The science process skill score recapitulation for the aspects concerned is presented in Table 2.

TABLE 2. Recapitulation of the Science Process Skills Aspect Scores

No.	Aspect of science Process Skills	Experimental Group			Control Group		
		Pretest	Posttest	Gain	Pretest	Posttest	Gain
1	Observation	61.4	65.9	0.12	60.7	50.0	-0.27
2	Classification	58.0	67.6	0.23	51.8	69.0	0.36
3	Interpretation	31.8	62.5	0.45	33.3	63.1	0.45
4	Communication	50.0	85.2	0.70	60.7	57.1	-0.09

The data in Table 2 indicate the occurrence of decreases in the scores for observation and communication as aspects of the science process skills of the control group. The decreases are indicated by the occurrence of gain scores with negative values for the two aspects. In the case of the control group, the increases occur in the scores for classification and interpretation as aspects of the science process skills, as indicated by the gain scores with positive values for the two aspects.

Aspect of Skills in the NoS: Science Generic Skills

The pretest and posttest results of both the experimental group and the control group in the field testing are presented in Table 3.

TABLE 3. Pretest and Posttest Science Generic Skills (SGS) Scores of the Experimental Group and the Control Group

No.	Component	Experimental Group		Control Group	
		Pretest SGS	Posttest SGS	Pretest SGS	Posttest SGS
1	Mean Score	41	71	41	56
2	Highest Score	55	88	73	80
3	Lowest Score	30	58	28	40
4	Variance	40.18	67.36	84.94	73.00
5	Standard Deviation	6.34	8.21	9.22	8.54

where SGS = Science Generic Skills.

Aspect of Skills in the NoS: Science Critical Thinking Skills

A descriptive summary of the pretest and posttest data for the critical thinking skills of each group concerned is presented in Table 4.

TABLE 4. Recapitulation of the Critical Thinking Skill Measurement Results

No.	Component	Experimental Group			Control Group		
		Pretest	Posttest	<g>	Pretest	Posttest	<g>
1.	Number of Subjects	40	40	40	39	39	39
2.	Highest Score	66	94	0.84	70	85	0.50
3.	Lowest Score	39	67	0.40	37	43	0.05
4.	Mean	50.18	79.15	0.58	49.26	61.36	0.25

where <g> =standard gain

Aspect of Attitude in the NoS

From the data resulting from the scientific attitude posttest, a mean score of 79.41 in magnitude is obtained for the scientific attitude of the experimental group while a mean score of 75.32 in magnitude is obtained for the scientific attitude of the control group. The mean score for the scientific attitude of the experimental group being higher is also indicated by the mean gain score obtained by the group concerned being 0.34 in magnitude. This mean gain score is greater than the one obtained by the control group, which is 0.18 in magnitude. A recapitulation of the scores for the aspects of scientific attitude is presented inTable 5.

TABLE 5. Recapitulation ofthe Scores of the Aspects of Scientific Attitude

No	Aspect of Scientific Attitude	Experimental Group		Control Group	
		Pretest	Posttest	Pretest	Posttest
1	Curious Attitude	63.2	56.2	53.2	56.4
2	Attitude Oriented to Discovery and Creativity	48.8	61.5	52.1	46.3
3	Environment-Sensitive Attitude	52.7	61.3	54.5	57.1

Aspect of Knowledge in the NoS

From the data resulting from the posttest of achievement in learning knowledge, a mean score of 78.54 in magnitude is obtained by the experimental group while a mean score of 71.96 in magnitude is obtained by the control group. It indicates that the mean score for knowledge as aspect of class learning achievement of the experimental group is greater than that of the control group. The score for the learning achievement of the experimental group being higher is also indicated by the mean gain score of 0.44 in magnitude obtained by the group concerned. This mean gain score is greater than that obtained by the control group, which is 0.32 in magnitude.

Results of the Analysis on the Effectiveness of the Science Learning Set Based on Local Potential

Prerequisites to Hypothesis Testing

Normality testing administered to both the experimental group and control group indicates that the data come from populations with multivariate normal distribution. Equality testing of the variance-covariance matrix or the multivariate homogeneity testing done yields a Box's M value of 3.527 in magnitude with a value of sig. of 0.330 at α of 5% or 0.05. The conclusion that could be drawn from the test of Box's M is that sig $>$ 0.05 so that it is declared that H_0 is accepted, which means that the variance-covariance matrix of the population of the two samples is equal or, in other words, the two samples concerned come from a homogenous population.

One-Way MANOVA

The analysis of difference inlearners' science skills and scientific attitude between the experimental group and the control group is done by comparing the two groups concerned in the matter of the gain scores obtained for science skills and scientific attitude. A recapitulation of the gain scores for IPA skills and scientific attitude of the experimental group and the control group is presented in Table 6.

TABLE 6. Recapitulation of Gain Scores for Science Skills and Scientific Attitude in the Main Testing

Exposition	**Experimental Group**		**Control Group**	
	Science Skills	**Scientific Attitude**	**Science Skills**	**Scientific Attitude**
Mean Gain Score	0.37	0.34	0.22	0.18
Highest Gain Score	0.67	0.62	0.71	0.58
Lowest Gain Score	0.00	0.05	0.00	-0.30

The data presented in Table 6, indicate difference in science skills and scientific attitude between the experimental group and the control group. The difference is indicated by the mean gain score for science skills of the experimental group being 0.37 in magnitude while that of the control group is 0.22 in magnitude. So is the case with the mean gain score for scientific attitude, with that of the experimental group being 0.34 in magnitude while that of the control group is 0.18 in magnitude.

From the statistic testing of one-way MANOVA or T^2Hotelling, the value of significance obtained is 0.006 in magnitude or the value of significance obtained < 0.05. The conclusion that could be drawn from theone-wayMANOVAor T^2 Hotelling statistic testing is that there is significant difference in mean score for learners' science skills and scientific attitude between the experimental group and the control group.

Science learning with local potential as basis is found to be effective when viewed from the point of education as an aspect of the nature of science in line with the statement by [4] that humans have always been curious about the world around them. The curiosity that humans have always had about their world surely includes that about local potential. Mean while, science learning with local potential as basis is also found to be effective when viewed from the point of attitude as an aspect of the nature of science in line with the explanation that one of the points in the nature of attitude in science is that attitude is learned in society. In fact, according to [13] the learning of attitudes occurs in a society, both formally and informally, and, therefore, attitudes are culture-oriented.

Science learning with local potential as basis is also found to be effective when viewed from the point of skill as an aspect of the nature of science, as it is explained by the [4] that one of the approaches to science learning that are to train students' thinking skills is done by visiting and using external resources. Such an approach makes IPA learning interesting, meaningful, and effective, as it is also explained that visits to these places (regarded as local potential) make the learning of science more interesting, meaningful, and effective. The effectiveness of IPA learning viewed from the point of generic skills as an aspect of the nature of science is also supported by the statement by [8] that generic skills have emerged as one of the important aspects to bring out the best of students to survive in their careerand, hence, educational institutions should be pro active in outlining better educational systems for students to practice generic skills in class situations as well as in real-world situations. And the real-world situations surely include those involving elements of which each could be regarded as local potential.

CONCLUSION

Based on the research data obtained and the results of the analysis undertaken, it could be concluded that the learning conducted with local potential as basis is effective when viewed from the point of learners' IPA skills (i.e., process, generic, and critical thinking skills) and scientific attitudein Grade VII and Grade VIII at SMP.

REFERENCES

1. Alexon, Pembelajaran Terpadu Berbasis Budaya, (Bengkulu: Unit FKIP UNIB Press, 2010).
2. Cain, S. E., & Evans, J. M., Sciencing: An Involvement Approach to Elementary Science Methods, (Columbus: Merril publishing company, 1990).
3. Chiapetta, E., & Koballa, T., Science Instruction in the Middle and Secondary Schools: Developing Fundamental Knowledge and Skill, seventh edition. (Boston: Allyn and Bacon, 2010).
4. Curriculum Development Centre, Integrated Curriculum for Secondary Schools, Ministry of Education Malaysia, (2002).
5. Depdiknas, Undang-undang RI Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional, (2003).
6. I Wayan Suastra, Ketut Tika, & Nengah Kariasa, *Jurnal Penelitian dan Pengembangan Pendidikan,* **3**, 258-273, (2011).
7. Kubicek, J., Inquiry-Based Learning, *Canadian Journal of Learning and Technology.* **31**(1) 1-7 (2005).
8. Jalil, Z. A., Yusoff, A. M. & Daud R., *International Journal of Science Commerce and Humanities*.Volume 3, No. 7, December 2015.
9. Martin, M. O., Mullis, I. V., Foy, P., Stanco, G. M., TIMSS 2011 International. Chestnut Hill, MA, USA: TIMSS & PIRLS International Study Center, IEA, (2013).
10. Mishra, S.K. &Yadav, B. , Effect of Activity-Based Approach on Achievement in Science of Students at Elementary Stage. *International Journal of Basic and Applied Science,* Vol. 01, No. 04, April 2013.
11. Mendikbud, Permendikbud No. 81 A. Tahun 2013 tentang Implementasi Kurikulum, (2013).
12. Organization for Economic Cooperation and Development (OECD), PISA 2012 Results in Focus: What 15-year-olds know and what they can do with what they know. (Paris: OECD, 2014).
13. Pitafi, A. I. & Farooq, M., *Academic Research International*, Vol. 2, No. 2, (2012).
14. Purwanti Widhy H, Sabar Nurohman, & Widodo Setyo W., *Jurnal Pendidikan Matematika dan Sains,* Vol. 1, No.2, (2013).
15. Republik Indonesia, UU RI No. 20 Tahun 2003 Tentang Sistem Pendidikan Nasional, (2003).
16. Suratsih, *Pengembangan Modul Pembelajaran Biologi Berbasis Potensi Lokal Dalam Kerangka Implementasi KTSP SMA di Yogyakarta.* Laporan Penelitian Hasil Penelitian Unggulan UNY (Multitahun) Tahun Anggaran 2010, UNY, FMIPA, Yogyakarta, (2010).
17. Suryadarma, I., Diklat Kuliah Etnobotani. Yogyakarta: Jurusan Pendidikan Biologi FMIPA UNY, (2008).