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Development of Integrated Practical Guideline for Alternative Technology for Waste of Gold Mine Environment

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Abstract

West Kalimantan is a povince which has rich natural resources, one of which is gold mining. Besides it has many advantages, there is a lot of disadvantages produced by Mining like waste residue of gold mine that will be very dangerous for society lived along the Mining Environment. In education, one effort to minimize the negative result is by educating students through the development of integrated practical guidlines adapted to the living environment of students which have been damaged bacause of gold mine. It is extremely important for creating the correlation between lesson materials with students' environment, thus the learning process will be meaningful for them, and they can give contribution to solve the enviromental problem. This research aimed to develop lesson materials in form of practical guideline based on school's environment , and integrated with alternative technology for waste of gold mine environment in West Kalimantan Province. Borg and Gall design model was chosen as research method. Initially, teaching module concluded materials and media was validated by two validators and two science teachers. Data were analyzed qualitatively, it showed that integrated practical guideline for alternative technology for waste of gold mine environment is teoritically valid with score of A (very good). Therefore, it can be concluded that this development can produce the feasible practical guideline that will be used by students which is integrated with alternative technology for waste of gold mine environment.

Keywords: practical guideline; alternative technology for environments; waste of gold mine.

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1. Introduction

1.1. Background

Kalimantan has an area of approximately 539,460 km2 with 45% of the total area designated as the Lung of the world [2], but continuous evaporation leads to diminishing green land. West Kalimantan has an overall area of 14.6 million Ha,with 5.4 million Ha being used as a mining field [3]. Extracted and marketed gold provides much benefits for human [4] but gold mining is also very damaging to the environment that causes severe deforestation; land degradation; destruction of forest ecosystems. [5] Climate change and the global environment have progressively changed in recent years [6] causing environmental problems in rivers, soils and water that affect the balance of the existing environment in West Kalimantan [7]. According to the province of West Kalimantan [8] drought, reduced water supply, reduced diversity of fish is a problem of the people of West Kalimantan. Based on Central Institution of Statistics [9] 717 of 2298 villages in West Kalimantan have contaminated water contents. The use of land that altered the Kapuas River in Indonesia from living space and livelihoods became one of ecological diseases and collapse [10].

It is estimated that small and artisanal gold mining is released from 640 to 1350 mg of mercury per year to the environment, averaging 1000 mg yr^{-1}, from at least 70 countries. 350 mg yr^{-1} is instantly emitted into the atmosphere while the remainder (650 mg yr^{-1}) is released into the hydrosphere (river, lake, soil, tailings) [11]. One of the most troubling problems for people around the location of PETI (Unlicensed Gold Mining) is the use of toxic hazardous substances (B3), namely; mercury (Hg). The use of mercury as a material for bonding and separating gold seeds with sand, mud and water and holes (gold mining excavation pits) and un-managed gold mining remnants and utilized again will have an impact on gold miners and communities around the PETI location [12]. The use of mercury in gold mining as a separator and binder of gold ore with sand, this mercury is filtered using cloth to get the rest of gold. The filtered effluent is then squeezed by hand. Water remnants of mercury-containing mining are allowed to flow into the river and are left behind under the gold. Unmanaged gold wastes will have an adverse effect on miners, as well as communities around the mine, such as nervous system disorders, brain damage, paralysis, stunted growth, kidney damage, bone fragility and DNA or cancer damage [13].

Environmental damage in West Kalimantan needs to be the concern of all citizens, including the students. Student awareness of environmental issues is in line with the level of knowledge that students have. [14] Science is a learning that is produced systematically, organized, and structured by human thought driven by the curiosity (sense of knowledge). Science learning can be a vehicle for students to learn about the nature and self that can be applied in everyday life [15]. Science learning will not be liked by students if it is not related to daily life. Science learning is irrelevant according to the students, because the emphasis of concept and basic understanding of science is not related to student life [16]. If associated with the daily life of students. It will be liked by students as it provides a meaningful learning experience for students. The ability to corralate between students' environment with scientific lesson is need to be owned by an educator. This linkage can make students understand the conceptual lesson of science and problems in the student environment. Practical guideline used by teachers in West Kalimantan has not yet integrated the concept of science with the student environment. By 2013, Indonesian government has imposed a new curriculum that directs decentralization of education.

Decentralization in education can be directly managed by each region. Education is not limited for exploring or developing academic potential and other resources, but also education is expected to develop the potential of local excellence respectively and solve the student's environmental problems in through learning process.

By reality, teachers have not yet developed teaching materials that integrate students' environmental problems, hence it is necessary to develop a teaching material that integrates the solution of the student's environmental problem. The practical guideline is the right resource for integrating solutions to environmental problems. The teaching process with a practicum guide provides students with experience to follow the process, observe objects, prove, analyze and draw conclusions [17]. The practical guideline can motivate students to develop a material and space for understanding in a scientific approach [18]. Practical lesson can also make it easier for students to understand and interpret the concept of science [19].

This practical guideline is a practical role that integratesthe alternative technology for enviroment of mining waste using phytoremediation. Phytoremediation is an environmental restoration through a plant-based biological approach [20]. The heavy metal content can be reduced and neutralized by a cheaper method known as Phytoremediation [21]. This technology is a cost-effective and alternative innovation to treat environmentally hazardous waste [22]. One type of aquatic plant that can be used in neutralizing heavy metal pollution is *Eceng gondok* (Eichhornia crassipes). The advantage of enceng gondok (Eichhornia crassipes) is can grow rapidly [23]. It can reduce the metal content in water [20]. Besides that, it has long roots which are useful in heavy metal accumulation. Although this plant is a disturbing plant [24] as it can reproduce rapidly. However it is an effective crop in waterpurification, it absorbs heavy metals primarily derived from roots [25].

Based on the explanation that has been proposed, thus it is strongly required to developthe integrated practical guideline for alternative technology for waste of gold mine. Incorporating local wisdom in learning will increase students' awareness to the environmental land conservation [26]. The development of local wisdom-based products around students 'environments can also increase students' awareness of the environment [27].

2. Materials and Methods

2.1. Research Method

This research is modification of research and development (R&D) [28] and aimed to produce product of integrated practical guideline for alternative technology for waste of gold mine with special topic of “Environmental Pollution”. It used dimprovement design by Borg and Gall, which covered some steps 1) research and collecting information; 2) planning; 3) development of prelimenary product; 4) field first trial; 5) revision to the product; 6) product trial; 7) revision of operational product (Borg and Gall).

2.2. Research Subject

Research subject is 30 students of class VII in State Senior Junior School of Belitang Hilir who sit in fisrt semester of academic year 2017/2018.

2.3. Development Prochedures

The first step in developing a practical guide is to seek and collect the necessary information in the development consisting of literature studies and field studies.

The second step is the researchers plan to design the product to be developed The third step is the researcher began to develop products consisting of the form of products that will be developed, drafting the concept for creating draft 1 of the product.

The fourth step is product validation performed by experts. In this study consists of four experts namely two lecturers and two science teachers. Validation instrument material for the experts can be seen in Table 1. The result of validation is declared feasible then it can be used for field trial.

Table 1: Contents for Validation of Integrated Practical Guideline for Alternative Technology for Waste of Gold Mine

No	Aspects	Indicators	Score
1.	Characteristics of teaching module integrated with environment and alternative technology	Characteristics of *fairness and accuary*	1
		Characteristics of *depth*	1
		Characteristics of *instructional soundness*	1
		Characteristics of *usability*	1
2.	Contents Feasibility	Depth of materials in line with cognitive improvement of students	1
		Accuracy of presented concepts	1
		Accuracy of facts	1
		Completeness of teaching materials	1
		Advantages of teaching materials	1
		Coherence and chronology	1
		Materials integration with theme	1
		Suitability of examples with material	1
3.	Performance	Clarity objective and indicators of teaching materials	1
		Simple and complete instructions	1
		Materials are presented logically and sistematically	1
		Presented materials motivate cognitive ability	1
		Suitability of figures and materials	1
		Mind concept is presented	1
		Presenting of students worksheet	1
		Clarity presentation of resume	1
		Glosary	1
		Evaluation test/ quiz	1
4.	Language	Suitability with EYD role of Bahasa	1
		Clear sentences	1
		Effectivity and effeciency of Bahasa	1
		Systematically writing rules	1
		Writing of references	1
Total Score			27

Development test is done after the revision, student worksheet done with limited legibility test tothe students of class VII. Limited testing is tried to junior high school students using a student literacy response questionnaire. Student response questionnaire and readability of student responses can be seen in Table 2. By the questionnaire, it can be seen the legibility responses of students against the practical guideline.This questionnaire provides student responses presented using a scale of 1 to 5. The results of this test can be used to improve the practical guideline developed and can be used for field activities.

Table 2: Content of Students Questionnaire to the Practical Guideline

No	Aspects	Indicators	Total Item
1.	Convenience in understanding the teaching materials	Readability	1
		Easily Use	1
		Language	3
		Materials	1
		Compatibility theme	1
		Figure quality	1
		Supplementary facilities	2
		Evaluaation	1
2	Appealing media	Performance	1
		Materials presentation	1
		Supplementary facilities	1
Total			14

2.4. Technique for Data Analysis

Data in this research were collected using questionnaire. The questionnaire instrument is used in the validation of students 'science worksheets by expertlecturers and teachers and students' responses on the legibility of practical guideline. Analysis of data used isconcerned on legibility of student responses.Qualitative analysis is used by researchers in analyzing suggestions from validators.

Their advices and suggestion can be used to improve the practical guideline. Quantitative analysis is used by researchers in analyzing assessment data from validators. Validation values obtained at each point, then summed up as actual scores (X).

Thisactual score is then converted to a qualitative value with reference to the conversion of scores into a scale of five. This is to determine the feasibility of the quality of the developed practical guideline. Hence, references converting scores to five scaleswill be shown in Table 3.

Table 3: Actual Score Conversion to Five Scales

No.	Interval	Mark	Category
1.	X > xi + 1.80 Sbi	A	Very Good
2.	xi + 0.60 Sbi <X ≤ xi + 1.80 Sbi	B	Good
3.	xi - 0.60 Sbi <X ≤ xi + 0.60 Sbi	C	Average Good
4.	xi - 1.80 Sbi <X ≤ xi – 0.60 Sbi	D	Less Good
5.	X < xi – 1.80 Sbi	E	Very less Good

The feasibility of product will be determined using minimum score "C" which is represents average good. Therefore, if the results have at least score of "C", thus the product is feasible to be used.

Students response to the readability of product will be used for analysis their responses to the practical guideline. This result is used for measuring and improving the quality of practical guidline.

3. Result and Discussion

3.1. Result of Prelimenary Study

The results of interviews tosciencteachers are known that the teaching materials used in learning activities have not integrated with environmental conditions around the students, especially waste generated by gold mining. Since it is important to teach students from the beginning about environmental damage, they will know and can contribute in handling the environmental problems.

3.2. Planning and Development of the Integrated Practical Guideline for Alternative Technologies for Waste of Gold Mine Environment

1) Development Steps of the Practical Guideline

The developed environmental teaching materials integrated with alternative environmental waste gold mine technologies. Broadly speaking the steps ofteaching materials include:

a) Analyze the curriculum

This step aims to identify the competencies that become the reference or references in the development of a practical guideline. The selection of materials is done by referring to the competencies demanded in the curriculum of 2013, KI 1-4, KD 3.8 and 4.8

b) Analyze learning resources

This step is intended to analyze the availability, conformity, and ease of learning resources that will be the

material in the preparation of a practicum guide. Some of the learning resources used for the development of this practical guide include environmental textbooks, research reports related to gold mining and environmental technology and scientific research journals, especially those related to the environmental conditions caused by the existing gold mining inWest Kalimantan.

2) Development of environmentally oriented integrated teaching materials for Alternative Technology of Gold Mining Wastes

The development of environment-oriented teaching materials aims to equip students to have the skills of environmental literacy with alternative environmental technologies, so that in its development it refers to the key characteristics described by [30] on the characteristics of environmentally oriented teaching materials including:

a) Fairness and Accuracy

The explanation of the material on the practice guide was done with the characteristics of fairness and accuracy in describing the condition of environmental issues and problems that exist in West Kalimantan and can reflect different views on the problems occurring in West Kalimantan. The material contained in the practicalguideline provides information, opinions, issues and environmental issues caused by gold mining that lead them to make their own conclusions. To present the data - data in the form of information on pollution that occurs in the river, the land due to gold mining in support of relevant data and accurate taken from journals and scientific research, for example the data area of the gold mining area existing in West Kalimantan, environmental damage, metal water pollution, impact of environmental pollution.

b) Depth

Environmental pollution material in practice manual developed directed to build awareness to remind students understanding of nature and environment and environmental problems around the students and the environment globally and how between environmental components interact and have their respective functions, build student values and perceptions about the issue especially environmental events occurring in West Kalimantan. In the practice guide presented comparison of environmental conditions of West Kalimantan 15 years ago with the present state of the environment, also displayed globally in the caseof environmental pollution Minamata due to mercury in japan

c) Instructional soundness

Environmental pollution materials in developed teaching materials are designed to support the learning process using learning techniques that can create an effective learning environment. Contextual learning that links material to real daily life, students are directed to create new knowledge from the knowledge that students already have through new experiences. The material is not presented in separate disciplines but is also linked to economic, political and cultural aspects so that students can see relationships in a broader context with a perspective that is in tune with real life. In practice guide presented by showing the culture of West Kalimantan

community activity in environment, impact of gold mining for economy and environment of West Kalimantan citizen and government policy in education, environment and gold mining

c) Usability

Materials concerned to the environmental changes are designed to be easy to use, clear and logical and refer to long-term goals for students to have life skills in addressing and solving life problems, especially environmental issues. In the practice guide presented by featuring articles and journals alternative environmental technology phytoremediation

3) Validation and Revision

a) The validation results of material and media by validators

Validation of practical guidance aims to obtain data on the feasibility of integrated wastewater guidance of alternative environmental technologies of mine waste in accordance with the Ministry of National Education (*Depdiknas*), which is an assessment of the characteristics of teaching materials with environmental literacy, content feasibility, presentation, language and graphical displaywhich is in the developed practice guide. The results of the assessment of two experts can be seen in Table 1. Practical guidelines validated by two lecturers and two science teachers, obtained data in the form of qualitative data and quantitative data. Qualitative data is data in the form of suggestions and input from validator for practice guide. Quantitative data in the form of scoring valuation of the validator in the practice guide. The suggestions and feedback provided by the validators to the developed practical guideline can be seen in Table 4.

Table 4: Validator Suggestions for Practical Guideline

No.	Validators	Suggestions
1.	Lecture 1	Adding real condition of environment around students influenced by gold mining and river of Kapuas
		Adding the figure of Kalimantan Island on the cover
2.	Lecture 2	The title should contain word of integrated
		Revising several wrong terms in practical guideline
		Laying basic competencies compatible with core competencies
		Revising the practical objective from water for living to be students are able to distinguish and determine the characteristics of clean water and polluted water
		Deleting temperature as indicator for clean water and adding density as indicator of clean water
		Making comparison of *enceng gondok* and adding factor density as indicator of clean water
		Adding questions test related to practical lesson
		Writing the references in accordance with guideline
2	Science Teacher 1	Adding few questions test
3	Scicene Teacher 2	Adding few questions test

Table 5: Assessment Data of Validators

No	Aspects	Indicators	Validator I	Validator II	Teacher I	Teacher II
1.	Characteristics of teaching module integrated with environment and alternative technology	Characteristics of *fairness and accuary*	5	5	5	5
		Characteristics of *depth*	5	5	5	5
		Characteristics of *instructional soundness*	4	4	4	4
		Characteristics of *usability*	5	4	5	5
2.	Contents Feasibility	Depth of materials in line with cognitive improvement of students	5	4	5	5
		Accuracy of presented concepts	4	4	5	5
		Accuracy of facts	5	4	5	5
		Completeness of teaching materials	5	4	5	5
		Advantages of teaching materials	4	5	5	5
		Coherence and chronology	5	4	4	5
		Materials integration with theme	5	4	5	5
		Suitability of examples with materials	5	4	5	5
3.	Performance	Clarity objective and indicators of teaching materials	5	4	5	5
		Simple and complete instructions	4	4	5	5
		Materials are presented logically and sistematically	5	4	4	4
		Presented materials motivate cognitive ability	5	4	4	4
		Suitability of figures and materials	5	4	5	5
		Mind concept is presented	4	4	5	5
		Presenting of students worksheet	4	4	5	5
		Clarity presentation of resume	5	4	5	5
		Glosary	5	5	5	5
		Evaluation test/ quiz	4	4	4	4
4.	Language	Suitability with EYD role of Bahasa	5	5	5	5
		Clear sentences	5	4	4	5
		Effectivity and effeciency of Bahasa	5	4	5	5
		Systematically writing	5	4	4	5

		rules				
		Writing of references	4	4	4	4
5	View and grapics	Text or letter readability	5	5	5	5
		Colour composition	4	5	5	5
		Layout setting	5	4	4	4
		Quality view of figure/ animation	4	4	5	5
		Consintency	5	5	5	5
Total Score			150	136	151	153
Average Score			147.5			
Maximum Score			160	160	160	160
Percentage of Total Score (%)			93.75	85.00	94.37	95.62
Average Percentage (%)			92.18			
Category			Very Good	Very Good	Very Good	Very Good

According to Table 5, it illustrated that validation result given by lecture and science teacher can be presented in form of diagram as shown in Figure 1.

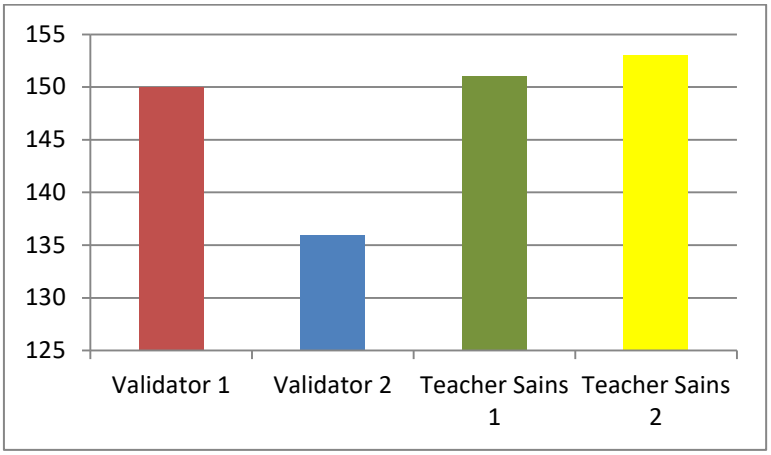

Figure 1: Score given by Validators and Science Teacher

The average score obtained from four validators will convert into five scales as shown in Table 5, then the result of conversion score will be presented in Table 6.

Table 6: Decision Making based on Score given by Validators

Mark	**Interval**	**Category**
A	$X \geq 134,34$	Very Good
B	$108,78 < X \leq 134,34$	Good
C	$83,22 < X \leq 108,78$	Average Good
D	$57,66 < X \leq 83,22$	Less Good
E	$X < 57,66$	Very Less Good

According to the assessment given by leactures and teachers, the average score of all components is 147.5. If the score had been converted in accordance with table of decision-making, the developed practical guideline got score A with category of very good. And the guidline is declared to be valid and feasible with minimum score of "C". Therefore, those practical guideline is feasible to be used.

The practical guideline that had been validated will be revised then based on validators suggestions will be tested for field trial to the students of class VII as limited response test in form of questionnaire. The questionnaire is filled out to indicate the effectivity of developed practical guideline. The limited test has 30 students, and the analysis result showed that the practical guideline categorized with very good. The responses of students will be shown in Table 7.

Table 7: Students Responses to the Practical Guideline

No	Aspects	Average Score	Score	Category
1	Convenience in understanding the subject	4.42	A	Very good
2	View of Media	4.46	A	Very good
Average		4.44	A	Very good

Table 7 illustrated the responses of students for practical guideline. The average score will be shown as diagram in Figure 2.

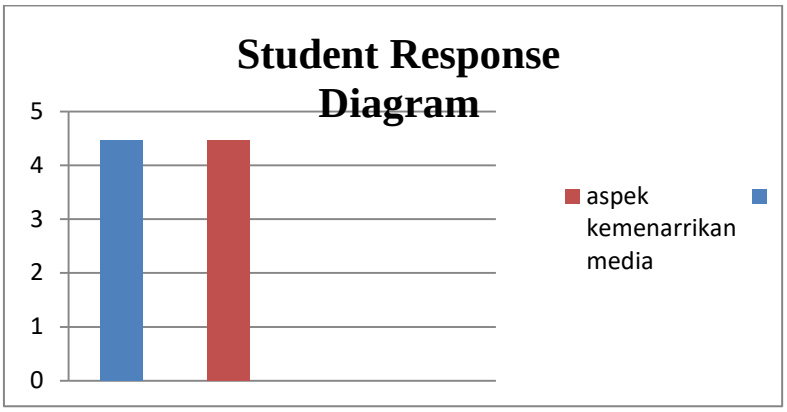

Figure 2: Responses Diagram of Students Readability

Students also provide feedback and comments on a questionnaire guideline. One example of student comments is as follows:

"This practical guideline makesmeunderstand learning easily"

"The practical guideline is interesting because it presents images and recent environmental issues around me"

"This practical guideline makes me aware of the negative impacts of gold mine waste pollution" The practicalguideline is a rule in carrying out the practicum which can also be used as an evaluation tool. Practicallessom are an integral part of science learning called experimental science. It is in line with Sagala's opinion [17] which explained that the process of teaching and learning by using practice guides can provide students with experience in following processes, observing objects, proving, analyzing and drawing conclusions. Hence the students gain knowledge and skills. The main purpose of the practicum is to train learners to work according to scientific procedures to acquire knowledge, skills and scientific value "[15]. A practical guideline integrated with local culture can be perceived directly by students [31]. Environmental education for sustainable development emerges as an important approach to promote students to preserve and preserve the natural environment in their environment [32].

4. Conclussion

By this research, the product developed by researchers is integrated practical guideline for alternative technology for waste of gold mine environment. This practical guideline had been develop successfully and declared as valid rpoduct and feasible to be used by validators. The result of students responses related to the readability significantly showed that this practical guideline can improve students understanding to the condition of environment polluted by waste of gold mine around their living environment.

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References

[1]“Indonesia, Malaysia, dan Brunei Darussalam Bahas Heart of Borneo http://www.dephut.go.id/index.php?q=id/node/3566 diakses pada 10 Maret 2018 Pulau Kalimantan.

[2] Peraturan Presiden Perpres No. 3 tahun 2012 tentang Rencana Tata Ruang

[3] Laporan Investigatif Eyes on the Forest Jaringan Kalimantan Barat (2016). monitoring izin usaha pertambangan minerba di kalbar Laporan investigatif . Pontianak : Eyes on the Forest

[4]Encarta (2002) Encarta Encyclopedia – mining, MSN Learning and Research, http://encarta.msn.com/find/search.asp?search=mining.

[5] Kouankap Nono Gus Djibril1, Tah Bong Cliford1, Wotchoko Pierre1, Magha Alice1, (2017). Artisanal gold mining in Batouri area, East Cameroon:Impacts on the mining population and their environment. Journal of Geology and Mining

[6] Elizabeth McKinnon (2002) The environmental effects of mining waste disposal at Lihir Gold Mine, Papua New Guinea . Journal of Rural and Remote Environmental Health 1(2): 40-50

[7] Gunradi. R, Rohman dkk (2004), Pendataan Evaluasi Pemanfaatan Bahan Galian Pada Bekas Tambang dan Wilayah Peti Daerah Sambas, Povinsi Kalimantan Barat. Pontianak : Sub direktorat Konservasi

[8] Provinsi Kalimantan Barat (2000) Sumber Neraca Kualitas Lingkungan Daerah – NKLD 2000). Kalimantan Barat: Pemerintah Daerah

[9] Badan Pusat Statistik (2014). Infographmap- Peta proporsi Desa/Kelurahan di Indonesia yang Mengalami Pencemaran air

[10] Oliver Pye, Irendra Radjaawali, Julia (2017) . Land grabs and the river: eco-social transformations along the Kapuas, Indonesia Journal Canadian J of Development Studies / Revue canadienne d'études du développement

[11] Kevin H. Telmer and Marcello M. Veiga N. Pirrone and R. Mason (2009). World Emissions of Mercury from Artisanal and Small Scale Gold Mining Mercury Fate and Transport in the Global Atmosphere.

[12] Subanri, (2008) Kajian Beban Pencemaran Merkuri (Hg) Terhadap Air Sungai Menyuke Dan Gangguan Kesehatan pada Penambang Sebagai Akibat Penambangan Emas Tanpa Izin (PETI) di Kecamatan Menyuke Kabupaten Landak Kalimantan Barat. Tesis. Magister Kesehatan Lingkungan Universitas Diponegoro Semarang.

[13] Titin A gustina (2014). kontaminasi logam berat pada makanan dan dampaknya pada kesehatan. journal teknobuga volume 1 no.1 – juni 2014

[14] North American Assoction For Environmental Education (NAAEE) (2011) Developing a Framework For Assessing Environmental Literacy Washington DC. The National Science Foundation

[15] Depdiknas (2004) Kurikulum Tingkat Satuan Pendidikan. Jakarta: Departemen Pendidikan Nasional

[16] Holbrook, Jack. (2005). Making chemistry teaching relevant. Chemical education international, 6, 1-12.

[17] Sagala. S (2005) Konsep dalam makna Pembelajaran. Bandung

[18] Suparno paul (2013). Metodologi Pembelajaran Fisika Konstruktivistik & menyenangkan. Yogyakarta: Universitas Sanata Darma

[19] Fuad Muhammad (2016) Pengembangan SSP Zat dan Energi Berbasis Keunggulan Lokal Untuk Meningkatkan Literasi Sains dan Kepedulian Lingkungan. Jurnal Inovasi Pendidikan IPA, 2(1) 2016,

66-75

[20] Zumani. D, Suryaman.M & Dewi S.M Pemanfaatan eceng gondok (eichhornia crassipes (mart.) solms) untuk fitoremediasi kadmium (cd) pada air tercemar Jurnal siliwangi vol. 1. no.1. nov. 2015 issn 2477-3891 seri sains dan teknologi

[21] Truu. J., Talpsep. E., Vedler. E (2003) enhanced biodegradation of oil shale chemical industry solid wastes by phytoremediation and bioaugmentation institute of molecular and cell biology, university of tartu

[22] EPA (Environmental Protection Agency) (2012). A Citizen's Guide to Phytoremediation. United States

[23] Pasaribu. G & Sahlawita (2007) Pengolahan eceng gondok sebagai bahan baku kertas seni. Proceding eksose hasil-hasil penelitian

[24] Chuan. Z.J (2010) The Perfomance and Mechanism of Removal of Heavy Metals From Water by Water Hyacinth Roots as a Biosorbent Material. City University of Hong Kong

[25] Liao.S.W & Chang W.L (2004) Heavy Metal Phytoremediation by Water Hyacinth at Constructed Wetlands in Taiwan. Journal Aqua. Plant manage

[26] Miranita Khusniati1, Parmin 2, Sudarmin, Local wısdom-based scıence learnıng model through reconstructıon of indıgenous scıence to improve student's conservatıonıst character, journal turkish science education volume 14, issue 3, september 2017

[27] Andam S. Ardan (2016) The Development of Biology Teaching Material Based on the Local Wisdom of Timorese to Improve Students Knowledge and Attitude of Environment In Caring the Persevation of Environment International Journal of Higher Education Vol. 5, No. 3

[28] Borg, W.R dan Gall, M.D (2007). Educational Research An Introduction. New york. Longman

[29] Widoyoko, E. P. (2009). Evaluasi Program Pembelajaran. Yogyakarta: Pustaka Pelajar.

[30] North American Assoction For Environmental Education (NAAEE).(2000). Environmental Education Materials: Guidelines for Excellence. Washington, D.C.: NAAEE.

[31] Sri ambarwangi, Suharto (2014) Reog sebagai sarana appresiasi siswa dan penciptaan dalam seni dan budaya berbasis di atas kearifan lokal. Journal of Arts Research and Education 14 (1) (2014): 37-45

[32] Alexandar R. & Poyyamoli G. (2014). The effectiveness of environmental education for sustainable development based on active teaching and learning at high school level-a case study from Puducherry and Cuddalore regions, India. Journal of Sustainability Education,Vol. 7.