Vocational School Student' Perception on Plastic Waste Management: the role of Recycling Education

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Abstract
Recycling is one of the effective methods for reducing the negative impact of plastic waste to the environment. It is expected that the youth could play a role, to be responsible for managing plastic waste. The purpose of this research is to analyse the influence of demography factor and recycling education on the vocational high school students' perception toward plastic recycling activities. This research employed a quantitative approach of one group pre-test and post-test design using a case study in mechanical engineering class of a Vocational High School in the city of Surakarta, Indonesia. The data collection technique was carried out through questionnaire distributed amount 31 students. Statistical data analysis was used to describe students' perceptions and test the hypothesis of the effect of recycling education on students' perceptions of sorting waste for recycling. The recycling education was performed in 2 (two) sessions in which the first session covered the theory of plastic recycling. In the second session, the students were asked to use an injection moulding machine to recycle plastic into a simple product of a, key chains. The study indicated the recycling education significantly affects the student' perception in managing plastic waste for recycling purpose. It is found a notable difference between the students' post-test and pre-test score after attending the recycling education program. In this study, the demographics factors indicating from the student family background were not significantly have an impact on the student' perception plastic waste management. This study emphasizes the need for an integrated waste management education program on the school curriculum to increase the student' awareness toward environmental issues of plastic waste.

Keywords
recycling education, student perception, plastic waste management

1. Introduction
Considering their superior characteristics, plastic could be found in every aspect of life, from household into aerospace applications. Based on global data, in 2015 the demand for plastics increased by more than 320 million tons to 330 million tons in 2016 (Europe, 2017). Global plastic production reached 368 million tons in 2019 and according to Boyle & Örmeci, (2020) it is estimated that the amount of plastic production will increase by about 48 million tons higher than the previous year and this number is expected to increase continuously in the next 20 years. Figure 1 shows the increase in plastic production by year.

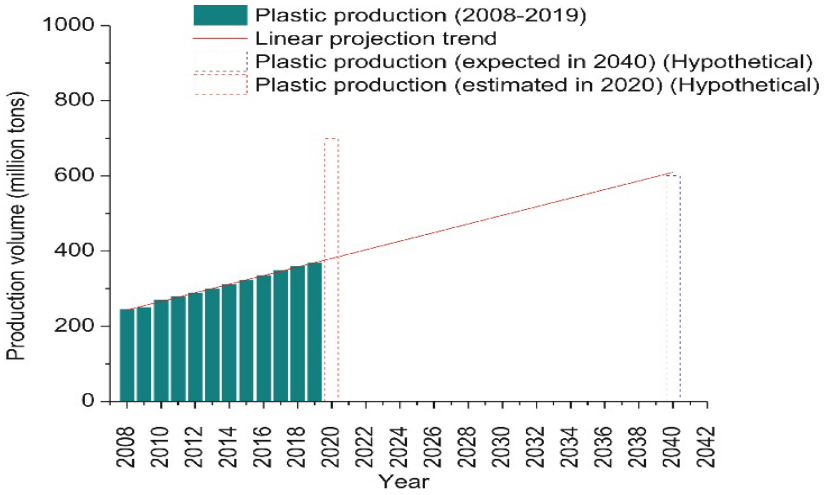

Figure 1 Plastic Waste Increase Chart

Excessive use of plastics may cause serious environmental problems (Phuong et al., 2016). Based on World Bank data released from, in 2016 the world's waste income reached 2.01 billion tons of waste. Meanwhile, in Indonesia itself, based on the Ministry of Environment and Forestry (KLHK) in 2020, the national waste income reached 67.6 million tons or around 185,753 tons of waste per day. It can be concluded that every Indonesian citizen produces around 0.68 kilograms of waste per day (Setiawan, 2021).

Even though recycling is one of the important strategies in waste management, the recycling rate is considered low. Sustainable Waste Indonesia (SWI) revealed that the number of plastic waste recycling in Indonesia is still below 10 percent (Badan Litbang, 2019). Most of the waste is currently disposed of in some form to landfills, only about 19 percent of waste is recycled and composted (Silpa Kaza et al, 2018).The low recycling rate could be resulted from several factors, one of which is the lack of knowledge toward recycling. Changing individual perceptions is critical to the success of a recycling program. Behavioural intentions on recycling are influenced by attitudes, subjective norms, individual behaviour control, awareness of consequences, moral norms and comfort (Wan et al., 2012). Individual attitudes and behaviour are the basis of all factors that influence recycling both positively and negatively (Smeesters et al., 1998). According to Dunlap et al., 1993; Inglehart, 1995; Hines, J., 1986, the level of consistency between one's attitudes and behaviour towards the environment is influenced by one's knowledge and awareness, behavioural commitment and sense of responsibility. One of the factors that influence students' attitudes, behaviour and awareness is demographic variables (Seacat & Boileau, 2018; Hornik et al., 1995).

Clear action should be performed to ensure that the youth could contribute to response the environmental issues on plastic waste. In this case, it is necessary to enhance the awareness and develop positive attitudes and behaviours in relation to recycling or other environmental problems (Williams, 2011). This present work focused on the development of recycling educational material, specifically for vocational students which characterised by practical learning. Further, the change of students' perception toward recycling after the education program was evaluated. This study also analyses the influence of demographic factors on the perception of vocational high school students in plastic waste management.

2. Methods

2.1 Research Design

This study was designed in One Group Pretest-Posttest control group quasi-experimental research design. The pre-experimental research was carried out with treatment to measure the impact of the experimental unit for evaluating the changes caused by treatment. A group was created to identify the effect of the independent variable by giving a pre-test questionnaire and a post-test questionnaire after the treatment. The treatment is a recycling education program, which conducted on two sessions: (1) theoretical aspects of plastic recycling education materials and (2) practice of plastic waste recycling. Theoretical part of the education program covered the following topics: 1) The impact of plastic on the environment, 2) Type of plastic materials, 3) Plastic recycling method. It aims to develop student

understanding to the recycling concept which expected to change their behaviour on waste separation before disposal. In the practical session, the students recycled plastic waste into a keychain using an injection moulding machine.

2.2 Participants

To implement the quasi-experimental research design, a vocational high school in Surakarta city, Indonesia was selected. There were 31 students age between 15-17 years old majoring in mechanical engineering that participated in the study. Table 1 shows the demographic details of the participants in this study.

Table 1 Participant's Demograhic

Participants' Demographic		Frequency	Percentage (%)
Father's employment	Employee	12	39
	Government Employees	0	0
	Entrepreneur	3	10
	Private Employees	7	23
	Other	9	29
Mother's employment	Employee	5	16
	Government Employees	0	0
	Entrepreneur	3	10
	Private Employees	1	3
	Other	22	71
Father' academic background	Elementary School	1	3
	Junior High School	10	32
	Senior High School	14	45
	Bachelor's degree	4	13
	Master's degree	0	0
	Other	2	6
Mother' academic background	Elementary School	6	19
	Junior High School	5	16
	Senior High School	14	45
	Bachelor's degree	3	10
	Master's degree	0	0
	Other	3	10

2.3 Measurements

A survey instrument was prepared to understand the extent to student perception about plastic waste management for recycling purposes as has been introduced by Altikolatsi et al., (2021). It consists of 8 (eight) question items of demographic information and 15 questions on 4-Likert scale answer options indicating perception of plastic waste management. After developing the survey's theoretical construct, an instrument validity was performed to ensure its applicability and consistency to measure the target. Through content validity, the second and third authors cross-validated the survey questions by identifying language clarity, theoretical relevance and practical pertinence. The Pearson's correlation was employed to assess the construct validity of a pilot test consisting of a group of 25 students. It was found that 9 (nine) question items on student perception are valid as the survey instrument presents the linear association between variables. Following the validity testing was a verification of the instrument' reliability and internal consistency through Cronbach's alpha. The valid and reliable instrument was then applied to the experiment group before and after the recycling education program. Participants' demographic information assessed is age, parents' employment and parents' academic background. In analysing the data, a quantitative approach was carried out using statistical method.

3. Results and Discussion

Participants filled out the pre-test before carrying out the treatment. The treatment is a recycling education program, which conducted on two sessions: (1) theoretical aspects of plastic recycling education materials and (2) practice of plastic waste recycling. Theoretical part of the education program covered the following topics: 1) The impact of plastic on the environment, 2) Type of plastic materials, 3) Plastic recycling method. Figure 2 shows the first session.

Figure 2 The First Session

Second session, practice of plastic waste recycling. The participants' response was asked to use an injection moulding machine to recycle plastic into a simple product of a, key chains. This activity was carried out in a machining engineering workshop, before the researchers prepared the tools and materials in advance. Researchers will explain how to use injection moulding and students will practice using tools and making key chain products. Figure 3 shows the second session

Figure 3 The Second Session

The participants' response is asked to fill out a post-test to find out how the perception changes towards plastic waste recycling after the recycling education treatment. The participants' response of pre-test and post-test were evaluated by summing up all the questions in the survey instruments. It is found that the average scores for the pre-test and post-test are 31.7097 and 30.7097, respectively. Table 2 exhibits the output of t-test in comparing the mean between the pre-test and post-test score.

Table 2 Output of T-Test

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-1.00000	1.61245	.28960	-1.59145	-.40855	-3.453	30	.002

Using a confidence level of 95%, it is concluded a significant difference in perceptions of plastic waste management after recycling education program.

This study amplifies previous findings that recycling education is an effective means of environmental education and creates understanding for students. Understanding the processes involved in recycling will enable communities to take advantage of recycling programs (Loonam, 2014). According to Bennett & Alexandridis (2021) educating students about recycling will have a positive impact on the environment and students will gain the skills and knowledge to implement a recycling system. Other studies conducted by Chow et al. (2017) focus on the educational impact of plastic recycling on elementary school students. In this study using three different teaching strategies, the results showed that the three strategies were able to increase student's knowledge about plastic recycling. Recycling education can also have a positive impact on students' attitudes and behaviour and increase them about recycling (Williams, 2011). Other research from Ugulu et al. (2015) also revealed the significant effect of recycling education on the understanding of high school students.

A person's perception toward recycling may affect the success of the program(Altikolatsi et al., 2021; Nyamwange, 1996). Perception is sometimes an obstacle for someone to carry out the recycling process (Hornik et al., 1995). the Lack of knowledge on the importance of recycling and the correct way of recycling could prevent the behaviour to sort out the waste for recycling purposes. A research work by Mrema (2008) showed that students' reluctant to recycle was caused by the lack of understanding on which materials that can be recycled.

Further, ANOVA test was performed to evaluate the influence of demographic factors on student perception before attending the recycle education program (Table 3).

Table 2 Output of ANOVA Test

Factor	Test of Homogeneity of Variances (Sig.)	Welch Test and Brown-Forsythe Test (Sig.)	ANOVA Test (Sig.)
1) Father's Employment	0.396	-	0.677
2) Mother's Employment	0.217	-	0.540
3) Father's Academic Background	0.554	-	0.370
4) Mother's Academic Background	0.001	0.134 and 0.665	0.545

Based on the ANOVA test, father's employment, mother's Employment, father's academic background and mother's academic background are not significantly affected student perception of plastic waste management. The finding of this present work are in contrast to the study of Malandrakis & Chatzakis, (2014) which showed the significant effect of parents' work on their children's attitudes and behaviour towards environmental issues. Another study by Ariesta & Wijaya, (2014) also found that the level of parents' education can have an influence on the level of participation in waste recycling management, because through the education obtained, a person will find it easier to communicate and interact with other people.

The influence of demographic factors on the results of the pre-test perception of recycling is one of the interesting points that needs to be discussed. Social influences from family, friends, and neighbours were found to affect the

perception of recycling (Altikolatsi et al., 2021; Karasmanaki, Evangelia Galatsidas & Tsantopoulos, 2019; Psarra, 2018; Kalaitzoglou, 2018; Ugulu, 2015; Mrema, 2008).

4. Conclusion

The study indicated the recycling education significantly affects the student' perception in managing plastic waste for recycling purpose. It is found a notable difference between the students' post-test and pre-test score after attending the recycling education program. In this study, the demographics factors indicating from the student family background were not significantly have an impact on the student' perception plastic waste management.

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