ISSUE ANALYSIS USING OPEN-ENDED QUESTIONS FOR HIGHER ORDER THINKING SKILLS (HOTS) DEVELOPMENT

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ABSTRACT

Analyzing environmental issues is an expression of how one should love and protect the Mother Earth. A significant manifestation is this case study of six grade 8 Filipino students whose thinking skills were determined when they analyzed an environmental issue. The study aimed to describe the students' thinking processes when they analyze the issue on plastic pollution. Using a survey questionnaire consisting of five open-ended questions about plastic waste, results reveal students' use of critical thinking skills based on Freedman's (1994) model of critical thinking skills when they analyzed the environmental issue. In answering the questions, the students generally made identification of the problem, synthesis, analysis and provision for a solution. Science teachers must develop a curriculum that will challenge the young people's higher order thinking skills and their desire to care for the environment. Teachers themselves must be creative in exposing the students to more open-ended questioning during class discussions. School administrators should initiate professional development program to teach critical thinking and similar studies should be conducted involving a larger group of students to attain generalizability of findings. Intervening factors such as adult verbal instruction, socioeconomic status, type of school, type of community and gender may also be considered as part of the study.

Keywords: Critical Thinking Skills, Local Environmental Issue, Open-Ended Questions, Plastic Waste, Thinking Skills.

INTRODUCTION

One of the aims of science education is set towards acquiring knowledge, attitudes, skills and values about, and for, the environment. The Philippines' Department of Education (DepEd) and the Department of Environment and Natural Resources-Environment Management Bureau (DENR-EMB) have identified specific values and skills concerning the environment that should be developed among Filipino learners in the secondary level. These include logical comprehension, emotional attachment, responsibility, moral reasoning and various thinking skills such as intuitive thinking, hypothesis testing, problem solving and critical thinking. Thus, recent trends in science education focus on higher order thinking skills (HOTS). Higher order thinking is thinking on a level that is higher than memorizing facts or telling something back to someone exactly the way it was told to you. When a person memorizes and gives back the information without having to think about it, we call that rote memory. That's because it's much like a robot; it does what it's programmed to do, but it doesn't think for itself. Thus, questions asked about an environmental issue will definitely develop students' thinking skills. Even before the implementation of the K + 12 curriculum in 2016 where all sciences are integrated (each quarter having a little of Chemistry, Physics and Biology), at an early age, Filipino learners were already being taught the skills of observing, describing, distinguishing, classifying, inferring, explaining,

analyzing, deducting, designing and assessing. However, no studies have been made on how these thinking skills are developed, demonstrated and observed in a grade 7 class, although studies have been recorded for other subject areas. Hence, this study was designed to determine the students' thinking skills when they analyze a local environmental issue. The results of the study can provide a database upon which future studies on the development of critical thinking in a science class can be conducted. Likewise, the study's documentation of a pattern of critical thinking skills of students may help teachers, curriculum planners and school administrators in revising and innovating the Science curriculum with a focus on environmental awareness and protection.

LITERATURE REVIEW

Thomas & Thorne (2020) described Higher order thinking, or "HOT" that takes thinking to higher levels than restating the facts. HOT requires that we do something with the facts. We must understand them, infer from them, connect them to other facts and concepts, categorize them, manipulate them, put them together in new or novel ways, and apply them as we seek new solutions to new problems. According to Risnanosanti & Syofiana (2019), the use of HOTS and thinking reflectively can often be exchanged with the terms of the ability to think critically. The authors also reported that the 21st century learning implies the importance of critical thinking ability in solving problems for students in school. It also important because of its role in analyzing information that matches the existing data so that students can make correct proper in solving problems (Zamroni & Mahfudz, 2009). Further, it can make students be able to solve problems more perfectly, make decisions quickly and correctly, and can find links between facts. In addition, someone who has the ability to think critically will be a sober-minded person when he is faced with stressful conditions.

Analyzing an environmental issue is effective in developing critical thinking because students are encouraged to accept or reject statements based on evidence on matters about the environment. Issue analysis enables students to become skilled at analyzing any environmental issue for its players (the people or groups involved) and their positions, beliefs and values (Wise, 2014). Even during Socrates, and probably before, questions have been used to stimulate thinking in the classroom. Reviews of research findings on questioning contend that it is an effective skill "to stimulate student interaction, thinking, and learning" (Wile & Kindsvatter, R., 2000). According to the author, a teacher's questioning techniques, that correlate with enhanced achievement, include probing questions. Divergent or open-ended questions about issues are more likely to stimulate reflective thinking and other critical thinking skills. Questioning is an integral part of meaningful learning. The formulation of a good question is a creative act, and at the heart of what doing science is all about. As Cuccio-Schirripa and Steiner (2000) have stated, "Questioning is one of the thinking processing skills which is structurally embedded in the thinking operation of critical thinking, creative thinking, and problem solving' (p. 210). Good inquiry questions share several qualities, including being open-ended, thought-provoking and calling for higher-order thinking-but, most importantly, they need to be interesting... not to teachers, but to the students themselves". "Students have to be open to asking and hearing questions," says Cyr (2016). The author added that "It needs to be something they're interested in knowing and sharing. Good questions get the students to dream and explore areas they might not have expected."

METHODOLOGY

METHOD

Participants

This is a case study of six grade 8 students in a private high school in Metro Manila. The case students were selected from among the 42-member class in the honor section, *i.e.* two students each from the high, middle and low average groups. The study was conducted in the last quarter of 2018.

The Local Environmental Issue

The local environmental issue used in the study was the pollution problem on plastic use in the locality. With the implementation of the New Curriculum of the K + 12 program in 2016, this was appropriate to discuss in relation to the topic "Community Ecology: Disturbance".

The Research Instrument

The questionnaire which was administered to the six students consisted of five (5) open-ended questions about knowledge and perceptions on plastic use which the students could answer either in English or Filipino. Parallel questions in Filipino were prepared for those who needed further elaboration. The students' *verbatim* responses were recorded and analyzed.

To test the validity of the students' responses to the open-ended questions, one-on-one interviews or verbal answering of questions were conducted. These informal conversations were recorded in the researcher's journal.

Data Analysis

The answers to the questionnaire were analyzed using Freedman's (1994) model of critical thinking processes that are associated with understanding issues from analysis, evaluation and problem solving. Here, the model applied suggests 15 skills, namely, Perceiving several points of view, Weighing evidence, Making logical conclusions, Identifying relationships and patterns, Identifying main ideas, Identifying errors/detecting mistakes in logic, Making value judgments based on facts and figures not on opinions and conjectures, Organizing information and making firm judgments, Clarifying issues and terms, Setting standards for judging the value or logic of ideas, Verifying means confirming or proving the truth of an idea, Recognizing a problem using a variety of sources, Synthesizing information, Classifying issues and terms and Making generalizations.

RESULTS

Table 1 presents the different thinking skills identified in the students' answers to the five (5) open-ended questions about plastic pollution while Table 2 shows the summary of the identified thinking skills in the student' answers to the open-ended questions. As indicated in Table 1, the results of the study show that the case students employed many critical thinking processes which vary from one student to another as they answered open-ended questions about plastic pollution. While students 1, 2, 3 and 4 have almost the same number of thinking skills identified, students 5 and 6

have a lesser number of thinking skills. Nevertheless, they were all able to use different critical thinking skills which can be attributed to the open-ended questioning used in the interview. Students 1, 4 and 5 were boys while Students 2, 3 and 6 were girls.

Table 1. Different thinking skills identified in the student' answers to the open-ended questions

Critical Thinking Skills	Q1						Q2						Q3						Q4						Q5					
	Do you prefer buying house items in sachet or big plastic containers? Why or why NOT? State your reasons						Do you keep used plastic containers? Why or why NOT? State your reasons						What do you think are the effects of plastic pollution? Explain.						Does plastic ever biodegrade? Why? Why not? State your reasons.						What can you say about the plastic pollution in the ocean? What and how do you react to this scenario?					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
1. Perceiving several points of view																✓	✓	✓	✓		✓		✓					✓			
2. Weighing evidence	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	
3. Making logical conclusions	✓	✓	✓				✓		✓	✓	✓			✓					✓	✓		✓		✓	✓	✓		✓			
4. Identifying relationships and patterns																												✓			
5. Identifying main ideas				✓											✓			✓		✓		✓	✓	✓						✓
6. Identifying errors/detecting mistakes in logic																✓				✓	✓									
7. Making value judgments based on facts and figures not on opinions and conjectures			✓					✓		✓			✓	✓					✓				✓	✓			✓	✓	✓	✓
8. Organizing information and making firm judgments							✓		✓					✓	✓						✓				✓	✓	✓	✓		✓
9. Clarifying issues and terms																				✓	✓						✓		✓	✓
10. Setting standards for judging the value or logic of ideas						✓						✓									✓	✓		✓					✓	
11. Verifying means confirming or proving the truth of an idea															✓											✓		✓		
12. Recognizing a problem using a variety of sources							✓	✓	✓										✓		✓						✓		✓	✓
13. Synthesizing information															✓					✓			✓							
14. Classifying issues and terms										✓									✓					✓	✓					
15. Making generalizations	✓	✓	✓	✓	✓						✓	✓					✓					✓	✓				✓			
	3	3	4	2	1	2	4	3	4	4	3	3	2	4	4	3	3	3	6	6	6	5	5	5	5	5	5	6	4	4

Table 2. Summary of the identified thinking skills in the student' answers to the open-ended questions

Question Number	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6
Question 1	3	3	4	2	1	2
Question 2	4	3	4	4	3	3
Question 3	2	4	4	3	3	3
Question 4	6	6	6	5	5	5
Question 5	5	5	5	6	4	4
Total	**20**	**21**	**23**	**20**	**16**	**17**

Perceiving several points of view means attaining awareness or understanding of the issue through the senses. Examples of this thinking skill are reflected in the students responses to Question 3, to wit:

Plastics are great inventions… but at the same time, plastics are non-biodegradable. They affect our environment as plastics are placed everywhere." ***[Student 4]***

*Plastics are found near the bodies of water such as rivers, lakes, oceans and many more. They harm marine species because they rely on these plastics for food. You see, plastics are really harmful****."[Student 5]***

Plastics are really harmful. They harm aquatic life forms. Isn't it that when we use plastics, like balloons, they go down to bodies of water. They are eaten by aquatic life forms and they may die."[***Student 6]***

Weighing evidence means assessing the reliability and value of evidence that has already been determined to be relevant. For example, when Student 1 answered Question 2, he weighed the evidences between the pros and cons of using big and small plastic containers as she narrated:

I do both. Sometimes, to save money, I buy items in sachet. Especially when my family used to travel, we would buy shampoo, toothpaste, lotion, liquid soap etc. for convenience. In this way, we would travel light. But when we do the regular grocery shopping with my mother, we buy in big containers because it's more practical and economical. Also, my mother always tells me that we contribute less to plastic pollution.

Making logical conclusions is the act or process of deriving logical conclusions from premises known or assumed to be true. For instance, Students 4 and 5 knew very well the good effect of using big containers as they answered Question 1:

I want big containers because it's more economical. Though costly, contents are more than in sachet. It's eco-friendly because there is less pollution. ***[Student 4]***

I want the products in big containers. It will take a longer time to take/use/eat the content and you get to enjoy it that longer. I know I contribute less plastics in the environment. ***[Student 5]***

Identifying relationships and patterns possessing regularity or repetition. In Student 4's answer to Question 5, he was able to identify the pattern of plastic pollution as he mentioned the cause, effect and his hope for a remedy as he shared:

You see, I just read from the Internet that plastic pollution is emerging as a top threat to ocean ecosystems. Accordingly, by 2025, there could be 1 ton of plastic for every 3 tons of fish in the ocean. Plastic debris affects nearly 700 species worldwide through entanglement and ingestion, alters natural biological and chemical processes, provides a means for the introduction of toxins into the food web. According to the report, the majority of this debris comes from land-based sources (e.g., plastic manufacturers, processors, landfills, sewage overflows, litter). This is very alarming to think that the aquatic life forms are sources of our food.? How will mankind be fed if aquatic life forms are gone because of plastic pollution? I am very sad to know about this and I am aware of this. I hope this can be remedied.

Identifying main ideas means identifying the message of the issue as it is often expressed directly or it can be implied. For example, Student 3 and 6 identified the main issue of plastic pollution as they narrated:

Plastics pile up… there will be many plastics around. There will be no more space for us. How do plants get water from the soil if there are plastics in soil? ***[Student 3]***

Plastics are really harmful. They harm aquatic life forms. Isn't it that when we use plastics, like balloons, they go down to bodies of water. They are eaten by aquatic life forms and they may die. ***[Student 6]***

Identifying errors/detecting mistakes in logic means the ability to identify errors. Student 4 was able to explore the error on plastic use as he urged to find ways to solve the problem as she stated:

You see, everything we see around is plastic… because it is so cheap and useful. Can you imagine a world without plastics? What is the case of your phone made of? Our umbrellas, containers of personal hygiene products – these are all made of plastics. Try finding an easy way to store food at home without plastic. Or how about a tough, lightweight material for making tarps out of. But come to think of it- plastics are not biodegradable. They just pile up everywhere. And we should find ways to solve the problem of plastic pollution.

Making value judgments based on facts and figures not on opinions and conjectures means considering a personal opinion about how good or bad someone or something **is**. For example, in answering Question 1, Student 3 was able to demonstrate value judgement based on figures as she narrated:

I prefer to buy items in big containers. You see, if I buy lots of sachet products, I know I contribute a lot to plastic production. Imagine, If I buy a big shampoo that is 340 mL, it's only one plastic material. If I buy in sachet, equivalent to 340mL, it is about 23 sachets. The ratio is 1 big bottle: 23 sachets and there is a lot of difference. That's why I prefer big containers.

Based on facts, Student 2 answered Question 3 this way:

I know, plastics are dangerous for humans. I have read that we get toxins from plastics. I remember, we get lead and other toxic metals. How do we get this? It is very dangerous for humans. When we eat fish. Because used plastics go to the ocean.

Organizing information and making firm judgments means placing different concepts in logical arrangement for better understanding. For instance, when Student 1and Student 2 answered Question 5, they organized the information they know about the bad effects of plastic pollution as they narrated:

[Student 1]*: I pay pity for the marine environment. The marine life forms die because of plastic suffocation and eating. You see when kids with balloons, the moment they go down, the balloons go to bodies of water. Sometimes aquatic animals suffocate right away though there are some that*

eat small plastics that they can not digest. So the aquatic animals die. There must be done to stop killing aquatic animals.

[Student 2]: *I have read from magazines news about death of aquatic life forms in bodies of water. I really am sad about it. Plastic waste is littering our oceans and threatening the lives of millions of marine animals such as seabirds, fish, crabs and many other sea animals. These animals are dying and becoming sick because of this plastic problem. I am aware that after ingesting microplastics, the animals, may suffer for months or years before they die. So we must do something about this.*

Clarifying issues and terms means to make understandable or *clarify* the issue. In answering Question 5, Students 2, 4 and 6 were able to clarify the issue as they gave emphasis based on what they have read or seen in the media. These students have shared the following:

I have read from magazines news about death of aquatic life forms in bodies of water. I really am sad about it. Plastic waste is littering our oceans and threatening the lives of millions of marine animals such as seabirds, fish, crabs and many other sea animals. These animals are dying and becoming sick because of this plastic problem. I am aware that after ingesting microplastics, the animals, may suffer for months or years before they die. So we must do something about this. ***[Student 2]***

You see, I just read from the Internet that plastic pollution is emerging as a top threat to ocean ecosystems. Accordingly, by 2025, there could be 1 ton of plastic for every 3 tons of fish in the ocean. Plastic debris affects nearly 700 species worldwide through entanglement and ingestion, alters natural biological and chemical processes, provides a means for the introduction of toxins into the food web. According to the report, the majority of this debris comes from land-based sources (e.g., plastic manufacturers, processors, landfills, sewage overflows, litter). This is very alarming to think that the aquatic life forms are sources of our food.? How will mankind be fed if aquatic life forms are gone because of plastic pollution? I am very sad to know about this and I am aware of this. I hope this can be remedied. ***[Student 4]***

I am really sad about this situation. I pity the aquatic animals. We should not just throw away plastics, we should keep them. Every single plastic we throw, it is possible that it goes to waters and all these plastics will be eaten by aquatic animals. I have seen pictures of these aquatic animals in science news/magazines. So we need to do something good for the aquatic animals. ***[Student 6]***

Setting standards for judging the value or logic of ideas means *judging the value or setting standards. Student 6 was so firm to make judgment on the use of plastics as she answered Question 1 and Question 2 this way:*

Q1*: I do both. Sometimes, to save money, I buy items in sachet. Especially when my family used to travel, we would buy shampoo, toothpaste, lotion, liquid soap etc. for convenience. In this way, we would travel light. But when we do the regular grocery shopping with my mother, we buy in big containers because it's more practical and economical. Also, my mother always tells me that we contribute less to plastic pollution.*

Q2: *I keep used plastic containers. I sell them. I know I am able to help the environment. The more plastic I keep, the more chance that the environment becomes less plastic-polluted. I care for the environment and so everytime I see plastic materials; I keep them and sell.*

Verifying means confirming or proving the truth of an idea means it is about the *truth of an idea*. For instance, *when Student 1 answered Q5, he verified the truthfulness of the issue as she shared about plastic suffocation based on facts and observation. He narrated:*

I pay pity for the marine environment. The marine life forms die because of plastic suffocation and eating. You see when kids with balloons, the moment they go down, the balloons go to bodies of water. Sometimes aquatic animals suffocate right away though there are some that eat small plastics that they cannot digest. So, the aquatic animals die. There must be done to stop killing aquatic animals.

Similarly, Student 4 verified the truthfulness of the issue as he provided facts and information:

You see, I just read from the Internet that plastic pollution is emerging as a top threat to ocean ecosystems. Accordingly, by 2025, there could be 1 ton of plastic for every 3 tons of fish in the ocean. Plastic debris affects nearly 700 species worldwide through entanglement and ingestion, alters natural biological and chemical processes, provides a means for the introduction of toxins into the food web. According to the report, the majority of this debris comes from land-based sources (e.g., plastic manufacturers, processors, landfills, sewage overflows, litter). This is very alarming to think that the aquatic life forms are sources of our food.? How will mankind be fed if aquatic life forms are gone because of plastic pollution? I am very sad to know about this and I am aware of this. I hope this can be remedied.

Recognizing a problem using a variety of sources means identifying a problem using sources using books, and other learning resources. In answering Question 4, Students 1 and 3 were able to explore on plastic pollution by considering facts and information they obtained from science magazines and books. The students recognized the problem as they reported:

You know, it depends on the plastic. Based on my reading from science magazines and from books, most petroleum plastic does not biodegrade — it just fragments. From my readings, many bioplastics only biodegrade under very controlled conditions, and very poorly or not at all in the sea. The sea and oceans are really the ones affected. Plastics fragment into tiny pieces of microplastic, and this is what marine life ingests before entering our food supply chain. You see… we will never be able to recycle or even compost our way out of this mess — it's time to stop producing throwaway plastics. ***[Student 1]***

Oh no. Plastic usage is increasing every day and I know everybody is aware that it is not biodegradable. Non-biodegradable means that the material is decomposed. Decomposition is the process by which organic materials like animal manure, wood, paper are broken into simpler compounds. You know, when something is decomposed, it is buried in soil. Where organisms like bacteria can break it down. Then the decomposed material is recycled. The broken down material provides food for plants, enrich the soil and feed other living things. Plastic is not organic, it is made up pf PET (polyethylene terephthalate which is nearly indestructible. Bacteria can't

decompose PET. I have read from science magazines and books about this. You see, UV light can break down plastics but it takes a longer time. ***[Student 3]***

Synthesizing information means the way that students can take information from multiple sources and bring the information together. Such skill was identified when Students 2 and 5 answered Question 4 this way:

You see, everything we see around is plastic… because it is so cheap and useful. Can you imagine a world without plastics? What is the case of your phone made of? Our umbrellas, containers of personal hygiene products – these are all made of plastics. Try finding an easy way to store food at home without plastic. Or how about a tough, lightweight material for making tarps out of. But come to think of it- plastics are not biodegradable. They just pile up everywhere. And we should find ways to solve the problem of plastic pollution. ***[Student 2]***

Non-biodegradable describes large compounds that do not break down to a natural, environmentally safe condition over time. this does not happen to plastics. I can see them around. These plastics are just buried in soil over time, but these materials are there forever. They cannot be ever decomposed or degraded. Most plastics are non-biodegradable are widely used because of low cost, and durability. This durability is based on plastic being an uncommon target for organisms that can degrade such as bacteria, which makes it non-biodegradable. But I have read from some learning materials that plastics can be made biodegradable with the addition of certain chemicals that breakdown the structure of the material. So, I would like to think that there is still solution to plastic pollution. ***[Student 5]***

Classifying issues and terms means *defining* the *problem* or analyzing the nature of the *problem*. For instance, when Student 4 answered Question 2, he was able to define the nature of the problem as she shared what he observed at home:

I am aware that plastics are non-biodegradable. I hate to see them everywhere so at home, I collect them and sell them. Being the eldest, I have to tell my two (2) younger siblings to keep the used plastic containers and we sell them. I tell them, they contribute to less plastic production and maintain the beauty and cleanliness of the environment. ***[Student 4]***

Likewise, when Student 1answered Question 5, he emphasized the status of the marine environment due to plastic pollution:

I pay pity for the marine environment. The marine life forms die because of plastic suffocation and eating. You see when kids with balloons, the moment they go down, the balloons go to bodies of water. Sometimes aquatic animals suffocate right away though there are some that eat small plastics that they cannot digest. So, the aquatic animals die. There must be done to stop killing aquatic animals. ***[Student 5]***

Making generalizations means taking one or a few facts and making a broader, more universal statement. There were many instances that the students were able to make generalizations. For example, when Students 5 and 6 answered Question 2, they were able to make a general statement about plastic pollution as they said:

I pay pity to the environment when I see plastics scattered everywhere. And so, at home, I collect all used plastic containers in a box or in a garbage bag and sell them. You know, there's money in it. More importantly, I am happy that the environment is not polluted. I will see less plastics around. I get to help the condition of the environment. ***[Student 5]***

I keep used plastic containers. I sell them. I know I am able to help the environment. The more plastic I keep, the more chance that the environment becomes less plastic-polluted. I care for the environment and so every time I see plastic materials, I keep them and sell. ***[Student 6]***

DISCUSSION

Critical thinking is the ability to analyze situations or texts and make decisions based on that analysis. The researcher used students' writing of answers to open-ended questions in order to develop and represent the processes and products of their critical thinking (Bean, 2011) on the issue of plastic waste. Issue arises when there is a need to find solutions on how to solve the environmental problem. Based on the analysis of results above, the identified critical thinking skills showed a variety based on Freedman's model (1990) of critical thinking skills. It could be noted that all of students' written statements follow the general elements of critical thinking. With critical thinking, students could respond to various environmental issues in accordance with the competencies and scientific fields they do by identifying problems, synthesizing, analyzing and then providing solutions or remedies (Marni et al., 2019). The answering to open-ended questions aroused the students' critical mind to organize their thoughts. Carefully formulated questions as instructions are very important in producing quality writing or answers (Cheong, Zhu, Li, & Wen, 2019; Mohammed & Cunningham, 2019; Stewart, 2019; Yu et al., 2019). With the given questions, students were more focused in displaying their responses critically. Responding or reacting to issues and making them as learning materials is more interesting for students than learning is only focused on theory (Borglin, 2012).

The writing of answers to the open-ended questions was done as the students provided data, evidence, and the right reasons so that they could draw conclusions in the end correctly. There was sharpness in their analysis as they enriched their critical vocabulary in writing their responses. When students are able to analyze objectively and evaluate problems well, critical thinking skills will greatly support their academic performance (D'Alessio, Avolio, & Charles, 2019). Although the critical thinking element does not appear as a whole in the essay, it does not affect the substance of the critical content of the student's responses. Along Freedman's model (1994) of critical thinking skills, the general elements found in the student's written statements always follow this pattern – identification of the problem, synthesis, analysis and provision for a solution. Almost all the students' statements started with identifying the problem which was on plastic pollution. In the Synthesis element, the students used various information from multiple sources such as books, magazines and other learning materials so that they could bring the information together. As noted, the Analysis element dominates the other elements as it often appeared at the beginning of the writing or at the middle part of the essay. In addition, it was noted that the Analysis element becomes the main focal point in initiating a good writing of the students. This was consistent with the statement that critical thinking is analytic thinking, which a way of thinking that focuses on the process of analysis of various things (Donosoeputro, 1993). Since the issue has already been stated in the form of open-ended questions, the process of analyzing the issue requires investigation

and explanation. The students' analysis of the issue depended on their ability to find answers to any of following questions which were partially part of the open-ended questions:

Question	***Sample Students' Answer***
1. What is the issue all about?	Plastic pollution
2. Why is this issue important now?	It is important because it affects our environment.
3. What is the nature of the issue?	Plastic use contributes to plastic pollution
4. What caused the issue?	Our bad use of plastic
5. What are the risks?	Plastic pollution affects the soil, aquatic life etc.
6. What are the benefits?	We can save the environment by reselling the plastic and not using plastic
7. How is the issue solved?	By avoiding use of too much plastic

Solving problems and drawing conclusions are skills in critical thinking. At the end of the students' essay or written statement, there was almost an element of providing a solution. This must be the Evaluation element where the students were able to share their thoughts on what solution or remedy to do. This element makes them distinguish between strong and weak or irrelevant points (Watson, et.al., 2002). Before the evaluation, students sharpen their analysis of the issue presented based on their prior knowledge and based on the information they get. This was noted as the students presented some facts and figures to explain plastic pollution. When they are accustomed to analyzing the problems around them, this will sharpen their intellect in assessing and concluding many things. Writing statements will further open their horizons to sharpen their knowledge and expertise. It also becomes a way to develop students' critical thinking skills.

CONCLUSIONS

Although the study involved a small sample size, the findings clearly show that students do employ critical thinking processes when they analyze a local environmental issue. This study is an example of how to assess the extent to which students think and feel critically about the environment. Educators have to be aware of the cognitive and affective capabilities of students so that a good science curriculum that focuses on protecting the environment can be developed and implemented. Science teachers must develop a curriculum that will challenge the young people's higher order thinking skills and their desire to care for the environment. Teachers themselves must be creative in exposing the students to more open-ended questioning during class discussions. This is important to develop and evaluate the student's thinking skills. Teachers must find means to include this strategy in many of their lesson plans, or perhaps as a culminating activity for each quarter. School administrators should initiate a program to train teachers on how to teach and use the inquiry approach in teaching to facilitate the development of critical thinking in their students. Similar studies should be conducted involving a larger or a more representative group of students to attain generalizability of findings. Hence, the instrument may be modified to a multiple-choice

type of test with high level questions. Intervening factors such as adult verbal instruction, socioeconomic status, type of school, type of community and gender may also be considered as part of the study.

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