

## **The Effectiveness of Natural Science Modules Towardcritical Thinking Ability and Student Performance: A Development Research**

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**Abstract:** *Students in Indonesia still have low thinking ability, moreover on the implementation of natural science. One alternative solution to this problem to sharpen their critical thinking ability by developing the natural sciences modules. This research aims to examine the effectiveness of environment-oriented natural science's module using the concept of pollution and wastes on the vocational high school (Sekolah Menengah Kejuruan/SMK). The subjects are the XI grade students of SMKNegeri 1 Daha Selatan of Hulu Sungai Selatan District. This research was conducted on the academic year of 2016/2017. The data about the module effectivity including 1) the result of critical thinking, 2) performance appraisal results, 3) cognitive appraisal result. The data was collected through various tests and observations which were analyzed descriptively. The result shows that environment-oriented natural science's module using the concept of pollution and wastes are considered effective based on 1) the average of critical thinking is categorized as good, 2) the average of students' performance result is categorized as good, 3) the result of cognitive studying through N-Gain Module is categorized as high.*

**Keywords:** *natural science module, critical thinking, effectiveness*

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### **I. Introduction**

Students in Indonesia still have low thinking ability, moreover on the on the natural science's implementation (PISA, 2005). Overall, Indonesian students' natural sciences literacy based on PISA study in 2015 is relatively low, which is ranked 62 out of 69 evaluated countries (OECD, 2015). This low thinking ability has no sign of enhancement from time to time.

Critical thinking ability is a part of high-level thinking ability. Filsaime (2008) stated that critical thinking is a process that emphasizes logical and rational thinking. Critical thinking ability can be obtained through practical activities in the learning process (classroom activity).

Learning process in schools, including in vocational high schools, already used student worksheets (*LKS/Lembar Kerja Siswa*), but not yet accommodating critical thinking ability as the main aspect. If this is still continued, Indonesian students' ability will be left behind. That is the reason why we need innovation which is oriented on the learning process. One alternative is by fixing the learning sources.

The learning sources (students' books) have several problems, either the limited availability or on the distribution. One alternative which can be done is by developing independent learning sources in form of learning module through development research. In order to become high-quality modules, it needs to be developed through expertise tests, individual tests, small group tests, and field tests (Tessmer, 1998). Through these ways, it will result in a valid, practical, and effective module.

Subjects in vocational high school are categorized into three: 1) productive subjects, 2) normative subjects, and 3) adaptive subjects. Module-based learning aims to attract students' interest, even though teachers will be still involved.

Environment-based natural science's module aims to increase students' awareness of the environmental issues, and transform the knowledge into positive actions to the school's environment or society. The modules are formed in intact and systematic so it can be used without teachers' guidance (Depdiknas, 2008a). The implementation of environmental education to the students can be increased in order to create an environment-caring society (Miles, Harison & Mackenzie, 2006). The conducive, tranquil, and green learning environment will influence the learning process and its results.

Natural science is included on the adaptive subject. The students think that adaptive subjects are not as important as productive subjects. The natural science's teachers have the habit to use materials outside the adaptive subjects. So, the students only learn natural science on the cognitive domain and are not pushed to

develop their thinking potential. Based on those arguments, the researchers do the research of natural sciences effectivity on vocational high school through designed-based research.

## II. Methods

This research used expertise tests, individual tests, small groups test, and field tests. The subjects are XI grade students of *SMKNegeri 1 Daha Selatan ofHulu Sungai Selatan* District. The data about the effectiveness including 1) the result of critical thinking, 2) performance appraisal results, 3) cognitive appraisal result. The data are obtained through various examines and observations which were analyzed descriptively

### Research Results And Analysis

The summary of the average of critical thinking ability is shown in Table 1.

**Table 1.**The Summary of the Average of Critical Thinking Ability: Small groups tests

Critical Thinking Ability	Module 1 (%)	Module 2 (%)	Average (%)
Designing research questions (Inference)	80	70	75
Creating hypothesis (Inference)	80	70	75
Data collecting (Interpretation)	85	85	85
Data analyzing (Eksplanation)	80	80	80
Creating conclusion (Evaluation)	90	85	87,5
Average	83	78	

Notes:85 < 100% = very good; 70 < 85% = good; 50 < 70% = less good; 10 < 50% = not good

Based on Table 1, the ability of critical thinking has an average score around 78-83% which is categorized as good. The summary of the performance appraisal result is shown in Table 2.

**Table2.** The Summary of the Average of Performance Appraisal: Small Groups Tests

No	Students' Name	RTKs Done	%
1.	Mardiati	8	100
2.	Maria Ulfah	8	100
3.	M. Ali	7	87,5
4.	M. Rizki Akbar	6	75
5.	M. Yanto	7	87,5
6.	Rizki	6	75
Average			87,5

Notes: 85 < 100% = very good; 70 < 85% = good; 50 < 70% = less good; 10 < 50% = not good

Table 2 shows the performance ability of the students with the average percentage of 87,5% (very good). Table 1 and 2 shows that the critical thinking ability is categorized as good, and performance ability is categorized as very good. The module is stated as expected effectiveness.

The actual effectiveness of critical thinking ability of the students through field examine is shown in Table 3

**Table 3.**The Students' Critical Thinking Ability through the Field Tests

Critical Thinking Ability	Group	Module 1 (%)	Module 2 (%)	Average	Category	
Designing Question(Inference)	Research	1	80	80	80	Good
		2	80	80	80	
		3	80	70	75	
		4	70	70	70	
		5	70	80	75	
		6	70	70	70	
Average				75		
Critical Thinking Ability	Group	Module 1 (%)	Module 2 (%)	Average	Category	
Creating (Inference)	Hypothesis	1	80	80	80	Good
		2	80	80	80	
		3	70	70	70	
		4	80	70	75	
		5	80	70	75	
		6	80	70	75	

Average				75,83	
Critical Thinking Ability	Group	Module 1 (%)	Module 2 (%)	Average	Category
Data collecting (Interpretation)	1	90	80	85	Good
	2	80	80	80	
	3	80	80	80	
	4	80	70	75	
	5	70	70	70	
	6	80	70	75	
Average				77,5	
Critical Thinking Ability	Group	Module 1 (%)	Module 2 (%)	Average	Category
Hypothesis examineing (Explanation)	1	80	80	80	Good
	2	80	80	80	
	3	70	80	75	
	4	80	70	75	
	5	80	70	75	
	6	70	70	70	
Average				75,83	
Critical Thinking Ability	Group	Module 1 (%)	Module 2 (%)	Average	Category
Creating conclusion (Evaluation)	1	90	80	85	Good
	2	90	80	85	
	3	80	80	80	
	4	80	80	80	
	5	80	70	75	
	6	80	70	75	
Average				80	

Notes: 85 – < 100% =VeryGood; 70 –< 85% = Good; 50 –< 70% = LessGood; 10 –< 50% = NotGood

Table 3 shows the critical thinking ability of the students on the field tests results on the average results of designing research questions (interference) is 75%, creating hypothesis 75,83%, data collecting (interpretation) 77,5%, data analyzing (explanation) 75,83%, and creating conclusion (evaluation) 80%. Table 3 shows that critical thinking ability of the students on the field tests is categorized as good.

The summary of performance ability to look for actual effectiveness on the field examine for Module 1 is showed in Table 4.

**Table 4.** The Summary of Group’s Performance Ability through the Field Tests.

Group	RTKs done	%	Category
1	8	100	VeryGood
2	8	100	VeryGood
3	8	100	VeryGood
4	7	87,5	Good
5	7	87,5	Good
6	8	100	VeryGood
Average		95,83	VeryGood

Notes: 85 – < 100% =VeryGood; 70 –< 85% = Good; 50 –< 70% = LessGood; 10 –< 50% = Not Good

**Table 4** shows the students’ performance ability on the field tests has the average score of 95,83% which is categorized as good.

The pre-test and post-test results of the students to see the actual effectiveness on the field tests with module 1, is shown in Table 5.

**Table 5.** The Result Summary of the Students' Pre-tests and Post-tests with Module 1 through the Field Test.

Number of the Students	AveragePre examine	AveragePost examine	N-Gain	Category
30	28,33	78,53	0,70	Medium

Notes: N-Gain > 70= High;  $0,30 \leq$  N-Gain  $\leq$  0,70= Medium; N-Gain < 0,30= Low

Table 5 shows the result of the students' pre-test and post-test with module 1 through the field tests have the average of pre-test is 28,33, the average of post-test is 78,53, and N-Gain score is 0,71 which is medium category.

The result of the students' post-test and pre-test to see the actual effectiveness on the field examine with Module 2 is shown on Table 6.

**Table 6.** The Summary of the Pre-test and Post-test Result of the Students with Module 2 through the Field Test.

Number of the Students	Average ofPre-test	Average ofPost-test	N-Gain	Category
30	29,97	79,57	0,71	High

Notes: N-Gain > 70 = high;  $0,30 \leq$  N-Gain  $\leq$  0,70 = medium; N-Gain < 0,30 = low

Table 6 shows the result of pre-test and post-test of the students with module 2 through field tests has the average score of the pre-examine is 29,97, the post-test is 78,80, and N-Gain is 0,71 which is categorized as high. The module is considered has actual effectiveness. Based on this research, it can be concluded that the module is effective due to several considerations: 1) the resulting average of critical thinking ability is categorized as good, 2) the resulting average of the students' performance ability is categorized as very good, 3) the result of cognitive learning through N-Gain module is categorized as high.

(Critical thinking ability acts the good category of effectiveness indicator. This is supported by the previous researchers (Kurniawati and Atmojo, 2015; Zaini and Supiati, 2016). Critical thinking ability becomes one indicator of the developed module effectiveness. Critical thinking ability includes designing research questions (inference), creating the hypothesis (inference), data collecting (interpretation), data analyzing (explanation), and creating conclusion (evaluation).

The resulting average of students' performance ability is categorized as very good. The previous reports confirm this result (Arifin, 2012; Purnomo, 2012; Parmin, 2012; Abdunor, 2014; Ripani, 2014; Imama, 2015; Kartini, 2015) which stated that the module effectiveness is fulfilled based on the psychomotoric ability result.

The result of cognitive learning through N-Gain module is categorized as high. The difference between pre-test and post-test scores indicates the increasing understanding and concepts mastering by the students after the learning with the module. This confirms the research done by Wiyono (2013) about the development of mathematics learning set is fulfilling the effective criteria through problem-solving in the experimental class increase as much as 0,661 with medium category using Gain tests.

The expected effectiveness from small groups tests based on the critical thinking ability of the students has an average score of 80,5% which is categorized as good and the result of the performance ability has the score of 83,33% which is categorized as good.

The actual effectiveness of the field tests shows the critical thinking ability of the students with the percentage of 75-80% which is categorized as good. The performance ability reached the percentage of 80-100% which is categorized at least good. This result is in line with the previous researches (Arifin, 2012; Purnomo, 2012; Parmin, 2012; Abdunor, 2014; Ripani, 2014; Imama, 2015; Kartini 2015; Zaini & Dini, 2015) that reported the module effectiveness has been fulfilled based on the psychomotor ability, social ability, critical thinking ability results with the indicators of designing research questions, creating hypothesis, designing examines, and creating conclusion, is categorized as good.

Actual effectiveness is also derived from the result of pre-test and post-test of the students on the field test. On module 1, the average score for pre-test is 28,33 and post-test is 78,53 with N-Gain of 0,70 which is a medium category. On module 2, the average score for pre-test is 29,97 while the post-test is 79,57 with N-Gain 0,70 which is a medium category. The difference between pre-test and post-test indicates there is an increase of understanding and concept mastering of the students after learning using an environment-oriented module.

Based on the expected and actual effectiveness, the module is categorized as effective. Pharakhrusitpattanaporn (2012) stated that effectiveness of a teaching method could develop critical thinking ability of the students.

### III. Conclusion

The results show that environment-oriented natural science using pollution and wastes concept is categorized as effective based on 1) the average result of critical thinking ability is categorized as good, 2) the average result of students' performance is categorized as very good, 3) the result of cognitive learning using N-Gain module is categorized as high.

### References

- [1]. Abdunor. 2014. Research and Development of Fish Diversity Module in Mangrove Forest Area to Establish Student Conservation Cadre MAN 5 Martapura. Thesis Master of Biology Education LambungMangkurat University. Banjarmasin, Unpublished (In Indonesia).
- [2]. Arifin, S. 2012. Development of Classroom Action Research Module to Enhance Student Understanding and Creativity. *Jurnal Vidya Karya*. 27pp.55-56 (In Indonesia).
- [3]. Depdiknas. 2008a. Writing Module. Directorate General of Quality Improvement of Educators and Education Personnel, Jakarta (n Indonesia).
- [4]. Filsaime, D. K. 2008. Revealing the Secrets of Critical and Creative Thinking. The 2nd edition is translated by Sunarni. Achievement Pustakaraya, Jakarta (In Indonesia).
- [5]. Imama, N. A. G. dan Zaini. 2015. Development of Greening School Based Module the Concept of Plant Classification At SMKN 1 Takisung.Proceedings of the 2nd National Seminar and Workshop on Biology, Science and Learning are carried out by FMIPA UM Malang on 17-18 October 2015. Malang: UM Press(In Indonesia).
- [6]. Kartini, N. 2015. Development of Learning Tools IPA Junior High School Using Inquiry Model Guided Topic Classification of Objects.Thesis Master of Biology Education LambungMangkurat University. Banjarmasin, Unpublished (In Indonesia).
- [7]. Kurniawati, W., & Atmojo, E. S. (2015). Development of Integrated Inquiry Based Worksheets The Nation's Subject Group for Growing Student's Thinking and Scientific Character. *Jurnal Elementary School (online)*, 2(1), pp. 47-53.(<http://upy.ac.id/ojs/index.php/elementaryschool/article/view/File/54/46>), Accessed 14 Maret 2016.
- [8]. Miles, R., Harrison, L., Mackenzie, A. Cutter. 2006. Teacher Education: a Diluted Environmental Education Experience. *Australian Journal of Environmental Education*, 22 (1). pp. 49–59.
- [9]. Nieveen, N. 1999. Prototyping to reach product quality. In J. van den Akker, R. Branch, K.Gustafson, N. Nieveen, and T. Plomp (Eds.), *Design approaches and tools in education and training* Dordrecht: Kluwer Academic Publishers.
- [10]. OECD Programme for International Student Assessment. 2015. *PISA 2015 Released Field Trial Item Kognitif*. Doc: CY6\_TST\_PISA 2015FT Released Cognitive Items.
- [11]. Parmin, E. 2012. Development of Course Module Learning Strategy of Teaching Learning Science Based on Science. *Jurnal Pendidikan IPA*. 1. Pp. 8-12.
- [12]. Pharakhrusitpattanaporn, P., Piromijitrapong, S., dan Ashavabhumi, S. 2012. A Teaching Method to Develop a Critical Thinking of the Student of the General Education Ecclesiastical School. *Journal of Social Science*. 8(3). Pp. 467-471.
- [13]. Plomp, T. & Nieveen, N. 2007. An Introduction to Educational Design Research. Proceedings of the seminar conducted at the East China Normal University, Shanghai (PR China), November 23-26, 2007.
- [14]. Purnomo, D. 2012. Effect of Use of Pollution Research Result Module on Pape River Surakarta as Biology Learning Element of Environmental Pollution Discussion to Student Learning Result. Teacher Training and Education Faculty of SebelasMaret University. Surakarta (In Indonesia).
- [15]. Ripani, A. 2014. Development of Mangrove Plant Conservation Module that Potential as Food Ingredients to Establish Student Conservation Candidate of MAN 5 Martapura.Thesis Master of Biology Education LambungMangkurat University. Banjarmasin, Unpublished (In Indonesia).
- [16]. Tessmer, M. 1998. Planning and Conducting Formative Evaluation. London: Cogan Page.
- [17]. Wiyono. 2013. Mathematical Learning Concept Attainment Model Improves Triangle Material Problem Solving Ability. *Journal of Educational Research and Evaluation*, 2 (1): 50-54.
- [18]. Zaini, M. & Dini J. A. 2015. Development of Learning Tools Ecology Topics on Critical Thinking Skills of Madrasah Aliyah Students. *Journal of Biology Education Indonesia*Journal of Biology Education Indonesia, 2(1) 2016:39-47.
- [19]. Zaini, M., & Supiati. 2017. Developing Learning Device on Environment Pollution Topic in Senior High School. Article number 31887-TSS. *The Social Sciences*, Medwell Journal Scientific Research Publishing Company (in press).

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