Biosfer: Jurnal Pendidikan Biologi

Journal homepage: http://journal.unj.ac.id/unj/index.php/biosfer

Caricatures and comics based on gender towards concept understanding: A learning media on environmental pollution

Sisean Baga[1*], Deden Ibnu Aqil[2], Maria Magdalena Rosaline[3]

[1] Department of Demography and Environmental Education, Universitas Negeri Jakarta, Indonesia
[2] Department of Economic Education, Indraprasta PGRI University, Indonesia
[3] Department of Applied English Linguistics, Atma Jaya Catholic University of Indonesia, Indonesia

*Corresponding author: siseanbaga_9908921006@mhs.unj.ac.id

ARTICLE INFO

Article history
Received: 10 January 2022
Revised: 31 January 2022
Accepted: 14 March 2022

Keywords:
Caricature
Comic
Environmental Pollution
Gender
Media

ABSTRACT

One crucial thing in environmental learning is how gender-based media is not yet used optimally to improve concept understanding in the classroom. Students will not develop pro-environmental concerns and behavior if they do not understand pollution and environmental issue. This study aims to prove the influence of learning media and gender on understanding environmental pollution concepts in a Secondary High School in Jakarta, Indonesia. The method used is an experiment with a 2 x 2 factorial design. The sample is taken based on the stratified random sampling technique that consists of 40 students with 20 males and 20 females from two Senior High Schools in Jakarta, Indonesia. The instrument used in this study was 32 multiple choice questions to measure students' understanding, consisting of translating, interpreting, and extrapolating dimensions. The data analysis interpretation shows an interaction effect between learning media and gender on understanding the environmental pollution concept. Therefore, this study recommends that teachers use various media such as caricatures and comics that are proven usable to accommodate gender differences and enhance conceptual understanding in the classroom.

Baga, S., Aqil, D. I., & Rosaline, M. M. (2022). Caricatures and comics based on gender towards concept understanding: A learning media on environmental pollution. *Biosfer: Jurnal Pendidikan Biologi, 15*(1), 134-146. https://doi.org/10.21009/biosferjpb.25318

INTRODUCTION

One of the essential teaching goals is to help students understand the main concepts in a learning object, not just remembering isolated facts (Jelatu & Kurnila, 2019; Matook et al., 2013). According to Santrock, understanding the concept is the key to learning activities (Santrock, 2008; Toledo et al., 2014). Without understanding, the expected knowledge, skills, and attitudes will not be meaningful, and the learning process experienced by students cannot be applied in everyday life. Concept understanding is a part of cognitive ability (Aditya & Oktavilia, 2020; Baga et al., 2021; Reisberg, 2019).

The environmental pollution concept combines concrete and abstract concepts that require imagination to describe pollution schemes (Appannagari, 2017; Khan, Mashhod Ahmad, Ghouri, 2011). In studying this concept, what is needed is memorizing several facts or concepts and a deep understanding of the environmental pollution concept. In improving the environmental pollution concept understanding, learning media that makes it easier for students to understand the subject matter is needed. In the learning process, learning objects that can increase students' imagination are needed (Reisberg, 2019). In addition, it takes an object that students easily understand in understanding certain concepts. Students' understanding can emerge if guided by media that can increase imagination.

Students in the class are distinguished based on the biological dimension consisting of boys and girls. Gender is not just gender that is generally used in determining a person's sex between men and women. This is reinforced by Santrock, who explains gender in a broader term (Ismail et al., 2021; Kamid et al., 2020). He states that gender sees differences in the socio-cultural and psychological dimensions of sex (Aikman & Unterhalter, 2007; Santrock, 2008). Differences in social interaction at school cause boys and girls to have different experiences, needs, and knowledge (Aguillon et al., 2020; Gunawan et al., 2017; UNESCO, 2015). The knowledge gained is influenced by different interests in particular objects. (Maadal, 2020; Mukuni et al., 2020; Santrock, 2008; UNESCO, 2015). Hence, to properly handle this matter, teachers are encouraged to apply various learning media (Aikman & Unterhalter, 2007; Cuadrado-García et al., 2010; UNESCO & Education, 2019).

Learning media helps students understand the lessons being taught so that they are more durable in memory so that the lessons learned can be applied in daily activities (Berlian et al., 2021; Djannah et al., 2020). The teaching and learning process is one of the fundamental factors influencing students' behavior in their daily activities. If students are excited about the learning process and understand the lessons, they will apply them in their lives. The teaching and learning process is easy to know if it is assisted by learning media that can attract students' attention. Alternative media that can be easily understood and imitated by students in their daily behavior are comic and caricature media.

Comic and caricature media have something in common; they are visual media that attract students' attention with attractive images and colors (Al-Rabaani, Ahmed Hamed & Al-AAmri, 2017; Istianah et al., 2020; Rina et al., 2020). The stunning form of comics and caricatures raises students' curiosity to understand the contents of the media without having to be persuaded. The two media have differences in their content. Caricature media is more in the form of images that tend to criticize a policy or object, it has few words, but each image contains an implied meaning (Teke et al., 2013). In contrast, comic media emphasizes reading with a plot and includes an explicit purpose in the reading (Liniasari et al., 2021; Mcgarr et al., 2021).

Those empirical and theoretical facts underlie the need to find the most appropriate learning media that students easily understand. This is reinforced by research findings that state that gender affects the function of learning media effectiveness (Gunawan et al., 2017; Seifert & Sutton, 2015). If appropriate alternative media according to gender exists, then the information contained in the media is more easily transferred to students (Jelatu & Kurnila, 2019; Wuryanti et al., 2020). That way, students do not just memorize but understand concepts more deeply to be applied in their daily lives. The teacher must also analyze the need for alternative learning media that is appropriate and needed according to the learning objectives and the students' genders.

Based on the study results, it was found that teachers still have low ICT competence. The creation of multimedia products is proof of teachers' low ICT competence, especially those related to environmental impacts or environmental problems that are not yet feasible compared to traditional products such as posters or handicraft creations (Gutiérrez-Martín et al., 2022). Therefore, teachers' skills are required to present varieties of learning media so that the needs for both genders can be adequately fulfilled according to their understanding characteristics.

This study aims to prove the influence of caricatures and comics based on gender towards concept understanding. This research is also to find out which learning media suits male or female students better between caricature and comic. The suitability of learning media refers to the value of concept understanding that students obtained.

METHODS

Research Design

There are three variables in this study, namely learning media as the first independent variable (X1), gender as the second independent variable (X2), and understanding of the environmental pollution concept as the dependent variable (Y). This type of research is causal quantitative because it wants to prove the effect between

variable X towards variable Y (Putrawan, 2021). The method that is used is experimental. The design used was a 2 x 2 factorial design with A (Learning Media) x B (Gender). The variable constellations mentioned above in the research design are shown in Table 1.

Table 1.
Factorial Research Design

Gender	Learning Media	
	Caricature Media (A1)	Comic Media (A2)
Male (B1)	10 students	10 students
Female (B2)	10 students	10 students

Population and Samples

The sample of this research is 10th-grade students in two different schools, namely Senior High School A, which is located in Tambora District, Jakarta, Indonesia, and Senior High School B located in Palmerah District, Jakarta, Indonesia. Senior High School A applied to learn with caricature media, meanwhile Senior High School B applied to learn with comic media. Sampling used a stratified random sampling technique. From this technique, class 10 Science 1 in SMA A and class 10 Science 3 in SMA B were chosen. Class 10 Science 1 consists of 18 students comprised of 11 male students and seven female students. Class 10 Science 3 consists of 36 students comprised of 14 male students and 22 female students. The age range of the two classes is 16-17 years old. Sampling ended with purposive random sampling with the same number of male and female samples, ten students in each cell.

Instrument

This study was designed to prove which learning media is suitable for each gender in understanding the environmental pollution concept. Concept understanding is the internal ability of students obtained from an active thinking process covering 3 (three) dimensions, namely translating (translation), interpreting (interpretation), and extrapolating (extrapolation) to the environmental pollution concept. The assessment is obtained from the students' understanding scores. The test was given to 50 different students to test the reliability of the multiple-choice questions. Students answered 50 multiple choice questions with choices A, B, C, D, and E. After being tested on 50 students, 32 multiple choice questions passed the instrument test used in the study. Those 32 questions are declared as valid in medium and high categories. While the reliability test results are declared as reliable for all statements with a reliability value of 0.84 which is categorized as high. Student responses were analyzed by matching them with the rubric developed by Anderson & Krathwohl (2010). The distribution map of conceptual understanding is summarized in Table 2.

Table 2.
Instrument Outline for Environmental Pollution Concept Understanding (Analyzing data on environmental changes, their causes and impacts on life).

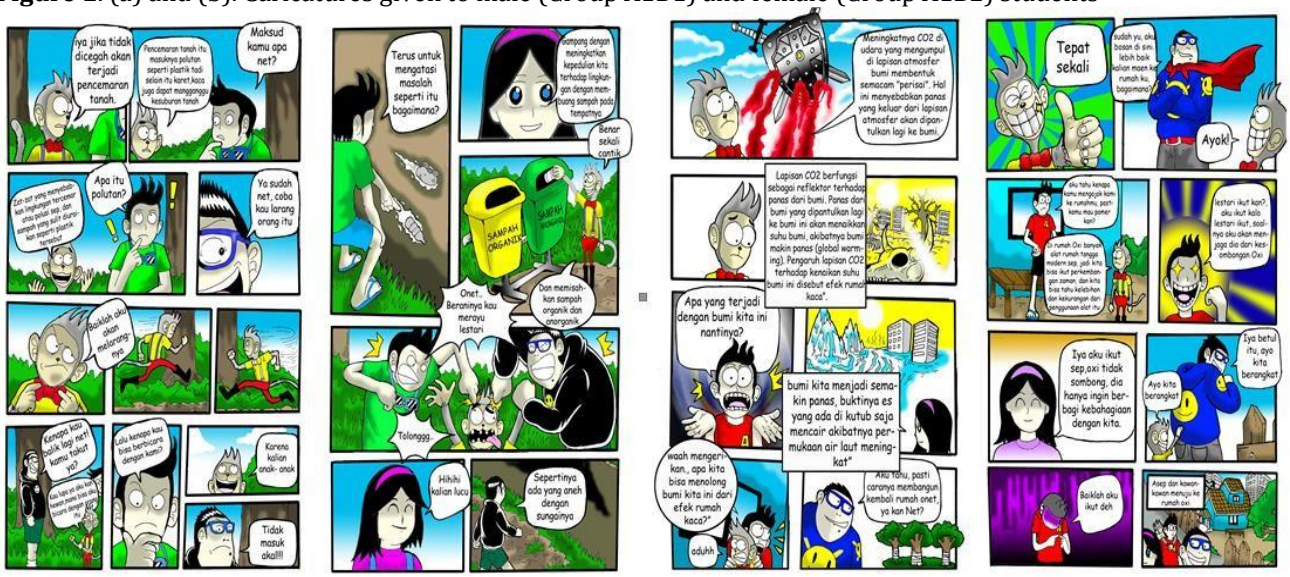
No	Dimensions	Understanding Indicator	Environmental Pollution Concept			
			Water	Air	Land	Total
1	Translation	Categorizing	2, 21	3, 20	11, 22	6
2	Interpretation	Distinguishing	1, 15, 30	4, 28	12	6
		Explaining	5, 16, 31	6, 7, 14, 27	23	8
3	Extrapolation	Predicting	9, 17, 32	8, 18, 29	24	7
		Concluding	10	13, 19	25, 26	5
Total Questions						**32**

Procedure

This research begins with determining the school, population, and sample. Next step is the preparation for the definition of conceptual, operational, and grid preparation. Then, the development of an instrument test is done which refers to the understanding of environmental pollution concept indicators. After the instrument test has finished, then it is compulsory to measure the validity and reliability. The instrument test that fulfills the validity and reliability tests can be used to measure the students' conceptual understanding after learning by using 2 different media. The process of learning the environmental pollution concept is carried out in 3 meetings according to the time allocation in accordance with the carried-out results of basic competence analysis. The following are examples of caricature and comic images given to different classes according to Figure 1 and 2.

(a) **(b)**

Figure 1. (a) and (b). Caricatures given to male (Group A1B1) and female (Group A1B2) students



(a) **(b)**

Figure 2. (a) and (b). Comics given to male (Group A2B1) and female (Group A2B2) students

Data Analysis Techniques

Students' concepts understanding is obtained from the average multiple-choice test results in each aspect of understanding. The data is processed through descriptive statistics test in the form of mean, minimum, maximum and standard deviation. To facilitate the data presentation, the results of this study are arranged in the form of a relative group distribution of ideas (Siregar, 2010). The aim is to determine the total frequency and percentage that fall into certain categories. Thus, it is easy to find out the spread of the initial data.

The data were tested for prerequisites through the normality test using the Kolmogorov Smirnov (KS) and the homogeneity test using the Bartlett test. KS test results obtained that Dcount = 0.17 is smaller than D table = 0.21, then H0 is rejected. This means that the sample comes from a population that is normally distributed. Meanwhile, the Bartlett test is divided into the media group homogeneity test (X2count = 2.30 is smaller than X2t table = 3,841, then H0 is rejected), the gender group variance test (X2count = 3.21 is smaller than X2table = 3,841, then H0 is rejected), and the joint variance test between A and B (X2count = 0.554 is smaller than X2table = 7.815, then H0 is rejected). This means that the sample comes from a population that has a homogeneous variance. Furthermore, the data is tested using a two-way analysis of variance (two-way ANOVA) and continued with Dunnet test for all treatments. All data analysis activities use Microsoft Excel.

RESULTS AND DISCUSSION

a. The frequency distribution result in the conceptual understanding of environmental pollution on male students who are taught using caricature media (A1B1)

Ten male students in this group were taught using caricature media. The score on the understanding of environmental pollution concept by male students taught using caricature media obtained a mode of 28.00, an

average of 28.20, a median of 28.00, a variance of 3.00, a standard deviation of 1.53, the lowest score was 26, and the highest score was 31. The result of frequency distribution in understanding the environmental pollution concept by male students who were given caricature media can be seen in Table 3.

Tabel 3.
The frequency distribution result in the conceptual understanding

No.	Class Interval	Median	Absolute Frequency	Cumulative Frequency	Relative Frequency (%)
1	25 - 26	25.5	2	2	20
2	27 - 28	27.5	4	6	40
3	29 - 30	29.5	3	9	30
4	31 - 32	31.5	1	10	10
Total			**10**		**100**

b. The frequency distribution result in the conceptual understanding of environmental pollution on female students who were taught using caricature media (A1B2)

Ten female students in this group were taught caricature media. The score on the conceptual understanding of environmental pollution by female students taught using caricature media obtained a mode of 25.00, an average of 24.50, a median of 25.00, and a standard deviation of 1.96. The lowest score was 21, and the highest score was 28. Distribution can be seen in Table 4.

Table 4.
The frequency distribution result in the conceptual understanding

No.	Class Interval	Median	Absolute Frequency	Cumulative Frequency	Relative Frequency (%)
1	21 -22	21.5	2	2	20
2	23 – 24	23.5	2	4	20
3	25 – 26	25.5	5	9	50
4	27 – 28	27.5	1	10	10
Total			**10**		**100**

c. The frequency distribution result in the conceptual understanding of environmental pollution on male students who were taught using comic media (A2B1)

Ten male students in this group were taught using comic media. The score on the conceptual understanding of environmental pollution by male students taught using comics media obtained a mode of 24.00, an average of 23.90, a median of 24.00, a variance of 4.00, and a standard deviation of 2.54. The lowest score is 21, and the highest score is 27. The distribution can be seen in Table 5.

Table 5.
The frequency distribution result in the conceptual understanding

No.	Class Interval	Median	Absolute Frequency	Cumulative Frequency	Relative Frequency (%)
1	21 - 22	21.5	2	2	20
2	23 - 24	23.5	4	6	40
3	25 - 26	25.5	3	9	30
4	27 - 28	27.5	1	10	10
Total			**10**		**100**

d. The frequency distribution result in the conceptual understanding of environmental pollution on female students who were taught using comic media (A2B2)

Ten female students in this group were taught using comic media. The score on the conceptual understanding of environmental pollution by female students taught using comics media obtained a mode of 25.00, an average of 25.10, a median of 25.00, a variance of 3.00, and a standard deviation of 1.70. The lowest score was 22, and the highest score was 28. The distribution can be seen in Table 6.

Table 6.
The frequency distribution result in the conceptual understanding

No.	Class Interval	Median	Absolute Frequency	Cumulative Frequency	Relative Frequency (%)
1	21 - 22	21.5	1	1	10
2	23 - 24	23.5	2	3	20
3	25 - 26	25.5	5	8	50
4	27 - 28	27.5	2	10	20
Total			**10**		**100**

e. Students Percentage in Each Question Dimensions of Conceptual Understanding of Environmental Pollution

Each number per question is given a percentage based on the students who answered correctly. This percentage is added up with other percentages that are in the same dimension of conceptual understanding and averaged by the number of questions per dimensions. After that, the percentage results obtained in each aspect of students' conceptual understanding can be seen in Table 7. Students' conceptual understanding with the highest percentage is male students taught using caricature media by 84%, and the lowest is male students taught using comic media by 74%.

Table 7.
Percentage on Each Dimensions of Conceptual Understanding based on Gender

No.	Dimensions	Caricature and Male		Caricature and Female		Comic with Male		Comic and Female	
		%	Category	%	Category	%	Category	%	Category
1	Translation	80%	Good	77%	Good	85%	Good	88%	Very Good
2	Interpretation	84%	Good	79%	Good	73%	Enough	75%	Enough
3	Extrapolation	88%	Very Good	76%	Good	65%	Enough	70%	Enough
	Total	84%	Good	77%	Good	74%	Enough	77%	Good

The highest dimensions are found in the translation (88%) and extrapolation (88%) dimensions. When female students are taught using comics, The translation dimension (88%) is higher than male students who are given comics (A2B1), male students who are given caricature (A1B1), or female students who are given caricature (A1B2). The translation is a person's ability to communicate ideas into other languages, other terms, or other forms (Reisberg, 2019; Santrock, 2008; Yuliani & Suragih, 2015). Female students taught using comic media are accustomed to reading explicit dialogues. Students are used to communicating in different forms. This habit makes students able to master the translation dimension.

When male students are taught using caricature media, the extrapolation dimension (88%) is higher than male students who are given comics (A2B1), female students who are given comics (A2B2), or female students who are given caricature (A1B2). Extrapolation is a thought or prediction based on understanding the tendencies or conditions described in the communication that makes it possible to make conclusions ((Wuryanti et al., 2020). This is reinforced by female students' habit of reading information and reviewing it in different languages, which strengthens translation skills when learning with comic media. Male students taught using caricature media have been accustomed to finding information implied in caricatures. Caricatures containing pictures with implied meanings cause students to find information that matches the picture. This condition stimulates students to conclude the concepts contained in the information on the caricature. The research of Al-Rabaani et al. (2017) reinforces this; cartoon/caricature media that lacks writing or writing that only functions as a trigger for implied information cause students to be forced to create their ideas. This causes male students who like to think differently to find suggested ideas so that the extrapolation ability in caricature learning is high.

In contrast, the lowest dimensions are the interpretation of male students taught using comic media. Although men tend to like comics, their ability to analyze concepts is low. Men tend to enjoy discovering something or implied information. Caricature media allows this to happen. Meanwhile, comic media does not stimulate students to make their ideas based on available information because the information in the comics is complete. Male students taught using comics media find it difficult to make predictions according to the cases presented. The further analysis was carried out using Microsoft Excel followed by the Dunnet test because the data for each cell was the same to determine the significance. The results summary of two-way Anova analysis can be seen in Table 8.

Table 8.
The results summary of two-way ANOVA analysis

S. Varians	JK	db	RJK	Fcount	t_{table} α=0,05	t_{table} α=0,01
Between A	28,90	1	28,90	8,48	4,11	7,40
Between B	19,60	1	19,60	5,75	4,11	7,40
AxB Interaction	52,90	1	52,90	15,53	4,11	7,40
Within Group	122,60	36	3,405	-	-	-
Total	224,00	39		-	-	-

Based on the result of the analysis of variance (ANOVA) in Table 6, it can be interpreted that Fcount both Between A (8.48), Between B (5.75), and A x B interaction (15.53) indicate that Fcount > Ftable. The null hypothesis (H0) is rejected, and the alternative hypothesis (H1) is accepted. This proves that there are differences in students taught with caricatures and comics. In addition, the study found that caricature as a learning medium creates a better outcome for male students' concept understanding whereas female students thrive more with learning through comics.

There is a significant effect of learning media interaction (A) and gender (B) on students' conceptual understanding of environmental pollution. Therefore, it is necessary to proceed with a different test on the simple effect to find out whether there is a significant difference by using a one-way variance analysis followed by the Dunnet test. Based on the Dunnet test, there were significant differences between all treatments.

The results of this study indicate that overall, there are differences in students' conceptual understanding of environmental pollution between groups of students who are taught by caricature media and students who were taught by comics media, as well as between groups of boys and girls. In addition, there is a very significant interaction between learning media and gender on understanding the concept of environmental pollution. Based on the results of data analysis that has been carried out, it can be stated several things as follows:

Differences in understanding the environmental pollution concept between caricature media and comic media

The results of the ANOVA calculations for groups A1 and A2 show that Fcount = 8.48 at > Ftable at α =0.05 = 4.11. The test results prove a significant difference in understanding the concept of environmental pollution between students who were taught by caricature media than students who were taught by comic media. This study shows that learning media made a significant contribution to enhancing the quality of learning outcomes.

Testing the first hypothesis shows that the average score of understanding the concept of environmental pollution in students taught with caricature media is 26.35, which is higher than the average score of environmental pollution conceptual understanding of students taught by comic media of 24. 65. Based on the results of testing the data on understanding the concept of environmental pollution, it turns out that the learning taught by caricature media is more effective than understanding the concepts of students who are taught by comic media. This indicates that learning caricature media is a visual media that is very helpful for students in understanding the lesson.

Caricature media and comics media are two visual graphic media that have images that attract students' attention. In terms of increasing students' understanding, caricature media can stimulate students to understand an object (Eker & Karadeniz, 2014; Febriansyah et al., 2020; Toledo et al., 2014). Caricature media emphasizes students' critical thinking skills with implied information, not in dialogue like in comics. Students not only know but must understand the meaning of the caricature. Comic media is a graphic visual media that has pictures and conversations that attract students' attention. Still, the information that the teacher will convey is already contained in the dialogue so that students only need to read and memorize like reading a book. The difference is that comics media are assisted by pictures that attract students' attention.

Caricature media is media whose material is implied in the pictures. Caricature media emphasizes the critical thinking skills of students. Comic media is graphic visual media that has pictures and conversations that form interactions between characters that attract students' attention and the material or information already contained in the media (Al-Rabaani, Ahmed Hamed & Al-AAmri, 2017; Neil, 2012; Saputra & Saputra, 2021). Based on this, it is clear that caricature media requires students to understand the image's meaning because there is no material written in the caricature. The material contained is implied, which causes students not to be required to memorize but to understand the picture's meaning first. After understanding the students, they compose concepts based on the truncated information through a discussion process between their group friends. Caricatures demand and train students in critical thinking as well as to have social sensitivity and concern, further sharpening students' understanding and imagination (Reisberg, 2019).

A precious contribution from caricature media for learning in schools, especially when implementing the 2013 curriculum, is that caricature media can allow students to discuss what the meaning of the media contains. Caricature media can stimulate students to understand more deeply a material with exciting pictures and the

meaning implied in the image (Al-Rabaani, Ahmed Hamed & Al-AAmri, 2017; Eker & Karadeniz, 2014; Saputra & Saputra, 2021).

By applying caricature media to help the method or approach used by the teacher, it can also make it easier for the teacher to clarify a concept that is difficult for students to understand. Caricature media can stimulate students to use their power of understanding to interpret the meaning of the caricature so that it becomes complete information.

Caricature media stimulates students to find their concepts (inquiry and constructivism) compared to comic media, which has already been the subject matter in comic discussion (comic dialogue) (Gary, 2012; Rina et al., 2020; Udayani et al., 2021). Reisberg also supports this. He states that cartoon media in caricatures can stimulate students to find the information implied in the image (Halawa, 2020; Istianah et al., 2020; Reisberg, 2 2019; Toledo et al., 2014). According to Smaldino et al., if students search for information themselves and form information obtained through discussion, the meaning understood will be more memory-resistant (Smaldino et al., 2012).

Differences in understanding the environmental pollution concept for male students and female students

The results of the ANOVA calculations for groups B1 and B2 show that F_{count} = 5.75 at > F_{table} at α =0.05 = 4.113. The test results prove a significant difference in understanding the concept of environmental pollution between male students and female students. This shows that gender also contributes to understanding the learning process in this study.

Based on the data testing results, it turns out that male students have a higher understanding than female students on the concept of environmental pollution. This indicates that male students' understanding of environmental pollution material is better than female students. There are clear differences between male and female students in various ways. This is reinforced by Santrock, who states that gender with a broader term, namely gender, sees differences in the socio-cultural and psychological dimensions of sex (Aikman & Unterhalter, 2007; Maadal, 2020; Santrock, 2008; Seifert & Sutton, 2015). It also says that male and female students have differences in understanding something. Men in the psychological aspect are more likely to search for incomplete information on their own and understand the process rather than memorizing material that is already in the form of complete details (Ismail et al., 2021; Kamid et al., 2020). In contrast, women are better at remembering than in the process of understanding information. Understanding is at a higher level than just remembering information.

When viewed from the characteristics of female students, they tend to have better abilities in verbal tasks and in tasks that are deeper in the process of memorizing and understanding oral materials (Jamiah et al., 2016; Seifert & Sutton, 2015). In addition, girls tend to work on questions, as exemplified by the teacher. Girls outperform boys in verbal and divergent thinking skills and quickly understand varied words and sentence structures (Aikman & Unterhalter, 2007).

Male students have the ability in terms of spatial and abstract mathematics and scientific and scientific reasoning, innovative and creative in solving mathematical problems (Aikman & Unterhalter, 2007; Kamid et al., 2020). This is because men can rarely remember what the teacher teaches, so they look for solutions independently. In addition, men are more likely to prefer materials related to natural phenomena that occur. Male students use their right brain more concerning spatial or scientific material. Environmental pollution material is material in the fields of Biology and science, which requires students to memorize a concept and understand a problem that requires students to solve the problem. So that this material is more accessible for men to understand because men tend to use reasoning rather than memorizing. The findings of this study reinforce the findings that suggest that the male gender is better at understanding than the female gender.

For male students, understanding the environmental pollution concept is higher when taught using caricature learning media (A_1B_1) than comic media (A_2B_1)

When taught using caricature media, the average (mean) understanding of male students is higher than using comic media. After being taught using caricature media, the male students' mean is 28.20, while the male students' mean after being taught using comic media is 24.20. Based on the mean, there is a significant difference.

Caricature media is a media whose material is implied in the pictures (Baga et al., 2021; Eker & Karadeniz, 2014; Halawa, 2020). Caricature media emphasizes the ability of students to understand a particular object contained in the caricature media. Based on this, caricature media requires students to understand the image's meaning because there is no material written in the caricature. The point is that the information contained in the caricature media must be discussed first, or the caricature image must be understood first so that students can understand the meaning of the implied information. The implied material causes students not to memorize but to understand the picture's meaning first. After understanding the picture, students compose concepts based on the truncated information through a discussion process between their group friends. This explains that caricature media requires deep understanding, not only memorizing information. Gender also determines students' interest in an object. This is reinforced by the research of A. Toledo & Rosanelia T. Yangco, analyzing that verbal teaching through caricatures has an enormous effect on students' understanding of something (Toledo et al., 2014).

Based on research in education between boys and girls, there are different interests in something. This is reinforced by Elliot et al., who stated that men and women have different interests regarding the messenger media. These diverse interests lead teachers to provide more varied learning alternatives to control the differences in interest, sociocultural or psychological, among the male and female students. Men prefer media that can guide and stimulate male students to think more deeply.

According to Elliot et al., it is easier for men to understand material related to everyday life and nature than women (Ismail et al., 2021; Volpe et al., 1996). Male students in science learning emphasize scientific and intellectual activities. Meanwhile, female students focus more on memorizing activities. Men are more likely to understand science and mathematics more quickly than women because it is related to the intellectual ability of science. This study's findings strengthen the statement that male is better at understanding the concept of environmental pollution when taught using caricature media than when taught using comics media.

For female students, understanding the environmental pollution concept is higher when taught using comics media (A_2B_2) than using caricature media(A_1B_2)

Female students' average (mean) understanding is higher when taught using comic media than caricature media (look at the frequency distribution table for understanding the concepts in tables 4 and 5 above). The female students' mean taught using comics media is 25.10, while the female students' mean taught by comics media is 24.50. Based on this mean, the difference is higher in the average female students who are given comic media.

Comic media is graphic visual media that has pictures and conversations that form interactions between characters that attract students' attention and the material or information already contained in the media. Male students are lower than the average female students given comic media. After being given comic media learning, the male students ' mean is 24.20 while the female students' mean after being given comic media learning is 25.10. Based on this mean, the difference is higher in the female students' mean who were given comic media.

Comic media is graphic visual media that has pictures and conversations that form interactions between characters that attract students' attention and the material or information already contained in the media. Comic media already contains information that will be explained by the teacher, making it easier for students to memorize things because comics are the same as books. But some things distinguish it from books. Comics provide colorful and exciting pictures and funny conversations so that students don't have to read them. Comic media already contains information that will be explained by the teacher, making it easier for students to memorize things because comics are the same as books (Gary, 2012; Rina et al., 2020; Udayani et al., 2021). But some things distinguish it from books. Comic media presents colorful and interesting pictures and funny conversations so that students don't have to read them (Berlian et al., 2021; Mcgarr et al., 2021; Udayani et al., 2021).

Based on the previous description, it has been explained that there are differences between boys and girls in various ways. This is reinforced by Santrock, who states that gender with a broader term, namely gender, sees differences in the socio-cultural and psychological dimensions of gender (Jamiah et al., 2016;Reisberg, 2019; Santrock, 2008; Volpe et al., 1996). He also says that male and female students have differences in understanding something. Women in the psychological aspect are more likely to prefer seeing and hearing the information conveyed. Female students are less bored when reading something. Comic media has conversations containing material elements (information) and funny conversations, so female students understand it faster than boys.

Female students are more likely to memorize information that already exists. In contrast to male students, they are better at finding incomplete information and understanding the process than memorizing complete material. Comic media is more demanding of memorization skills because the material has been presented in conversation. Students do not have to think too deeply because the material or information is already written in the media. Women prefer media that attracts the attention of students and media that has a lot of reading. Women like to read information seen in daily life, magazines, novels, and women dominate those related to reading according to their respective appeals. This study's findings strengthen the previous findings that female achieve higher understanding when taught using comic than caricature because the information visibility in an object or media is a characteristic of comics favored by female students.

The interaction effect of learning media and gender on understanding the environmental pollution concept

The results of the ANOVA calculations for groups B_1 and B_2 show that F_{count} = 15.53 at > F_{table} at α =0.05 = 4.113. The test results prove a very significant influence between learning media and learning media on understanding the concept of environmental pollution. The interaction proves that each learning media has a different effect on understanding the concept of environmental pollution when applied to students of different genders.

Based on the results of the data analysis above, it can be explained that, in creating a quality learning atmosphere and process, it is necessary to support several components such as the application of learning models, methods, media, assessment techniques, and the teachers. If these components are optimized, they will positively

contribute to the quality of learning. Learning media and the diversity of students, in this case, gender, are essential aspects that must be optimized and considered in improving the quality of learning.

The application of learning media relevant to the learning objectives and materials is one of the factors directly related to learning, which is the driving factor for the effectiveness and efficiency of learning activities (Daryanto, 2016). The selection of learning media that is in line with the achievement of competencies and indicators and learning materials is an absolute thing that must be considered and becomes the teacher's attention.

Understanding the concept of students certainly will not be able to develop if there are no media that helps teachers in the learning process (Jelatu & Kurnila, 2019; Udayani et al., 2021). The unclear material that is difficult to understand can make it easier for students to understand the material with the help of the media (Alhajri & Mansour, 2018; Kanat, 2019). The selection of learning media that is relevant to the learning material considered by the teacher is difficult for students to understand if the presence of learning media can assist only the lecture method.

In this study, it is proven that caricature and comic can create a good understanding of concepts. Based on the results, it was also shown that there was a connection between media and gender. An important finding in the study is that male students' conceptual understanding is better than female's when they are given caricature as a learning media whereas female students' conceptual understanding is better when they are given comic as a learning media. This means that both media influence each gender. No research compares directly between caricatures and comics concerning gender. It is hoped that with this research, teachers are motivated to apply different media variations to accommodate both genders in the classroom based on their needs, requests, and experiences.

The success of learning activities cannot be separated from psychological or biological aspects. Gender is a psychological and biological aspect of a learning activity. It is called the psychological aspect because students have an interest in different things depending on their respective biological aspects. The biological aspect here is the different types of chlamydia. In schools, especially high schools, male and female genders have other interests in an object. The understanding gained by students through various learning media is influenced by gender, which determines the tendency of interest in an object (Aikman & Unterhalter, 2007; Maadal, 2020; Seifert & Sutton, 2015).

With the difference between male students and female students, teachers can have learning media that match the students' characteristics. At the very least, the teacher must be able to determine various alternative learning media to coordinate these differences into a unified whole. Thus, no party feels more benefited, or students feel too disadvantaged. The limitations of this study focus on the gadgets owned by students to see the whole comic media. The comic media is in the form of a landscape with speech balloons so that it is difficult for students to see in full with a 1-page format when reading through mobile phones. This obstacle greatly interferes with reading comics in the early class activities. The teacher's solution at the school was to prepare printed comics and give them to groups that did not use laptops/PCs. This minimizes the difficulty of students in reading comic media.

CONCLUSION

The conclusion of this study shows that overall, concept understanding of environmental pollution is different when students are taught using caricature and comic media based on gender differences. In this study, it was found that the value of concept understanding in students was higher if they were given caricature learning than comics. Meanwhile, female students have a higher understanding if they are taught using comics compared to caricatures. This study recommends that learning media alternatives need at least two media in completing one learning topic that accommodates both male and female students. The second recommendation is the need to train teachers in making caricature and comic media that can be implemented in learning. The third recommendation is to look for ready-made caricature and comics to save time. In addition, to build a deeper and more complex concept understanding, teachers can also ask students to create their own caricatures and comics. Lastly, the recommended method for future research is Research and Development (R&D) to improve other skills, such as verbal communication skills and students' creative or critical thinking.

ACKNOWLEDGMENT

All praise to the Almighty God for the blessings and abundance of grace that enable this research article to be finished. Thank you to all parties that have contributed and helped in completing this research in form of materials, funds, or anything else that are needed to publish the research article manuscript in accordance with the journal we want. Thank you to the two principals who have allowed the researcher to use their schools as the research sites so this study can run smoothly. Also, thank you to Marsella Metta Arvia, a veterinary medicine undergraduate at IPB University, and Vincent, a senior high school student at Sinar Dharma School Jakarta, Indonesia for helping in the process of finishing this article.

REFERENCES

Aditya, A., & Oktavilia, E. A. (2020). Tingkat Ekoliterasi Tenaga Pendidik Fakultas Ilmu Budaya UNSOED. *Nusa:*

Jurnal Ilmu Bahasa Dan Sastra, *15*(4), 433–446. https://doi.org/10.14710/nusa.15.4.433-446

Aguillon, S. M., Siegmund, G. F., Petipas, R. H., Drake, A. G., Cotner, S., & Ballen, C. J. (2020). Gender differences in student participation in an active-learning classroom. *CBE Life Sciences Education*, *19*(2), 1–10. https://doi.org/10.1187/cbe.19-03-0048

Aikman, S., & Unterhalter, E. (2007). *Practising Gender Equality in Education*. Oxfam.

Al-Rabaani, Ahmed Hamed & Al-AAmri, I. H. (2017). The Effect of Using Cartoons on Developing Omani Grade 4 Students' Awareness of Water Issues and their Attitudes towards Using them in Teaching Social Studies. *Journal of Social Studies Education Research*, *8*(1), 35–46.

Alhajri, S., & Mansour, H. (2018). New Approach of Using Social Media in Graphic Design at the Higher Education in Sultanate of Oman. *The International Academic Forum*.

Anderson, L.W dan Krathwohl, D. R. (2010). *Kerangka Landasan untuk Pembelajaran, Pengajaran dan Asesmen (Revisi Taksonomi Pendidikan Bloom)*. Pustaka Pelajar.

Appannagari, R. R. (2017). Environmental Pollution Causes And Consequences: A Study. *North Asian International Research Journal of Social Science & Humanities*, *3*(8), 2454–9827.

Baga, S., Hendriyani, M. E., Suratmi, S., & Rosaline, M. M. (2021). Students' Interest and Cognitive Ability through the Implementation of Comic Media. *International Journal of Biology Education Towards Sustainable Development*, *1*(1), 17–26. https://doi.org/10.53889/ijbetsd.v1i1.49

Berlian, M., Vebrianto, R., & Thahir, M. (2021). Development of webtoon non-test instrument as education media. *International Journal of Evaluation and Research in Education (IJERE)*, *10*(1), 185–192. https://doi.org/10.11591/ijere.v10i1.21007

Cuadrado-García, M., Ruiz-Molina, M. E., & Montoro-Pons, J. D. (2010). Are there gender differences in e- learning use and assessment? Evidence from an interuniversity online project in Europe. *Procedia - Social and Behavioral Sciences*, *2*(2), 367–371. https://doi.org/10.1016/j.sbspro.2010.03.027

Daryanto. (2016). *Media Pembelajaran: Edisi Revisi*. Gava Media.

Djannah, S. N., Sulistyawati, S., Sukesi, T. W., Mulasari, S. A., & Tentama, F. (2020). Audio-visual media to improve sexual-reproduction health knowledge among adolescent. *International Journal of Evaluation and Research in Education (IJERE)*, *9*(1), 138–143. https://doi.org/10.11591/ijere.v9i1.20410

Eker, C., & Karadeniz, O. (2014). The Effects of Educational Practice with Cartoons on Learning Outcomes. *International Journal of Humanities and Social Science*, *4*(14), 223–234.

Febriansyah, D., Dwiputra, K., Budiyanto, T. M., & Adz, T. (2020). Textbooks Transformation Into Digital Comics As Innovative Learning Media for Social Science Studies in Junior High School. *International Journal Pedagogy of Social Studies*, *5*(2), 9–16. https://ejournal.upi.edu/index.php/pips/article/view/29068

Friesem, E. (2018). *Too Much of a Good Thing? How Teachers' Enthusiasm May Lead to Protectionism in Exploring Media & Gender*. *10*(1), 134–147.

García-Ramos, F.-J., Zurian, F.-A., & Núñez-Gómez, P. (2020). Gender studies in Communication Degrees. *Comunicar*, *28*(63), 21–30. https://doi.org/10.3916/C63-2020-02

Gary, C. B. (2012). Connecting Through Comics: Expanding Opportunities for Teaching and learning. *US- China Education Review*, *19*(4), 385–395. https://doi.org/10.1136/emj.19.4.375-b

Gunawan, M. T. R., Adriany, V., & Noorman, S. S. (2017). *Learning Media and Gender in Early Childhood Education*. *2*(229), 247–250. https://doi.org/10.5220/0007048507960799

Gutiérrez-Martín, A., Pinedo-González, R., & Gil-Puente, C. (2022). ICT and Media competencies of teachers. Convergence towards an integrated MIL-ICT model. *Comunicar*, *30*(70), 19–30.

https://doi.org/10.3916/C70-2022-02

Halawa, S. (2020). *Meningkatkan Minat Belajar Siswa Dengan Menggunakan Gambar Karikatur*. *3*(5), 267–272. https://doi.org/10.31227/osf.io/6w9er

Ismail, A., Ahmad, N. S., & Aman, R. C. (2021). Gender of transformational school principals and teachers' innovative behavior. *International Journal of Evaluation and Research in Education (IJERE)*, *10*(3), 747–752. https://doi.org/10.11591/ijere.v10i3.21448

Istianah, F., Ambarwati, D., Lailiyah, F., Suryanti, & Rahmawati, I. (2020). Development of Water Cycle Comic Media to Improve Student Learning Outcomes. *Proceedings of the International Joint Conference on Arts and Humanities (IJCAH 2020)*, *491*(Ijcah), 313–319. https://doi.org/10.2991/assehr.k.201201.056

Jamiah, J., Mahmud, M., & Muhayyang, M. (2016). Do Male and Female Students Learn Differently? *ELT Worldwide: Journal of English Language Teaching*, *2*(2), 110. https://doi.org/10.26858/eltww.v2i2.1691

Jelatu, S., & Kurnila, V. S. (2019). Analysis of Translation Understanding from Verbal to Visual on Trigonometry Concept. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *9*(3), 191–202. https://doi.org/10.30998/formatif.v9i3.3663

Kamid, Rusdi, M., Fitaloka, O., Basuki, F. R., & Anwar, K. (2020). Mathematical communication skills based on cognitive styles and gender. *International Journal of Evaluation and Research in Education (IJERE)*, *9*(4), 847–856. https://doi.org/10.11591/ijere.v9i4.20497

Kanat, S. (2019). The Perceptions of Graphic Design Concept on Students Study on Graphic Design. *Journal of Education and Training Studies*, *7*(5), 65–75. https://doi.org/10.11114/jets.v7i5.4220

Khan, Mashhod Ahmad, Ghouri, A. M. (2011). Environmental pollution: Its effects on life and its remedies. *International Refereed Research Journal*, *2*(2), 276–285.

Liniasari, A. A. A. M., Yudiana, K., & Dibia, I. K. (2021). Comic-Based Learning Media with the Topic of Natural Resources. *International Journal of Elementary Education*, *5*(1), 80. https://doi.org/10.23887/ijee.v5i1.34327

Maadal, A. (2020). The relationship between locus of control and conformity. *Journal of Cognition and Culture*, *20*(1–2), 100–115. https://doi.org/10.1163/15685373-12340076

Matook, S., Brown, S. A., & Rolf, J. (2013). Forming an intention to act on recommendations given via online social networks. *European Journal of Information Systems*, *1*(7), 1–17. https://doi.org/10.1057/ejis.2013.28

Mcgarr, O., Gavaldon, G., & Herrano, F. M. S. de A. (2021). Using comics as a tool to facilitate critical reflective practice in professional education. *SANE Journal: Sequential Art Narrative in Education*, *2*(6), 1–6.

Miharja, F. J., Hindun, I., & Fauzi, A. (2019). Critical thinking, metacognitive skills, and cognitive learning outcomes: a correlation study in genetic studies. *Biosfer*, *12*(2), 135–143. https://doi.org/10.21009/biosferjpb.v12n2.135-143

Mukuni, K., Asante, D., & Almunive, W. (2020). Gender Diffrences in Student Perception of The Role of Learner-Content Interactions On Their Engagement In Online Courses. https://members.aect.org/pdf/Proceedings/proceedings20/2020/20_24.pdf.

Neil, C. (2012). *Comic, Linguistics and Visual Language: The Past and Future of a Field*. Palgrave MacMilan.

Putrawan, I. M. (2021). *Prinsip-Prinsip Logis Metodologi Penelitian Kuantitatif*. CV. Sadari. Reisberg, D. (2019). *Cognition Exploring The Science Of The Mind* (Seventh Ed). W. W. Norton & Company.

Reisberg, D. (2019). Cognition: Exploring the Science of the Mind Seventh Edition. New York: Norton & Company

Rina, N., Suminar, J. R., Damayani, N. A., & Hafiar, H. (2020). Character education based on digital comic media. *International Journal of Interactive Mobile Technologies*, *14*(3), 107–127. https://doi.org/10.3991/ijim.v14i03.12111

Santrock, J. W. (2008). *Educational Psychology*. McGraw-Hill Companies.

Saputra, N., & Saputra, M. (2021). Pemanfaatan Media Foto Karikatur Untuk Menaikkan Keterampilan Menulis Teks Anekdot Pada Siswa Kelas X Man 1 Pidie. *JIRA: Jurnal Inovasi Dan Riset Akademik*, *2*(1), 107–116. https://doi.org/DOI:10.47387/jira.v2i1.77

Seifert, K., & Sutton, R. (2015). Gender Differences in the Classroom. *Educational Psychology*, 72. https://courses.lumenlearning.com/suny-educationalpsychology/chapter/gender-differences-in-the-classroom/

Siregar, S. (2010). *Statistika Deskriptif Untuk Penelitian Dilengkapi Perhitungan Manual dan Aplikasi SPSS Versi 17* (2nd ed.). PT RajaGrafindo Persada.

Smaldino, S. E., Lowther, D. L., & Russell, J. D. (2012). *Instructional technology and media for learning* (10th edition). Pearson Education.

Teke, E., Pehlivan, M., & Haceminoglu, E. (2013). The effect of the science and technology course integrated with cartoonss on students achievement and attitudes. *Journal of Educational and Instructional Studies*, *3*(2), 129–134.

Toledo, M. A., Yangco, R. T., & Espinosa, A. A. (2014). Media Cartoons: Effects on Issue Resolution in Environmental Education. *International Electronic Journal of Environmental Education*, *4*(1), 19–51. https://doi.org/10.18497/iejee-green.99250

Udayani, N. K. R. T. K., Wibawa, I. M. C., & Rati, N. W. (2021). Development Of E-Comic Learning Media On The Topic Of The Human Digestive System. *Journal of Education Technology*, *5*(3), 472– 481. https://doi.org/10.23887/jet.v5i3.34732

UNESCO. (2015). *A Guide for Gender Equality in Teacher Education Policy and Practices*. United Nations Educational, Scientific and Cultural Organization.

UNESCO, & Education, J. (2019). *Gender, Media & ICTs (New Approaches for Research, Education & Training)*. United Nations Educational, Scientific and Cultural Organization.

Volpe, R., Chen, H., & Pavlicko, J. (1996). Personal investment literacy among college students: A survey. *Financial Practice and Education*, *6*(2), 86–94.

Wuryanti, S., Hadiana, D., & Purwati, R. (2020). Factors affecting the translation, interpretation, and extrapolation abilities in elementary school students' learning achievement. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *24*(2), 198–207. https://doi.org/10.21831/pep.v24i2.35730

Yuliani, K., & Suragih, S. (2015). The Development of Learning Devices Based Guided Discovery Model to Imrprove Understanding Concept and Critical Thinking Mathematically Ability of Students at Islamic Junor High School of Medan. *Journal of Education and Practice*, *6*(24), 116–128. http://search.proquest.com/docview/1773215035?accountid=8330