

## BUILDING UNDERSTANDING AND AWARENESS OF ENVIRONMENTAL POLLUTION THROUGH COMIC

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### ABSTRACT

Environmental problems such as widespread pollution are ongoing threats to the livelihood of the current and future generations. Engaging learning media such as comics can be used to instill the importance of understanding our role in solving environmental pollution problems. This paper reports the promising benefit of using comics in building junior high school students understanding and awareness of water, soil, dan air pollution. Comic is a visual medium, and whether students' specific learning preferences play a role in learning results was also determined and discussed.

**Keywords:** comic; environment awareness; environmental pollution; learning preferences

### ABSTRAK

Masalah lingkungan seperti pencemaran merupakan ancaman berkelanjutan bagi kehidupan generasi saat ini serta generasi mendatang. Media pembelajaran yang menarik seperti komik dapat digunakan untuk menanamkan pentingnya memahami peran kita dalam menyelesaikan masalah pencemaran lingkungan. Artikel ini melaporkan manfaat yang menjanjikan dari penggunaan komik dalam membangun pemahaman dan kesadaran siswa sekolah menengah pertama tentang pencemaran air, tanah, dan udara. Komik adalah media visual, dan apakah gaya belajar siswa berperan dalam hasil belajar juga diukur dan didiskusikan.

**Kata kunci:** komik; kesadaran lingkungan; polusi lingkungan; gaya belajar

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## INTRODUCTION

In 2012 American Chemical Society cemented *Silent Spring*, a book by Rachel Carson, as a monumental landmark that revolutionized how people understand their relationship with the environment (American Chemical Society, 2012). The book, published in 1962, is filled with scientific data concerning the disastrous effect of pesticides on the environment. Nevertheless, her masterful and eloquent writing still makes the book appealing to the general people. The ACS praised the book as scientific groundwork that sparked widespread debate and discussions, leading to new policies that protect the environment, public health, and safety from harmful by-products of technological advancement and human activities (American Chemical Society, 2012). In 1972, the book successfully contributed to the DDT use ban in the US. However, as technological advancement continuously

evolving, other human activities will create other threats to the environment.

Have we equipped the future generation to understand human activities' effect on creating pollutants that may result in catastrophic environmental consequences? studies found that may not be the case. Choi, Niyogi, Shepardson, and Charusombat's (2009) study analyzed seven widely used science textbooks and found that all the books, for example, did not distinguish between pollution and greenhouse effects or climate change. Andersson and Wallin (2000) studied Swedish high school students understanding of the dynamics of CO<sub>2</sub> emission and found that they have yet to understand the consequences of the greenhouse effect entirely or how to respond to CO<sub>2</sub> emission strategically. Another study by Skamp, Boyes, and Stanisstreet (2004) on Australian students found that aside from believing only a little or nothing about air pollution, they may feel that they do not contribute to it and are

not responsible for reducing it. This somewhat detachment with the environmental responsibility was also found in Myers, Boyes, and Stanisstreet (2004) in which, although some English students believe that they must take part in solving pollution problems, they feel that the responsibility weighs heavier on the government, corporations, or industries. Dimitriou and Christidou (2007) suggested that it is necessary to implement teaching materials and activities focusing on strengthening students understanding of pollution. Furthermore, Farmer, Knapp, and Benton's (2007) study proved that an appropriate learning activities approach could retain students' pro environment attitude even one year after learning. Further, McNeill and Vaughn (2010) study found that students' conceptual understanding impact students' actions and choices. Therefore, learning should consider on how students' actions can significantly impact the environment.

Reflecting on Barrow's (2012) analysis that Carson's book impacted environmental protection because the book was used not only as a written source to encourage public discourse concerning the impact of harmful human activities and technology on the environment but also became a visual source to further our understanding of the environmental effects of a pollutant. Barrow (2012) analyzed that at least sixteen prominent editorials captured Carlson's frightening vision of ecological vulnerability in an equally impactful fashion via cartoons or comic strips. With culturally resonant words and images, the comics permeate society and continuously rekindle conversations about environmental problems depicted in Carlson's book. In similar vein, Stewart and Clark's (2011) analysis of South Park, an animated satire premiered in 1997 consistent with *comics corrective*, reminded us that environmental advocacy should be broadly persuasive in message, tone, and delivery to encourage productive dialog.

Cartoons or comic strips or comics are commonly used interchangeably. This visual art form consisted of sequential images arranged in interrelated panels and accompanied by textual information in dialogue balloons and captions. When words often fail in teaching science, comics catch the eye, engage the reader, and incorporate narrative in ways that make them promisingly important teaching tools (see Shurkin, 2015). Previous studies have focused on visually conveying environmental and scientific problems

via comics to meaningfully improve students' understanding of specific environmental issues. Espinosa (2013) studied the implementation of comics in teaching environmental topics and found that using comics significantly improved students' understanding of environmental topics. Small (2016) illustrates the promising benefit of using comics to teach biodiversity because it can be a friendly reminder that the world's flora and fauna is in crisis and can encourage people to become more sympathetic to the survival of endangered living things and their habitats. Reinfried, Aeschbacher, and Rottermann (2012) empirical study evaluate the benefit of using learning materials containing comics in improving students' understanding of greenhouse effects. In their study on 289 Switzerland secondary school students, the learning materials resulted in satisfactory learning success, in which successful improvement was found in students' understanding of the role of CO<sub>2</sub> emission in the global greenhouse effect. A recent study by Aydin (2015) also explored the use of comics in improving students' understanding of environmental issues, in which the focus of the study was how to improve students' understanding of light pollution. Unfortunately, although studies already uncover comics' ability to improve environmental problems, study focussing on environmental pollution affecting three environmental compartments (air, water, and soil) as well as on how comics can build environmental awareness, was still limited. Therefore, this study explored comics' ability to support students' understanding and awareness of pollution in three environmental compartments.

## METHOD

Comics for teaching environmental pollution concepts were designed and develop according to 4D phase. The final product was used for Ninety-eight (98) junior high school students (7th-grade students) to learn about air, water, and soil pollution. Comics representing pollution in each compartment depicted human activities' effect on three environmental compartments. The implementation of learning environmental pollution with comics lasted for four meetings, forty minutes for each meeting. Introductions about environmental pollution were conducted in the first meeting, whereas air, water, and soil pollution were presented consecutively. When learn-

ing about each topic, the students were divided into groups, and each group took turns to present their response to the pollution problems depicted in the comic.

The Comics used to deliver air, water, and soil pollution concepts are presented in Figure 1. For conveying water pollution, the comic depicts a conversation between *Oryctolagus cuniculus* (Ory the Rabbit), *Cyprinus carpio* (Pio the Carp), and *Serinus canaria* (Serin the Canary). Pio is visibly in despair because most of Pio's friends were found floating lifeless on the water. Curious about what made most of the fish die, Pio, Serin,

and Ory then embark on a journey to trace what happened in the water body until they find that factory waste was discharged into the water. In another scenario, when Ory the Rabbit strolls around the village to meet *Mangifera laurina* or Mangi the Tree, Ory met *Lumbricus rubellus* or Ricus the Worm and finds Ricus sweltering. Ricus feels that the soil is too hot and painful to its skin. A concern Ory then combed through the forest and found agricultural waste, such as pesticides and other toxic substances, had polluted the soil.

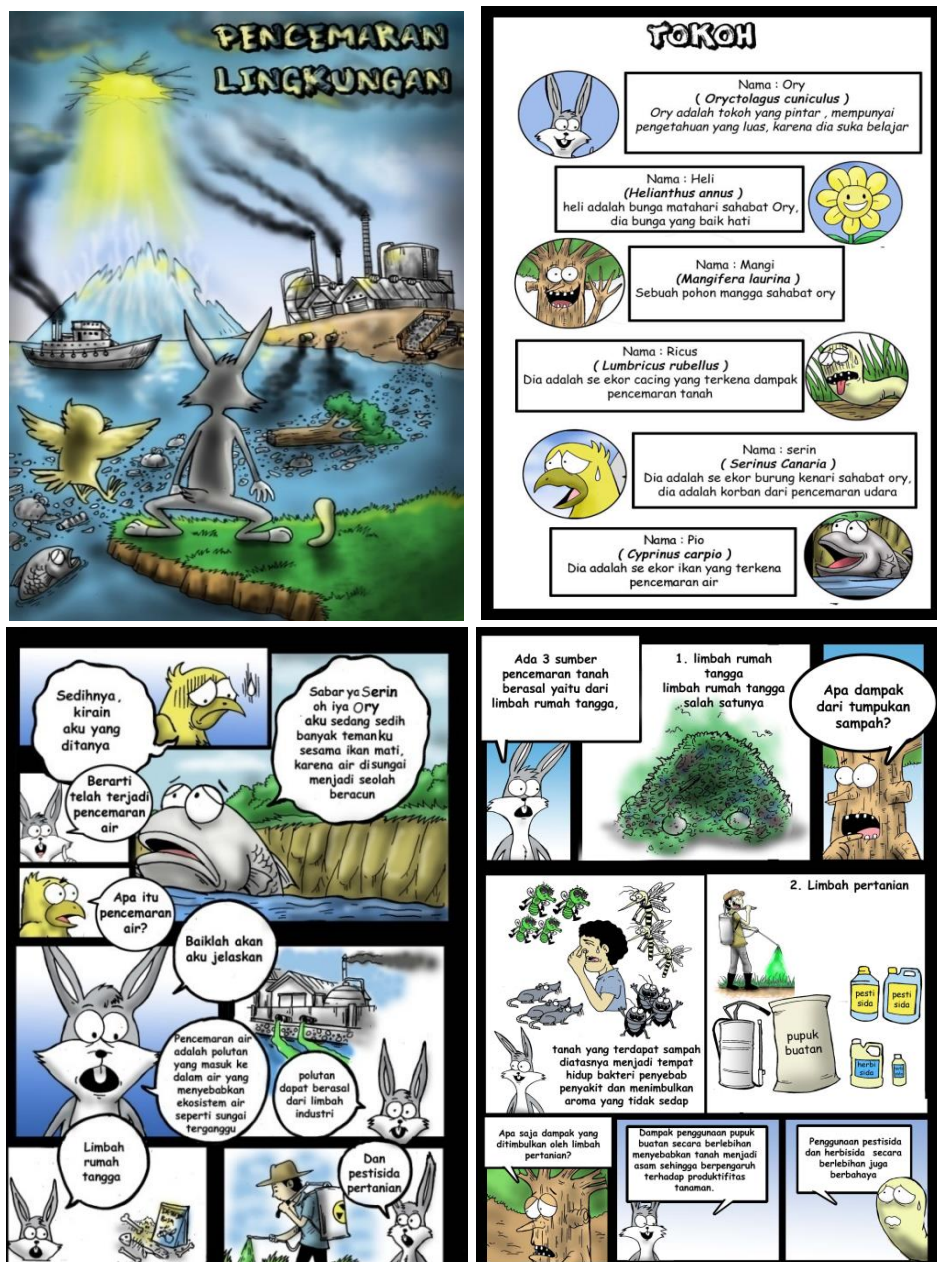


Figure 1. Comic for Water and Soil Pollution

Students' understanding of environmental pollution was evaluated with a pretest and post-test. Each test consisted of four essay questions and fifteen multiple-choice questions. Question examples were the connection between dumping waste such as plastics and other non-biodegradable waste to polluted soil or the effect of using pesticides for plants infested with plant hoppers. Students' environmental awareness was measured with a 20-statement questionnaire covering their attitudes, consciousness, responsibility, and participation (Table 1). The students were asked to choose their view of positive/negative statements by ticking strongly agree (ST), agree (S), disagree (TS), or strongly disagree (STS) box. For positive statements, scoring was 4 (ST), 3 (S), 2 (TS), and 1 (STS) whereas for negative statements scoring was in reverse, 4 (STS), 3 (TS), 2 (S), and 1 (ST).

Since comics are visual representations, understanding differences for differing students' learning preferences was analyzed. Each student's learning style was probed using a nine-question questionnaire and then classified the

into visual, auditory, kinesthetic, auditory-kinesthetic, and visual-kinesthetic learning preference. Data were analyzed descriptively, and students' understanding of differences before and after learning was analyzed statistically with SPSS version 20. Questionnaires were also used in probing students' responses to the comics used in learning and teachers' interview was conducted to explore students' environmental attitude after learning.

## RESULTS AND DISCUSSION

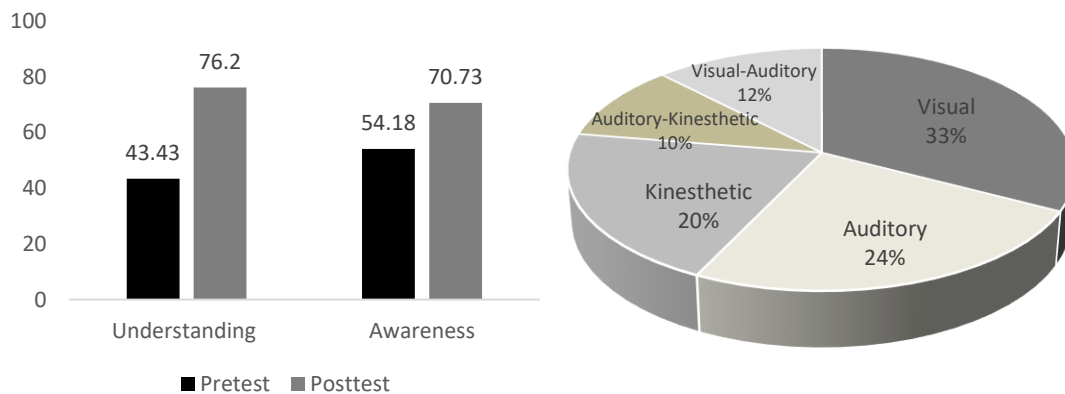
Students' understanding and awareness of environmental pollution improve after learning with comics (Figure 2). In terms of understanding, improvement was found in how the students understand the consequential effect of human activities such as littering, dumping, and burying non-biodegradable waste to the ground and the use of pesticides. For awareness, the highest students' improvement were found in their attitude toward littering and their perception of their role in protecting the environment (Table 1).

**Table 1.** Indicators and Score of Students' Awareness About Environmental Pollution

Indicators	Statements	Before	After
Attitude	I do not feel disturbed by the condition of the road which is littered with garbage (-)	2.28	3.61
	I will remind people when they litter (+)	2.47	3.61
	I do not like learning about the environment because it is boring (-)	2.83	3.46
	I would rather think about solutions to environmental damage than keep talking about it without any real action (+)	2.63	3.51
	Every society does not need to think about solutions to environmental damage (-)	2.64	3.60
Consciousness	I throw trash in its place (+)	2.79	3.68
	I let a friend litter to avoid a scene (-)	2.85	3.51
	Keeping the environment clean is an early effort to prevent disease (+)	2.85	3.73
	Separating organic and inorganic waste when disposing of waste can prevent soil contamination (+)	2.92	3.53
	I will cut down trees at will to meet economic needs (-)	2.79	3.66
	Because my house is near the river, I will throw garbage into the river (-)	2.90	3.76
Responsibility	Using air conditioners appropriately can reduce air pollution (+)	2.52	3.19
	Every society does not need to think about solutions to environmental damage (-)	2.85	3.50
	I have a stake in maintaining a healthy environment (+)	2.90	3.37
	Everyone who destroys the environment must be held accountable and subject to sanctions (+)	2.80	3.56
Participation	I am lazy to protect the environment because it is not my responsibility (-)	2.77	3.60
	I also went down to the river to clean up the clogged garbage (+)	2.77	3.46
	I was lazy when asked to help clean the gutters around the house (-)	2.72	3.42
	I will help residents use organic waste to make compost (+)	2.44	3.43
	I do not need to get involved in protecting the environment (-)	2.50	3.53

**Table 2.** Students’ Understanding and Awareness About Environmental Pollution

Indicators	Average Score	n	Statistical Test Result
Understanding	43.43 (pretest) 76.20 (posttest)	98	$p = 0.00, p < 0.05$ . Students’ understanding score in the pretest and posttest was significantly different
Awareness	54.18 (pretest) 70.73 (posttest)	98	$p = 0.00, p < 0.05$ . Students’ awareness score in the pretest and posttest was significantly different
Visual	80.5	32	$p = 0.45, p > 0.05$ . Students’ understanding score difference based on learning preferences was insignificant
Auditory	73.4	24	
Kinesthetic	72	20	
Auditory-Kinesthetic	77	10	
Visual-Auditory	78.3	12	



**Figure 2.** Students’ Understanding, Awareness, and Different Learning Preferences

Questionnaire and interview results suggested that students found the comic makes them able to visualize the impact of human activities on the environment. Using animals and plants as the center character and how these characters are affected by environmental pollution also makes the students feel emotionally concerned about their well-being. The results is in line with Small (2016) suggestion that comics encouraged people to see nature in a more symphatetic light.

It is also equally important that the awareness is retained after learning. Teachers reported that before and while firstly learn with comics, most students could not care less if their classroom was dirty with their snack packages garbage. However, after learning with comic, most students put their garbage in the garbage bin, and some were even willing to remind their friends if the friend was littering. These results corroborated previous studies (Dimitriou and Christidou, 2007; Farmer et al., 2007; Toledo, Yangco, and Espinosa, 2014) that appropriate learning approach could improve and retain understanding and attitude concerning environmental problems.

Learning with comics improved students’ understanding and awareness of environmental pollution as found in other studies (Reinfried et al., 2012; Espinosa, 2013; Aydin, 2015; Shurkin, 2015) and therefore, proved that comics could indeed become a powerful learning tool to teach environmental issues.

Statistical analysis (Table 2) showed that students’ understanding and awareness of environmental pollution before and after learning significantly improved ( $p = 0.00, p < 0.05$  for each students’ understanding and awareness about environmental pollution). Regression analysis was also carried out to determine whether students’ understanding impacts students’ awareness. Results suggested that the effect of students’ understanding on their awareness was 76% ( $R^2 = 0.76, p = 0.00, p < 0.05$ ) which indicated that students’ understanding of environmental pollution significantly predicts their awareness of environmental pollution problem. This result verified that students’ conceptual understanding impact students’ actions and choices (McNeill and Vaughn’s, 2010). As previously mentioned,



the statistical analysis results then also corroborated the teachers' report that students' daily attitudes improved after learning.

Students' learning preferences/styles differed (Figure 3), in which 77% of students were unimodal, and the remaining 33% were bimodal. Among unimodal and bimodal groups, students with visual learning preferences have the best understanding score (Table 1). However, statistical analysis showed that students' understanding score difference based on learning preferences was insignificant ( $p = 0.45$ ,  $p > 0.05$ ). This result aligns with Almgibbal's (2015) study that students' learning style preferences are not significantly correlated with students' achievement or grades.

Students' improved understanding and awareness about environmental pollution that eventually also transformed into their daily habit, proved that they learned meaningfully that human activities are deeply connected with ecological wellbeing. The use of engaging stories and sympathetic characters, which resulted in the comic ability to improve students' understanding and awareness, cemented the notion that environmental advocacy should be broadly persuasive in message and tone.

## CONCLUSION

Students' understanding and awareness of environmental pollution improved significantly after learning with comics. Improved understanding predicts their awareness of environmental pollution and the awareness becomes habits that they retain even after learning. The main feature of comics that eventually leads to improved understanding and awareness is the use of sympathetic characters and environmental situations, which encourages the students to emotionally connected with the environment. This study, however, only used junior high school students as sample. Further study can explore participants with differing education levels and ages to evaluate whether sympathetic characters and environmental situations are sufficient to improve understanding and awareness for older students.

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