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# Analysis of high school students' environmental literacy

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**Abstract.** The student's environmental literacy (EL) is a vital component to improve the awareness of student on environmental issues. This research aims to measure and analyse the EL of high school students, and how the topic of environment has been taught in high school. The research was conducted in February to April 2017. The EL was measured on three aspects, i.e. knowledge, attitude and concern. The participants were sixty-five (21 boys, 44 girls) purposively selected from students of grade X, XI and XII of one Senior High School in Karanganyar Regency, Indonesia. The knowledge of students on concepts of environmental issues was tested by fourteen main questions followed by supported questions. The result showed that 80% of students were classified as inadequate category. The attitude of students was measured by New Ecological Paradigm (NEP) consisted of fifteen items, and students' average score was 46.42 (medium). The concern was measured by fifteen statements about environment, and it was ranged from 2.58 to 4.18. EL of students may low due to students' lack understanding of the environment concepts, the limited theories and concepts transferred to students, inappropriate lesson plan to meet the EL components.

## 1. Introduction

Environmental issues, such as deforestation, forest degradation, water pollution and air pollution are the world-wide problem that causes serious impacts on life. Deforestation has threatened three continents in the world; Africa, America and Asia. Deforestation has led to the loss of biodiversity and soil degradation [1]. Rapid population growth and infrastructures development in the coastal area of Mumbai resulted in water contamination. The water of Mumbai Beach has been contaminated by anthropogenic heavy metals that caused adverse effects on human health, biodiversity, marine ecosystem productivity, and aesthetic [2]. Air pollution has been affected nine out of ten people living in urban areas around the world [3]. Exposure to air pollution in the form of ozone and NO<sub>2</sub> increases risk of death, asthma, lung cancer and respiratory infections.

Humans and the environment are closely linked and influencing one another. Either directly or indirectly, human activity has impact to sustainable living [4]. The declining of environmental quality was influenced by human excessive exploitation of natural resources without regard to the environmental carrying capacity and ecological functions [5]. Management of the natural resources should be done wisely, appropriately and sustained so that the continuity of living beings and preservation of the ecosystems can be maintained [6].

Education has an important role in addressing the complexity of environmental issues [7] [8]. Environmental education is an effort to manage the environment through a formal approach by



providing insight knowledge to students [9]. Environmental education is a commitment of the international government and community and implemented through the school curriculum.

Based on the results of the 1997 UNESCO's Tbilisi Declaration, environmental education aims to foster learners' environmental awareness and ability to provide solutions to the environmental problems. Environmental education attempts to involve learners in imparting knowledge to change beliefs, attitudes and behaviors towards the environment [10]. One of the ultimate goals of environmental education is to increase students' EL [11]. The implementation of environmental education integrates EL on it, so that the students understand the environmental and natural relationships with human being [12].

EL is the ability to care for the environment and ability to solve environmental problems [13] [14]. EL, affirmed by the Environmental Education and Training Partnership is the ability to overcome the existing environmental problems and avoid the emergence of the new problems. The concept of EL is emphasized on three aspects; nature, environmental issues, and suitable and sustainable solutions to existing problems [15].

EL was measured based on three aspects, i.e. knowledge, attitude and concern [16]. Knowledge is measured using fourteen multiple choice questions. Meanwhile, attitude was measured using a New Ecological Paradigm scale (NEP) consisted by fifteen items of statements with a likert scale. Concern was measured using fifteen statements with a Likert scale.

The questions of knowledge based on indicators of lesson plan, especially in the chapter of environmental changes and waste recycle. The fourteen questions have been tested for validity and reliability.

The EL of attitude was measured using NEP Scale. NEP is new paradigm in ecology, first NEP stands for New Environmental Paradigm. The conversion of New Environmental Paradigm to New Ecological Paradigm as a confirmation of ecological basis for society. The statements of NEP are air pollution, water pollution, loss of aesthetic value and conservation of natural resources. The NEP has been revised, so statements in the next article are environmental issues, such as waste, ozone depletion, deforestation, biodiversity extinction, global climate changes and global warming. The NEP was consisted by five components, each containing three statements, namely limits to growth, balance of nature, anti-anthropocentrism, anti-exemptionalism, and eco crisis [17]. Limits to growth is the belief that the earth's limitation to provide natural resources. Limits to growth was listed number 1, 6 and 11. Balance of nature is the belief that humans activity affects natural resources. Balance of nature was listed number 3, 8 and 13. Anti-anthropocentrism is the belief that humans may could change and control the environment. Anti-anthropocentrism was listed number 2, 7 and 12. Anti-exemptionalism is the belief that humans were responsible to preserve the nature. Anti-exemptionalism was listed number 4, 9 and 14. Eco crisis is the belief that humans cause environmental damage. Eco crisis was listed number 5, 10 and 15. The statements of concern about environment, especially perception and action on environmental issues. The fifteen statements have been tested for validity and reliability.

Students' EL can be seen through a learning process of biology in the classroom, especially in the chapter of environmental changes and waste recycle. Environmental education in classroom should actively involve teachers to build students' knowledge about the environment [12]. The teachers should understand the characteristics of the topic of environment by using contextual learning model, provides relevant-daily life examples to create meaningful learning [18].

The result of students' EL was important issues to be analyzed. This study aims to figure and analyze the students' EL and how the learning process run to nurture the EL of students, especially in the chapter of "Environmental changes and waste recycle".

## 2. Methods

The research was a quantitative-qualitative research conducted from February to April 2017 in one of the non-*Adiwiyata* (not-yet-green) high school in Karanganyar. The participated school has 18 science classes, and the topic of environment is taught in Grade tenth. The participants of this research were three classes selected purposively from three graders. The first class was Grade tenth, consisted of 17

students, while the second and the third class were grade eleventh and twelfth, each consisted of 24 students. Regarding the gender, there were twenty boys and forty-four girls of total joined as participants.

The data of EL was measured by testing knowledge, attitude and concern. The knowledge of students on concepts of environmental issues was tested by fourteen main questions followed by supported questions. The attitude of students was measured by New Ecological Paradigm (NEP) consisted of fifteen items. The concern was measured by fifteen statements about environment, which was modified from Al-dajeh (2011). Details of the instruments is figured out in Table 1.

**Table 1.** The Instrument for EL

EL Components	Types of Question	Number of Items	Scoring	Category
Knowledge	Multiple choice	14	Correct answer: 1 Wrong answer: 0	Category based on score of total correct answer Correct answer 10-14: adequate Correct answer 8-1: inadequate
Attitude	Likert scale	15	Odd numbers: SA (5), A (4), U (3), D (2), SD (1) Even numbers: SA (1), A (2), U (3), D (4), SD (5)	Category knowledge based on accumulative score: 16-30: very low 31-45: low 46-60: medium 60-70: high Category of attitude based on score of NEP components 4-6: very low 7-9: low 10-12: medium 13-15: high
Concern	Likert scale	15	Number 3, 8, 15: SA (5), A (4), U (3), D (2), SD (1) Other numbers: SA (1), A (2), U (3), D (4), SD (5)	Uncategorized

Notes: SA (Strongly Agree), A (Agree), U (Uncertain), D (Disagree), SD (Strongly Agree)

The knowledge of students was categorized into two groups. First category is "adequate", covers the score from 10 to 14 (maximum score of correct answer), while the second category is "inadequate", covers the lower range of score. The overall attitude of students was categorized into four groups, i.e. "very low", "low", "medium" and "high". While, the attitude can be categorized based on NEP components, i.e. limits to growth (question number 1, 6, 11); balance of nature (question number 3, 8, 13); anti-anthropocentrism (question number 2, 7, 12); anti-exemptionalism (question number 4, 9, 14); and eco-crisis (question number 5, 10, 15). The NEP components were categorized into four groups, i.e. "very low", "low", "medium" and "high". The concern only to know range mean on answer statements about environment (uncategorized).

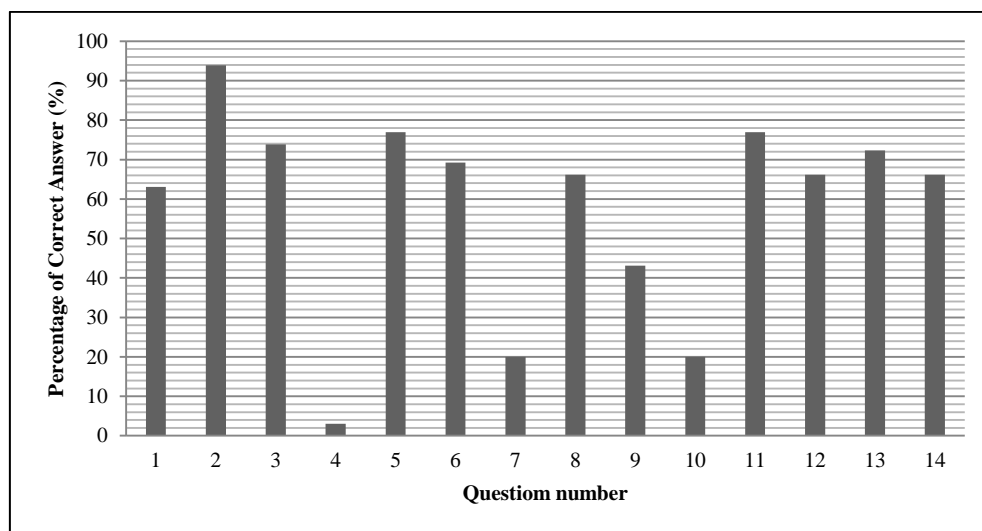
The practices of EL in the learning process were observed in one month or 9 meetings in the Grade X, when students learned about environmental changes and waste recycle. Observations were focused on students and teacher behavior, the learning content, and the activities of students during the learning process.

The interviews to grasp the information on what the factors that affecting EL, were conducted on a sample of 15 students which selected purposively based on the distribution groups of students' scores.

Two biology teachers who taught the classes and one vice principal of the curriculum were also interviewed. The results of the EL interview about the attitude and concern, and answers for knowledge questions were analyzed using some coding to understand the patterns and the number of similar answers [19].

### 3. Result and Discussion

The results of environmental knowledge measurement presented that the percentages of students' knowledge are in the range 3.08% to 93.85%. The results of environmental knowledge measurement (Figure 1).



**Figure 1.** The Results of Environmental Knowledge Measurement

Note: Question number 1 factual issues about environmental problems.  
 Question number 2 impact of environmental problems.  
 Question number 3 factors that causing environmental problems.  
 Question number 4 the threshold values of water pollution.  
 Question number 5 the water pollution.  
 Question number 6 how to deal with water pollution.  
 Question number 7 the factors that causing water pollution.  
 Question number 8 the fact of environmental change.  
 Question number 9 recycling.  
 Question number 10 the factors that cause, impacts, and ways to prevent tornado.  
 Question number 11 the impact of noise pollution.  
 Question number 12 and 13 how to handle noise pollution.  
 Question number 14 the impact of noise pollution.

The results of EL questionnaire as environmental knowledge show that 80% of students were categorized as inadequate and the rest classified as adequate. The questions number 4, 7, 9 and 10 have percentage of correct answer lower than 50%. The lowest percentage of correct answer is question number 4 (3.08%), which asked about threshold values of water pollution.

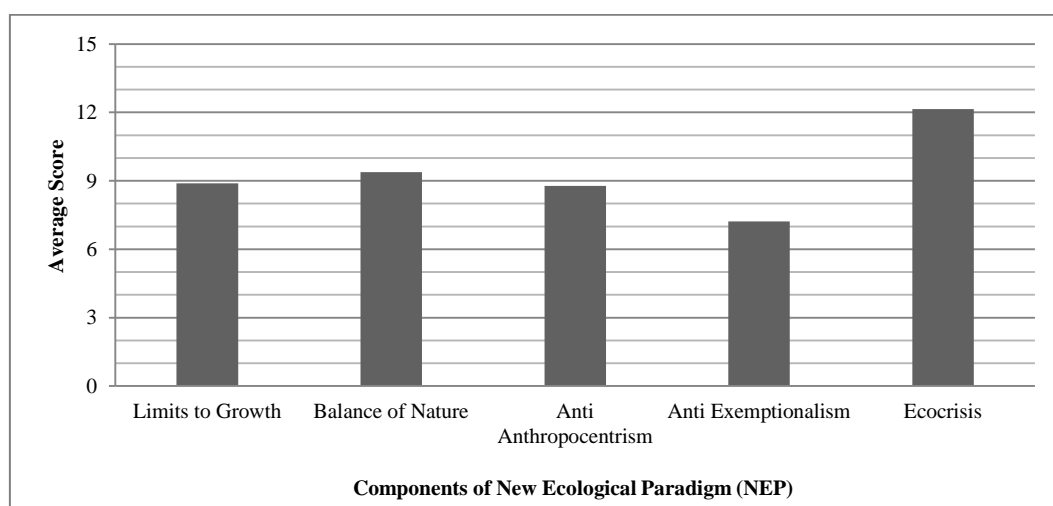
Question number 4 (Q4) is about the threshold values of water pollution. Environmental knowledge measurement shows that Q<sub>4</sub> has the lowest percentage of correct answer. Most of the students indicated lack of knowledge on threshold values of water pollution, showed by choosing the wrong answer that the students do not understand the concepts of BOD, COD and DO and fabricated inappropriate reasons. Other students partially understood about threshold values of water pollution, showed by choosing the wrong answer, and the lack of proper reasoning.

Question number 7 (Q7) is about the factors that causing water pollution. Some students did not understand the material on eutrophication, some students' even incapable to give reasons why eutrophication occurred. Most of the students partially understood the material, showed by the wrong answer, and give inappropriate reason. There are few students who already understood the material about eutrophication.

Question number 10 (Q10) is about the factors that cause, impacts, and ways to prevent tornado. Many students have not understood the cause, the impacts, and ways to prevent the tornado is showed by choosing the wrong answer and fabricate inappropriate reason. There are more students who have not understood the material than those who understood.

Close to 50% students had already understood the concept of recycling, shown by Question number 9 (Q9), compared with number 4, 7 and 10. Most of the students did not understand the concept of recycling because they could not distinguish between reuse, recycle, reduce, recovery and replace.

The result of the students' attitude measured by the New Ecological Paradigm Scale (NEP) questionnaire shows that overall average score was 46.42. The NEP consisted by five components, three statements each, that form the basis of environmental caring attitudes; limits to growth, balance of nature, anti-anthropocentrism, anti-exemptionalism and eco-crisis. The average students' score for each of NEP Components (Figure 2).



**Figure 2.** The Average of Students' Score for Each Of NEP Components

Note: Statements about limits to growth were listed on questions number 1, 6, and 11  
 Statements about balance of nature were listed on questions number 3, 8, and 13  
 Statements about anti-anthropocentrism were listed on questions number 2, 7, and 12  
 Statements about anti-exemptionalism were listed on questions number 4, 9, and 14  
 Statements about eco-crisis were listed on questions number. 5, 10, and 15

The average score of some components of New Ecological Paradigm Scale (NEP) were still categorized as low, i.e. limits to growth, anti-anthropocentrism, and anti-exemptionalism. The lowest score was the anti-exemptionalism (which is 7.22). The result of the students' attitude measured by the NEP questionnaire shows that most of students have not understood the concepts about the environment.

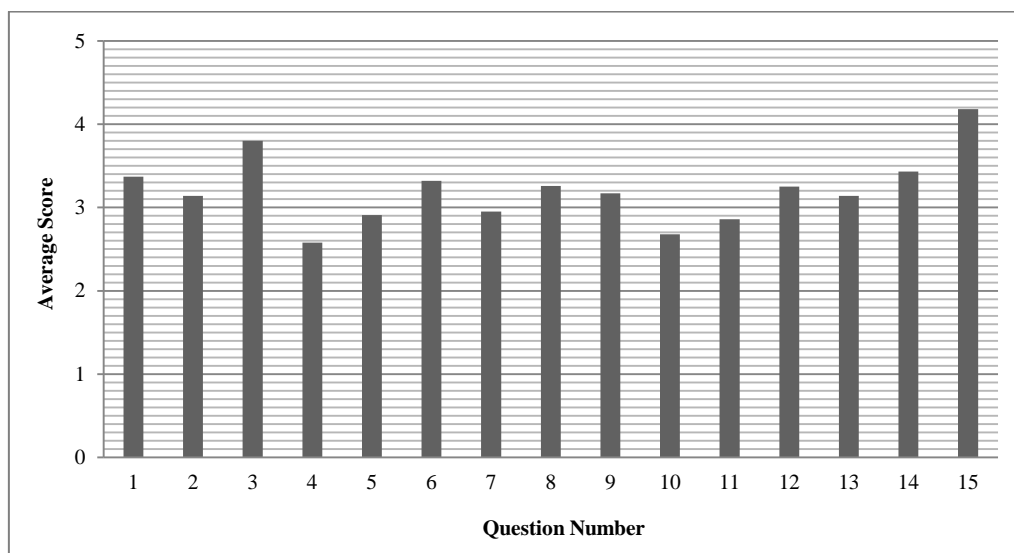
Anti-exemptionalism contains beliefs that humans were responsible to preserve the nature. Most students have not grasped the concepts of natural resources use and real-life examples, explanations of natural laws and the ways the nature works. The student still answers incorrectly and gives an inappropriate reason for concepts that belong to anti-exemptionalism.



Anti-anthropocentrism contains beliefs that humans may could change and control the environment. Most students have not yet understood about the management of the natural resources, environmental conservation and environmental ethics. Some students cannot give a reason to the facts about environmental issues and have not yet able to give examples of the application of environment conservation in daily life.

Limits to growth contains beliefs about the earth's limitation to provide natural resources. Most of the students have not understood the concept of natural resources, could not able to connect the concepts about the pyramid of the ecosystem with the Robert Malthus' theory. Most of the students also could not relate the facts of environmental damage to the factors that cause environmental damage and could not give a concrete example of proper use of the natural resources. Some of the students also have not understood that the earth has limitations as a resources provider.

Environmental concern can be seen based on the average score of each question. The result of environmental concern measurements using 15 questions shows that the average score was between 2.58 to 4.18. The result of environmental concern measurement (Figure 3).



**Figure 3.** The Average Results of The Environmental Concern Questionnaire

Note: Questions number 1, 2, 4, 6, 9, 10, 11, 12, 13, 14 and 15 were about the perceptions of the environment.

Questions No. 3, 5, 7, 8 were about the action on environmental issues.

The lowest average score for the environmental concern was 2.58 (question number 4). Question number 4 contains the perception about the use of plastic for shopping bags in everyday life. The results of environmental concern questionnaire show that some of the students were not have determined perception about the use of plastic for shopping bags. Some of the students have not fully understood the environmental impact of plastics usage. Students could not make opinion about the fact that the decomposition of plastics that can be sped up by the bacteria. There are more students who have understood about plastic recycling than those who have not understood, so that most of the students can decide their perceptions, but the reasons given were less detailed.

The result of observation of environment education learning in the classroom shows that the learning was dominated by teacher's continuous lecture (direct instruction learning) based on power point slides and the book. From the interviews, the teachers state they were unwilling to make variation for their teaching model. Their lesson plans show that they used discovery and inquiry. The teachers explained that the learning models besides the direct instruction were takes a long time and make hard to assess the students' ability.

The numbers of indicators and learning materials that teachers delivered at the classroom were 16 the students' understanding. The teachers also give no real-world and complex examples of environmental problems through video or pictures, so students only know the theories. Teachers should understand the characteristics of the learning material by using contextual learning model, provides relevant-daily life examples to create meaningful learning [18].

The analysis of learning instrument shows that the lesson plans were unsuitable for the needs of EL. The analysis was conducted based on indicators of each NEP. The indicators in the teachers' lesson plans have included limits to growth, balance of nature, anti-anthropocentrism, and eco-crisis components, but do not contain the anti-exemptionalism component.

Students' activity during environmental education learning activities were: a few students were listening to teacher and making note. Some of students talk to other, daydreaming, yawning, playing alone, using their gadget, reading to brochures, doing other tasks and leaning to friends' shoulder. Most of the students were interested to pay attention to learning when the teacher provides video, pictures and gives a real example of environmental issues. Environmental education was not only dealing with the theories and concepts, but also know the real problems so that the students were involved in solving problems and encourage the students to take action on the environmental issues [20].

Based on the interview with the vice principal of the curriculum, shows that the school has not yet integrated the environmental education into the curriculum, because of some shortcomings and limitations. The students have not able to implement what they learn in school, for example they still did not care about the trash in the classroom and school zone and the picket team shift were not going well. Observations show that the distance between the one trash can with another was 14.4 meters and not all classes have the trash can.

The implementation of environmental education in the classroom was still constrained and has not yet establishing high EL. The weakness of environmental education was the material and the lesson model applied in the school is not adequate and unsuitable so that the learners were not have complete understanding about environmental conservation. The proper action to overcome this weakness was to make learning plan that suitable to the characteristics of the learning materials [20].

#### 4. Conclusions

About 80% of students' EL were categorized as inadequate and the rest were classified as adequate. The students' attitude measured using New Ecological Paradigm scale (NEP) shows the average students' score was 46.42 (medium). Meanwhile, students' concern score was between 2.58 to 4.18. Observation during the learning process showed that the students did not understand well the learning content as the teachers taught only the theories and concepts without demonstration or application of those concepts through a series of experiment or investigation. Furthermore, teachers' lesson plan and the learning process conducted by the teachers have not fulfilled the EL components. The school, also has not yet integrated the environmental education through the curriculum.

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