

7-31-2020

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Recommended Citation

Rachman, Indriyani; Sugimaru, Chika; and Matsumoto, Toru (2020). USE OF PROBLEM-BASED LEARNING (PBL) MODEL TO IMPROVE LEARNING OUTCOMES IN ENVIRONMENTAL EDUCATION. *Journal of Environmental Science and Sustainable Development*, 3(1), 114-141.

Available at: <https://doi.org/10.7454/jessd.v3i1.1039>

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USE OF PROBLEM-BASED LEARNING (PBL) MODEL TO IMPROVE LEARNING OUTCOMES IN ENVIRONMENTAL EDUCATION

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(Received: 9 February 2020; Accepted: 29 July 2020; Published: 31 July 2020)

Abstract

Wastewater and household trash have become serious problems in major Indonesian cities due to the lack of environmental education for children and society as a whole. This paper will examine the urban lifestyle and the processing of waste, followed by an analysis of problem-based learning (PBL) experiments in elementary schools in various cities. The analysis will be supplemented with a questionnaire distributed to the students before and after the PBL trial. The article aims to offer an alternative educational environment that will evoke maximum learning results. It has been prepared using cross-tabulation research methods for three groups: The first group is comprised of students and teachers who have studied environmental education using the PBL method and through workshop activities. The second group comprises teachers who have studied environmental education using workshop activities. The third group includes teachers and students who have studied environmental education without the PBL model or workshop activities. Using cross-tabulation, show that the proportion of respondents increased after implementation compared to before is hand both Groups A and B. Group C does not show much change after implementation. From this study, authors conclude that groups using the PBL learning model with workshops showed significant changes in knowledge aspects.

Keywords: attitude; behaviour; environmental education; knowledge; problem-based learning.

1. Introduction

Management of the environment is increasingly a direct concern to many communities (Force et al., 2010). In developing new concepts in environmental education, of course, it will involve the use of various strategies that are packaged to be integrated with knowledge, individual environmental behavior, attitudes and values. (Ballantyne & Packer, 2010). In a to face future environmental challenges, and passing on the world to our children, then, the best way to ensure that the planet is better and healthier is to provide the knowledge and leadership skills for young people (Force et al., 2010).

If environmental education is essential, so is effective learning if the case is to produce young people who are environmentally friendly. One method that can be used is PBL ([The Growing Room, n.d.](#)). The PBL model makes students active. With hands-on, activity-based learning, for example, students make walkie-talkie by tying two cups with a string or blowing bubbles from soapy water. The result is happy, motivated students ([Ramadas, 2013](#)).

Environmental education plays an integral role in teaching young people to create healthy awareness and prepare appropriate environments for learning leadership skills to meet future environmental challenges and the development and maintenance of the human mind ([Ramadas, 2013](#)). With environmental education, students learn to balance between the environment and themselves. Environmental education can also complement formal and informal training that increases management skills to solve environmental challenges ([Vasconcelos, 2012](#)).

Collaboration between parents and teachers is important to build the character of the younger generation. Parents and teachers can support and encourage environmentally-friendly attitudes at home and in schools ([Kazemi & Ghoraishi, 2012](#)). Various efforts have been made to improve environmental education. New teaching methods are needed to support successful learning. Today, knowledge is required to create ethical standards capable of maintaining and protecting the environment to enhance the quality of human life. PBL can be an essential tool in environmental education.

This research aims to assess the feasibility of a problem-based primary school learning system in several Indonesian cities and to compare the facets of education before and after the programme 's implementation. This article evaluates the relationships between three elements from the results of the questionnaire: environmental knowledge, perception and actions. The findings of this experiment will help to establish the underlying principles and prospects for positive learning outcomes of the environmental education programme.

Environmental education objectives include environmental learning, environmental learning and environmental learning. The key focus of EE will be on introducing students to the real world in which they live and on the natural and social level, on allowing them to evaluate, assess, and draw inferences on environmental issues and concerns, on improving our understanding of environmental issues, as far as possible. Quality is not measured by the amount of modern teaching and learning tools but by the effectiveness of an instructor in using these resources, in order to motivate their students to develop information, research and implement various skills and adopt positive values and attitudes. ([Bušljeta, 2013](#)).

PBL has been well-established in schools belonging to the Deeper Learning Network. It is a vibrant structure to teach and practice team collaboration. Group work guides team members to help each other understand content and Finish well, tackle complex tasks that build in-depth knowledge of core concepts (McCarthy, n.d.).

The Government of Kitakyushu, in Fukuoka Prefecture, Japan, considers environmental education as a critical part of their curriculum. Therefore, all elementary schools are enrolled in environmental education learning with the PBL method using the *Midori no noto* worksheet. The Education Department of Kitakyushu City distributed a work sheet called "Midori no Noto" to all elementary school students in the Kitakyushu area, to be completed as homework during the summer vacation (Rachman et al., 2015). This study is a trial, assessing the implementation of environmental education with PBL, using the worksheet of Midori no Noto, adapted to the Indonesian condition (Rachman et al., 2015). It seeks to clarify the effectiveness and limits of the current environmental education program and determine its value and potential for improvement.

The success of Kitakyushu in educating people through formal education was inspiring, and the application of this method was then expanded to Indonesia. The successful use of PBL methods in environmental education learning in Indonesia can be an alternative for environmental education learning (Rachman et al., 2015).

Since 2006 the Ministries of Environment and Education have been working together on environmental education under the program Education for Sustainable Development. The Ministries of Environment have been working together on the plan. (Mukani & Sumarsono, 2017). The goal of the Adiwiyata School System is to enable schools to take environmentally friendly behaviour. This also promotes the implementation of policies in the fields of literacy, capacity building and protection of the environment. A test was done in 18 primary schools in six large towns in Indonesia to determine whether the use of the PBL method 'Midori no Noto' can improve students' knowledge, awareness and behaviour.

1.1. Literature

Environmental education is a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment. As a result, individuals develop a deeper understanding of environmental issues and gain the skills to make informed and responsible decisions (EPA, n.d.).

In one study explained that state that learning outdoors is defined as a method of experimental learning through all senses by way of exposure to the natural environment and provides students with more opportunities from which to learn (Louv, 2005). Learning outdoors is an authentic experience for students allowing them the chance to explore and investigate the world from outside the classroom. And according to the results of the study, learning outdoors could have benefits not only to students, but also teachers (Bjorge, Hannah, Rekstad, & Pauly, 2017). The natural world is available and accessible for all to learn from and appreciate.

The application of problem based learning in elementary schools will not be successful without the seriousness of the teacher, the teacher must make careful planning, both instruction, media, and explanations to students (Aldabbus, 2018). In mathematics subjects, the PBL model with a teaching approach makes students more interested in learning mathematics and to encourage students into an active, fun and significant learning process (Silva, Correia, De Almeida, & Monteiro, 2019). Problem based learning was born around 1980, developed in various places with various disciplinary differences (Savin-Baden, 2020). Traditional PBL approaches can be, however, very resource and time intensive, and often require one facilitator (a member of staff) for every group of 8-12 students (Ichinpei et al., 2016). Embedding and extending sustainability literacy within curricula through PBL thus presents considerable practical challenges, particularly at a time of competing.

Vasconcelos (2012) state that if our chosen aim in science education is to be inclusive and to improve students' learning achievements, then authors must identify teaching methodologies that are appropriate for teaching and learning specific knowledge. Project-based learning (PBL) is an active student-centered form of instruction which is characterized by students' autonomy, constructive investigations, goal-setting, collaboration, communication and reflection within real-world practices (Kokotsaki et al., 2016). In his study of 39 participants in his 'Environmental Education' course, Genc (2015), applied the PBL approach. He monitored their environmental changes when designing initiatives on environmental issues.

Teachers, in particular, see different types of pedagogical play, such as open-ended play, modeled play, and purposefully-framed play, as providing opportunities for young children and teachers to develop knowledge through experiences about environmental education in early childhood settings (Cutter-Mackenzie & Edwards, 2013). It is are equally important for educators to achieve this goal. Student autonomy in issue investigations and action planning should supplant coercive advocacy programs if a new generation of critical thinkers is to solve

new environmental problems and maintain or improve environmental quality on both local and global scales (Short, 2009).

Environmental project-based learning (E-PBL) offers opportunities for students to actively explore and address environmental challenges while building skills in teamwork and communication, research, data collection and analysis, community engagement, and reflection (NEEF, n.d.). Problem-based learning emphasizes group collaboration to solve real-world case scenarios (National Library of Medicine, n.d.). Using Problem-Based Learning for Occupational and Environmental Health Nursing Education (Ivicek et al., 2011). Findings of the study revealed that problem-based learning positively affects the teaching of mathematics and improves students' understanding of and ability to use concepts in real life (Padmavathy & Mareesh, 2013).

Through project-based learning, learners work within a team, and achieve the skills to plan, organize, and negotiate (Indrawan et al., 2018). PBL is a great structure for students to practice collaboration within teams. Done well, group work guides team members to help each other understand the content and tackle complex tasks that build deep knowledge of core concepts (McCarthy, n.d.).

By employing a method of learning assisted by multimedia, students are expected to be able to think to solve problems. The multimedia in question is Storytelling Cards. For Gingo Games, students use lawn and garden media to find and use simple tools for water filtration experiments, improve their cleanliness, and so on.

2. Methods

2.1. PBL Trial Procedure

The actions and flows of each process should be included in the groups. As shown in Figure 1, the PBL course is divided into five sections. Each teacher needs to be clarified by the PBL. The PBL Cycle affects primary school pupils' environmental education: in this case, this operation focuses on waste (Figure 1).

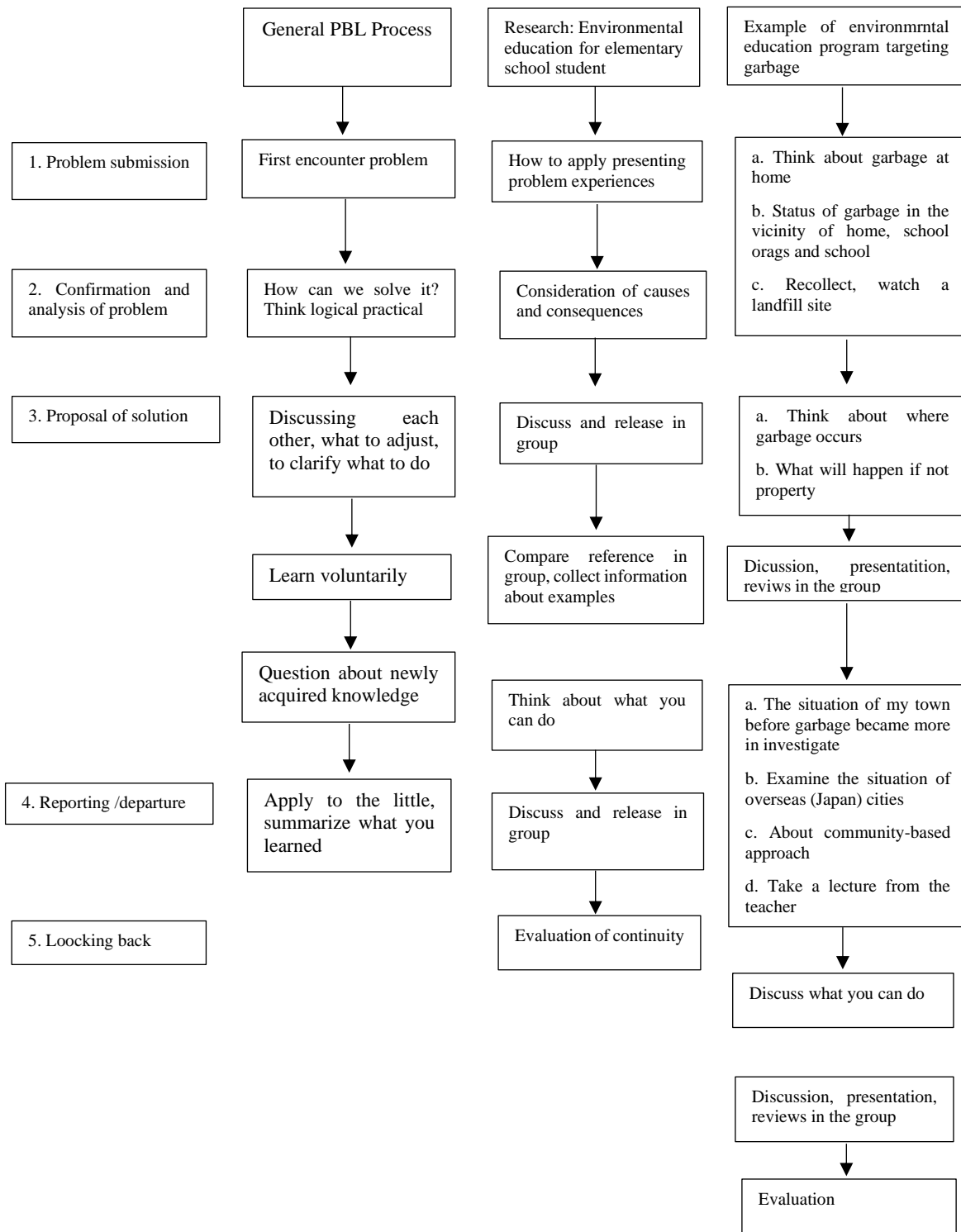


Figure 1. Class flow in PBL

Source: Authors (2019)

The first question is: what are the students' garbage experiences?

- a. Stage 1: Think of waste at home, near home and on the highways, as well as at school.
Collection: watch the location of the dump;

- b. Stage 2: The question is verified and evaluated. When are we going to overcome this? Speak of the causes and effects of waste objectively and practically. Talk of where the waste occurs, where it goes and what occurs if it's not treated properly. The three stages are routinely discussed by individuals and communities;
- c. Stage 3: The task of teachers is to advance each student and each community so that these activities can be performed smoothly and proactively.;
- d. Stage 4: Summarize, discuss and release a group announcement;
- e. Stage 5: The complete class selection analysis and assessment (Force et al., 2010). Period in this trial was used as worksheets and teachers' manuals versions of the “*catatan lingkunganku*.” This book is adapted for conditions in Indonesia from "Midori no Noo" method in Kitakyushu.

2.2. Trial and Verification Method of the Environmental Education Program

2.2.1. Survey Summary research area

The surveyed cities were Bandung area:167.3 km², total population: 2,490,622 (BPS Kota Bandung, 2020); Malang area: 252.1 km², total population: 850,000 (BPS Kota Malang, 2019), and Batu area: 202,3 km², total population: 258,000 (BPS Kota Batu, 2018). Since November 2015 to June 2016, in the primary schools in each city authors have introduced the environmental awareness programme. This impact was tested before and after the test via a questionnaire survey. before the trial the worksheet *catatan Lingkungan ku* in October 2015, the questionnaire was carried out and the questionnaire after implementation took place in August 2016.

2.2.2. Classification Research Method of the Comparison Target Group A, B and C

Collaborate with the Education Department in each city to choose which schools can be used as pilot projects, considering school conditions, achievements and school activities. Then select schools at the same level and separate them into three big groups in every city. The article chose Grades 4 and 5 to take part in this trial and discussed with the principal to determine class and with class teachers.

This article conducted a workshop (WS) on teacher strategies and environmental education for children in October 2015, using the supplementary readings that are given by us as shown in Figure 2, in the run-up to Implementation of the Environmental Education Program.

Also, initiated the environmental education system to clarify the effectiveness of WS for teachers and children and grouped the schools in each city into three groups: Group A – 157 individuals; Group B – 111 individuals. Elementary school classification examined in each area. Figure 2 demonstrates the flow of the inquiry process for Groups A, B and C. Workshops for groups A and B were held after the decision of School and Class and the distribution of the questionnaire free of charge to all students. Group A has carried out a WS of teaching and environmental education methods for teachers. Six months and two hours per week, they then introduced the software. Group B held the WS only for teachers and later, two hours a week, implemented the program for six months. None of the WS had been conducted by Group C. You only have the program implemented.

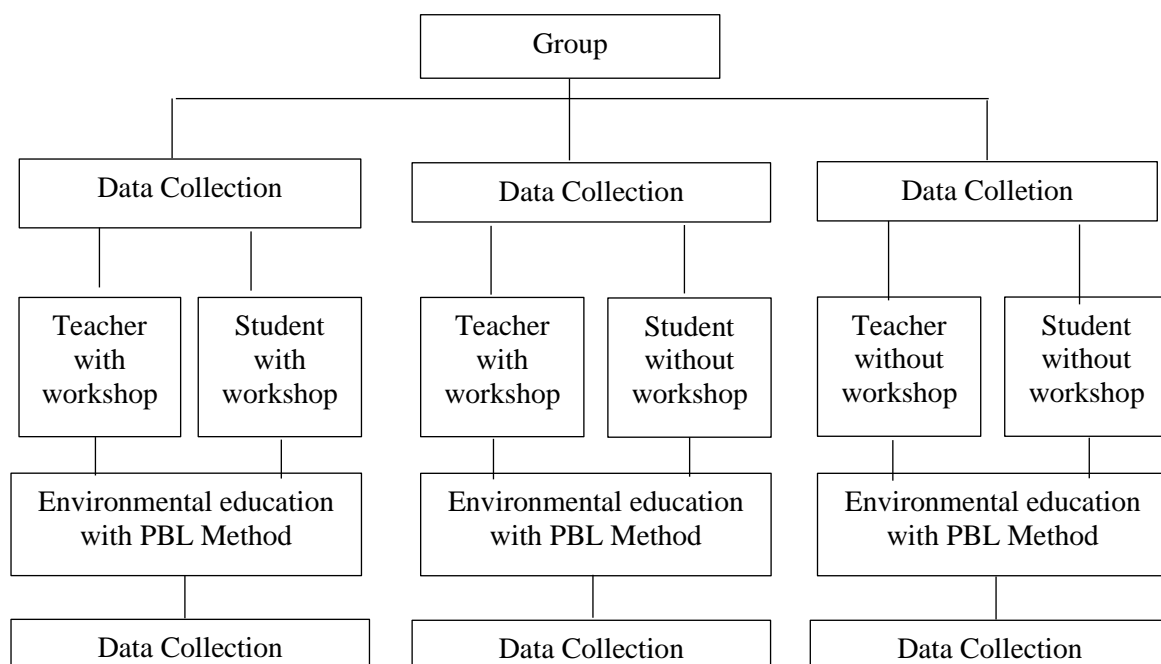


Figure 2. Flow of survey for research method in Groups A, B, and C

Source: Authors (2019)

Groups A and B teachers could communicate directly with us if there were parts of the material they did not understand. Authors answered almost all questions and difficulties encountered in the class. Finally, a post test was carried out after all projects had ended. Then the data was calculated using Cross-tabulation, Wilcoxon Rank Sum Test, and Relevance of Questions.

2.3. Research Results Data

Questionnaires were prepared around three items: environmental knowledge, awareness, and behaviour. There were 25 questions on knowledge showed in Table 1, 17 on awareness showed in Table 2, and 15 on behaviour showed in Table 3. The options for each question on knowledge were: (1) Correct, (2) Wrong, and (3) Do not know. The options for questions on awareness were: (1) I think so, (2) I agree a little, (3) Neither, (4) I do not think so, and (5) I do not think so at all. Finally, the contents of questions on behaviour/action. The alternatives for each question on behaviour/action were: (1) Yes, (2) No, and (3) Sometimes.

Table 1. Questionnaires Environmental Knowledge,

No	Knowledge Questionnaire
1	Right now, we are all facing serious environmental damage problems
2	In many forests in Indonesia there is a lot of ecosystem damage
3	Due to environmental damage, many natural disasters have occurred
4	We know the types of waste, namely organic and inorganic waste
5	Inorganic waste takes a long time to decompose
6	One of the industrial raw materials can come from plastic, metal and paper waste
7	Organic waste that can cause unpleasant doors, comes from leftover food and vegetables
8	The composting process requires a closed basket and processes for 1-2 weeks
9	Handicrafts, such as bags, pencil cases and tablecloths can be made from inorganic waste
10	Our role Reducing waste means reducing the amount of waste we generate
11	Finding new ways to use waste means we can reuse it
12	Using waste to re-create new items that can be used or resold means recycling
13	The existence of Water is the primary requirement of all living organisms
14	Water pollution by substances, energy, or other waste components that causes water quality to decline
15	Wastewater is discharged by waste from toilets, dishwashing water and dishwashers
16	We recommend that wastewater should not be discharged directly into the river
17	Household wastewater from the kitchen, used for washing dishes, mopping, washing clothes can be thrown into the backyard
18	Preferably, domestic wastewater must be treated before being discharged into rivers

No	Knowledge Questionnaire
19	Causing an imbalanced river or lake ecosystem is a characteristic of water pollution
20	The amount of garbage in the river body is the main factor causing flooding
21	The existence of organic and inorganic waste that is disposed of carelessly is one of the causes of river pollution
22	Water quality monitoring efforts can be done by looking at the physical, chemical and biological conditions of the water
23	One of the benefits of water is that it can be used for irrigation and hydroelectric power (PLTA)
24	Benthic macroinvertebrates are useful for monitoring water quality
25	If there is a change in odor and color in the water quality, this indicates that the water quality has decreased

Source: Authors (2019)

Table 2. Questionnaires Environmental Awareness

No	Awareness Question
1	Environmental damaged make me deeply concern
2	I don't want to do separation of organic waste and inorganic waste
3	I don't like if someone straw garbage at my yard and in my neighbourhood
4	I am disposing organic waste everywhere
5	Learning how to make compost is interested
6	learning how to plant flowers using compost is not interest
7	I think separated the waste sorting willing to start
8	I will to buy my daily needs in refill packages
9	I will spend my time for making bags out of rags or unused fabric
10	I will tell my parents and friends to become to be member waste bank members
11	In water use, I am very frugal
12	To save the rivers is not my responsibility
13	I am really interested in learning how to treat wastewater so that it will not pollute rivers
14	It is my habit to disposing wastewater to my backyard
15	Thinking about how to save rivers
16	For disposing waste to rivers and the surroundings is not my responsibility

No	Awareness Question
17	monitor rivers in my neighbourhood is not necessary

Source: Authors (2019)

Table 3. Questionnaires Environmental Behaviour

No	Behaviour Question
1	Make the clean for my neighbourhood clean
2	I not wasting paper as my contribution to forest preservation
3	I separation of organic and inorganic waste
4	I am cleaning my yards every time
5	I can make compost organic from my organic waste
6	Used bottles as the media for plant flowers and using the compost
7	To be a member of a waste bank in my neighbourhood is my willing
8	If I am gone to stores or supermarket, I am always bringing my own shopping bag
9	For everyday activity, I use Recycled products
10	If I hve time, I always take part in environment-related activities
11	I didn't use water unwisely
12	I'm trying to protect the river
13	I never dispose wastewater to my backyard, to keep my neighbourhood clean
14	I will not cause damage to the river ecosystem balance; I never dispose waste to rivers so that
15	The impact of wastewater disposal to our lives, I often observe rivers to see

Source: Authors (2019)

2.4. Analysis Research Method and Verification of Results

2.4.1. Cross-tabulation

A cross-tabulation with Groups A, B and C was carried out with the results of the questionnaire survey to make a comparison between knowledge and awareness prior to and after the environmental education program test. The effect of crosstabulation on question 13 of "knowledge," arranged in columns, for instance, is shown in Figure 4. Typically, the x2 test is an awareness item, "I am interested in learning how the wastewater is filtered to not pollute the river." Both Groups A and B indicate that, compared to before implementation, the percentage of those responded with "I think so" after implementation increased. In fact, the improvement after implementation can be seen in greater detail if the statement "I agree a little" is used.

However, after implementation, Group C shows no improvement. Also, this article carried out this cross-table on all questions and checked if the Wilcoxon rank sum test indicated a substantial difference between A, B and C.

3. RESULTS AND DISCUSSIONS

3.1.1. Wilcoxon Rank Sum Test

Firstly, division tables were established in which the level of satisfaction for the right column (the categories used for the testing of the contingency table) were ordered to be higher. The χ^2 test that ignored order knowledge, was, nevertheless, not true in the case of partitioned tables with ordered categories. In these cases, the Rank Sum test of Wilcoxon was successful.

The Wilcoxon Rank Sum Test was used to make comparisons between Groups A, B and C. The higher number (***) refers to the tests, which show that questions with major variations have been given the most important difference between colours.

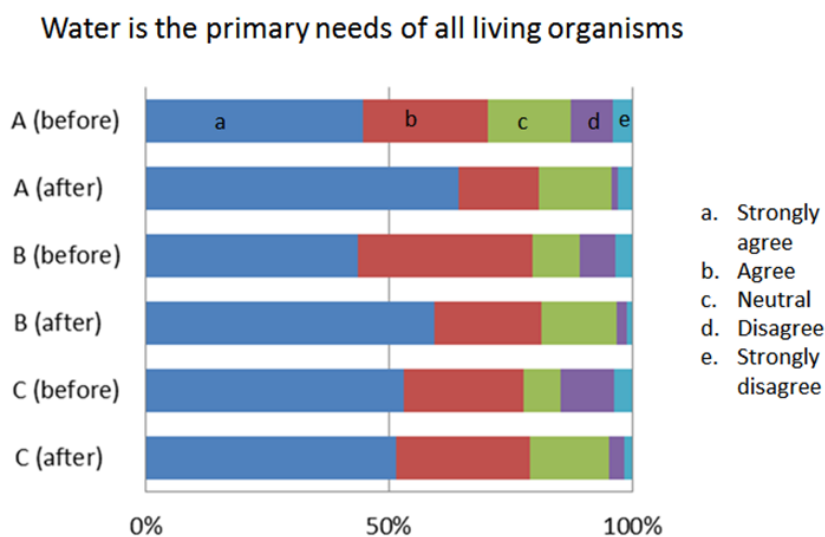


Figure 3. Cross-tabulation result of Q13 of the item “awareness”

Source: Authors (2019)

First, the results of intergroup comparisons between results for the item “knowledge” are shown in Table 4, The results of the distribution of questionnaires, the knowledge section is written in Table 4. that group A. for questions no 4,5,7,10,15,16,17 has a significant increase in value marked by (***) , while in group B. questions on no 1,4 , 8,10,14,20,22,24 which have a significant value. while in group C. there was question no.4, 6, 7, 13, 18 marked by (***) , namely the group that did not attend the workshop had less increase in value. In the knowledge

part, there were significant differences between questions related to garbage reduction, drainage methods, and the nature of water. Next, show in Table 5. but in Table 5. which is a measure of awareness, group C has a high value of increase, namely in question no 4,6,7,9,10,12,14,17 marked by (***) , while group B is in question no.6,7, 8,10,11,13,14,16. while in group A only 3,11,13,16 marked by (***) that means the number of questionnaire have significant result.

There were important variations between the questions of waste separation, water management and drainage methods among other questions in "information." The findings were intergroup comparisons between results for the item "information." Table 6, eventually. This is the outcome of intergroup comparisons with respect to comportement. In comportement, significant differences between waste separation, waste utilization and the drainage method were found. In this context, intergroup comparisons were found.

Table 4. Research results of inter- group comparisons in for the item of Knowledge

Number of Questionner	All City Group A	All City group B	All City Group C
1		***	
4	***	***	***
5	***		
6			***
7	***		***
8		***	
10	***	***	
11		***	
13			***
14		***	
15	***		
16	***		
17	***		
18			***
20		***	
22		***	

Number of Questionner	All City Group A	All City group B	All City Group C
24		***	

Source: Authors (2019)

Table 5. Research Results of inter- group comparisons in for the item of Awareness

Number of Questionner	All City Group A	All City group B	All City Group C
3	***		
4			***
6		***	***
7		***	***
8		***	
9			***
10		***	***
11	***	***	
12			***
13	***	***	
14		***	***
16	***	***	
17			***

Source: Authors (2019)

Table 6. Research Results of inter- group comparisons in for the item of Behaviour

Number of Questionner	All City Group A	All City group B	All City Group C
1			***
2	***	***	***
4		***	
5	***		
7		***	***
8			***
12	***		

Number of Questionner	All City Group A	All City group B	All City Group C
13	***		
15		***	

Source: Authors (2019)

3.4.3. Relevance of Question

For Figure 4, colors have been used. The questions that displayed major variations were of importance to the test, and bold lines indicated specific questions. Therefore, intelligence, perception, and actions were the following questions. The results showed that related questions are very high, as in Question No 5 on information. Concerning consciousness # 2 and behavior # 3. This means that intelligence, consciousness and actions have a relationship of response.

3.4.4. Description Analysis

Depending on the three different types of objects, this work had different answers. There were three alternatives to the "Information" questionnaire: A: yes, b: no, and c: do not know. The response pattern had five choices for the "conscient query": A: Strongly Compromise, B: Accept, C: Don't Know, D: Disagreement, and E: Strongly Dispute.

This study used chi square test cross-tabulation, where the hypothesis was H0: no differential / no effect. H1: Differences / influences are present. Chi-square count > chi-table is accepted according to criteria; then H1 is accepted. H0 will be approved if chi-square < chi-table calculates. The lambda value = 0.05 (means value) is then compared. If the requirement value – meaning value (P-value) > 0.05 – H0 is accepted, H1 is accepted when the criterion value – meaning value (P-value) < 0.05 – is decided. In this table, the sign (***) indicates that the value reached means that the workshop influences student changes, while the mark (-) indicates that this value does not affect student changes.

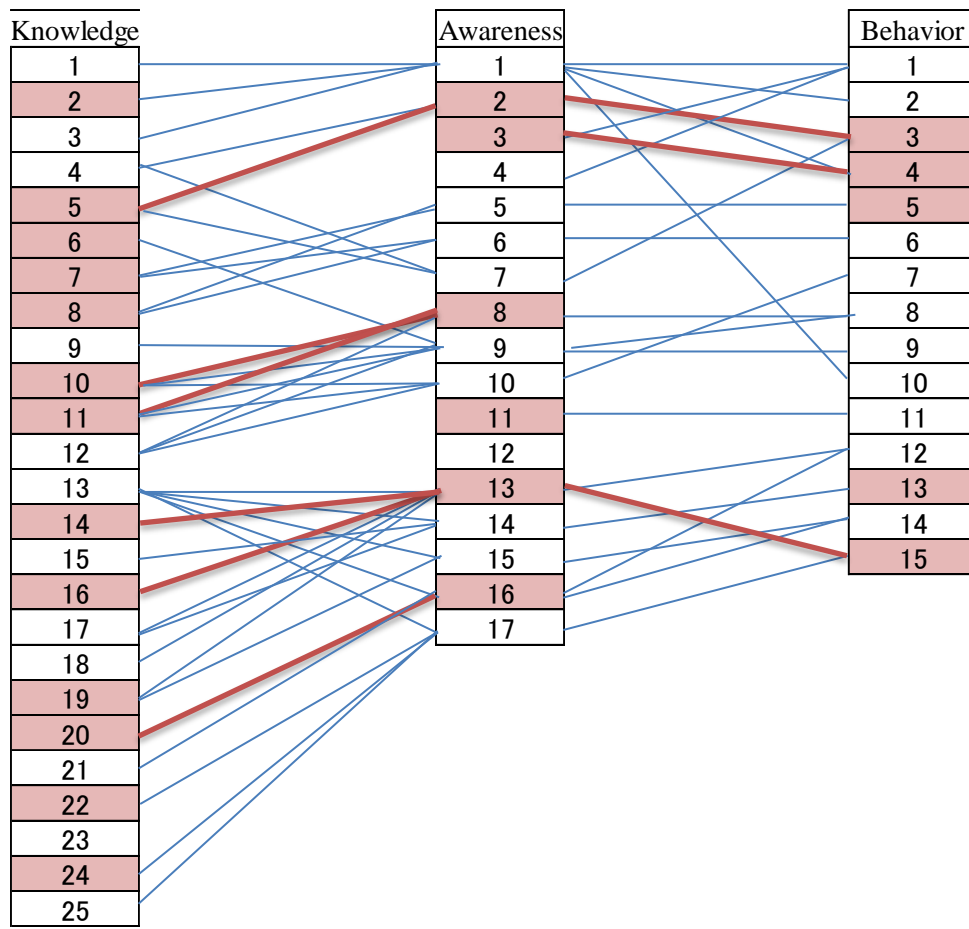


Figure 4. Relevance of the questionnaire
 Source: Authors (2019)

3.4.5. Wilcoxon’s Rank Sum Test in Inter-City Comparison

Group A was comprised of schools where students and teachers attended workshops and learned according to the methods given. The teacher followed this PBL method for one semester, with the material in accordance with the applicable environmental curriculum. From the calculation results, Group A from All-Cities showed a significant change after learning. In interviews with teachers from Group A of All-Cities, it was verified that they had followed the teaching steps they’d received during the workshop. With regard to Group A, Question #2 on garbage sorting and Question #9 in Malang city do not show significant changes after learning, which meant that the results showed no significant declining H1 values. In terms of behavior, Group A, and Questions 2 and 3 indicated that there was no significant change after learning. Regarding Group A, Malang City - Q2 showed 0.0587079, meaning that H1 was not accepted because it was smaller than 0.05. Q9 had a value of 0.397, i.e. no change. Regarding knowledge of Group C, there was almost no difference between the cities of Bandung, Malang, and Batu. On questions 5 and 18, the city of Bandung presented no differences or changes after the

workshop compared to before. In Awareness of Group C, Bandung City and Batu City have nearly the same results in Q2, Q4, Q6, Q9, Q10, Q12, Q14, and Q17. However, Group C of Malang city presented change.

Results of intergroup comparisons regarding the item Knowledge showed a lack of results in Q5 about wastewater and questions about air pollution, while results in the All-Cities Groups A and B showed an increase. For the item Awareness, the C group in Bandung showed no increase, nor did the results of intergroup comparisons for the item Behavior.

It is because environmental education is a subject in the local curriculum for the municipal government of Malang. In terms of information, Group A was insignificantly modified for Bandung City, Malang City and Batu City with a **** ranking. Group B experience had separate outcomes for cities of Malang and Bandung. Part of Group A displayed major shifts in consciousness in Bandung and Batu Region. Groups B and C showed a significant shift in perception in the city of Malang. Group A showed a little change and group C showed nearly no change in Batu City. The most significant improvements were seen in Malang Groups A, B and C. The city government has endorsed the environmental education system very strongly from the study of interviews with teachers in Malang City. Furthermore, it was proclaimed Green Education City by Green School and the Adiwiyata programs.

The city administration of Malang and local businesses and Bravijaya Universities have developed a project to be an Adiwiyata School for all schools in the city of Malang with 100% environmental education as a theme. The findings of the Bandung for Group C tests, consisting of teachers and students who were neither participants in or studied the PBL approach, nor used the Midori no Noto "My Environmental Notebook," showed no answers for awareness questions for Q5 and Q18. Q5: The mean value was 0,548, while its value is greater than $>0,05$; Q18: 'Domestic wastewater must be prepared before the disposal of water,' which was 0,0894445. Q5: 'Inorganic waste is long of time for decomposition.' Which indicated that the theory was neither approved nor modified after six months of learning environmentally. Therefore, in future environmental education, it would be important to learn about food waste and household water waste.

For the awareness questionnaire, Group C in Bandung City and Batu City presents almost the same results, that is, insignificant changes in the following questions. Each question has results of less than 0.05, indicating that H_0 was accepted. This means that, regarding this theme, no changes were verified after six months of learning activities. Thus, it is necessary to learn about waste and wastewater by using the "My Environmental Notebook." Similarly, Behavior

in Group C of Bandung and Batu Cities shows no change for six-month period of learning activities. Test results in Malang City, for groups A, B and C, showed almost no differences in results, knowledge, behavior and awareness. Notably, Group C was a group where the teachers and students didn't follow the introduction learning method or use the materials workshop introduction. Malang City's Groups A, B, and C presented almost no differences in their results. Group C, which had teachers and students and did not get any treatment, showed different results.

Almost all schools located in the area of Malang City have been on the Adiwiyata school program. The concept of Green School and Adiwiyata programs compels all schools in Malang city to provide environmental education textbooks (Malang Green School program).

Malang is the city with the highest amount of Adiwiyata schools (Handbook Adiwiyata). The Malang city government, in cooperation with Brawijaya University, implemented the Green School and Adiwiyata school projects, and developed learning media related to environmental education. The seriousness of Malang city government in building an environmentally friendly city is shown by the many schools that focus on environment education activities. The education department also works with several large corporate social responsibility (CSR) events for periodic environmental education, book-making packages (e.g. Malang's Green School program handbook), worksheets, and training for teachers, such as the "Catatan LingkunganKu," Indonesian "Environmental Conservation Notes."

Environmental education (EE) gives teachers an essential opportunity to develop their expertise in environmental education. It's included in Bandung 's local curriculum. The Education Department recommends that all schools be run, but each school leaves the decision. The principal has the right to determine whether an EE is to be retained. Nearly all Bandung teachers teach EE by science, sport and/or religion to their students in classrooms. Notwithstanding a local content lesson, the Education Department of Malang says EE is needed. All schools in Malang therefore need to have a subject of EE instruction. EE activities with all staff, teachers, students and parents must be carried out. Parents contribute to the maintenance of the school park and the production of organic compost. Batu City is a tourist environmentally friendly destination with EE learning topics offered in all schools. Teachers in Batu City have enrolled in the EE teaching and training program. The goal of Batu City is to have an Adiwiyata School and a Green School in every School. All the schools will be Adiwiyata schools highly recommended by the local government.

3.4.6. Comparison between Groups

There are several significant differences between the before and after responses to the workshop program. Groups A and B increased their "knowledge items," which meant that their students had memorized and understood the issues raised in the environmental education programs and were able to utilize additional teaching materials. In particular, there were even greater differences with questions related to waste and drainage. These questions seem to be closely related to their daily lives, and additional teaching materials are effective with them. Yet, the same A, B, and C groups in groups showed little improvement with regard to "awareness" and "behavior." However, the difference between awareness and behavior is relatively significant, as in waste. Sorting methods, water savings, drainage screening learning methods, and not draining in the home area. The related in terms of knowledge, awareness, and behavior. Similar to "knowledge" items, these questions are closely related to the awareness and behavioral items considered to be effective.

3.4.7. Comparisons between Cities

Batu City's greater awareness was the difference in importance. In Batu Town, tourism is a big industry. The mayor compels schools to educate the public to preserve an atmosphere that is suitable for sightseeing. Many steps have been placed in place to promote the provision of environmental education by teachers, such as through teacher pay. Nevertheless, the gap between waste problems in Bandung City and water-related concerns in Malang City was fairly small. Since Bandung City is a city of industry and Malang City an agricultural city, the degree of understanding is believed to have been deepened by studying each city 's unique class characteristics which represent awareness and behavior. A cross-tabulation was conducted by grouping schools into Groups A, B and C to evaluate conditions before and after the environmental education system evaluations, using the results of the survey survey questionnaire.

The analysis is being carried out for Groups A and B where improvements can be more clearly observed, especially in Group A, where positive responses have-nonetheless, after the completion of the program, Group C did not change much. The Wilcoxon Rank Sum Test was used to compare classes A, B and C. In the item 'knowledge,' the issues relating to garbage reduction, drainage procedures and the nature of water were significantly different. The understanding of problems such as waste isolation, water conservation and irrigation strategies was substantially different. In questions like trash separation and drainage methods, significant

differences were found in the behavior item. In addition, information, understanding and comportemental significance were found for questions concerning waste separation and reduction, wastewater contamination, and waste. In addition, several specific questions were listed. and reduction, wastewater contamination, and waste.

Although workshops were conducted for teaching and students in Group A, the sensitivities and behaviors of Group B and C were not significantly different. Thus, based on survey results, authors made intercity comparisons only for Group A for Bandung City, Malang City and Batu City. Wilcoxon 's ranking amount test was also used as research method. Bandung City and Malang City posed significant differences in the topic of information, but almost all problems were subject to substantial differences in Batu City. Bandung City showed a major difference in waste-related issues, while Malang City presented a major difference in water-related issues.

The element "compassion" showed a substantial difference in waste-related issues in Bandung City, and in the water-related issues Malang City was substantially different as well as consciousness items. Not only information, but also the effect on perception and behaviour could be derived in the waste and water market, which was largely focussed on this PBL. The findings show that improvement in information is not affected in consciousness or behaviour. Therefore, the programme, to encourage children to conceptualize ways of improving their environment in future, needs to be improved. Tables 4 highlight similarities and disparities in environmental education learning through teacher interviews about the use of worksheets in Bandung, Malang and Batu.

Authors will compare the outcomes of groups A, B and C by analyzing the effects of the trials. Authors show that the amount of positive learning outcomes is increased by learning from PBL. Environmental education offers students valuable opportunities to deal with real issues that go beyond the walls of the classroom. Authors can see the importance of their classroom studies to our planet's complex environmental challenges, and develop the skills required to solve the problems creatively and to defend themselves effectively.

Teachers in a modern, student-centered educational environment, become multi-role educators able to engage students in the process of gaining knowledge and developing skills independently (Kudryashova et al., 2015). The teacher's position as facilitator is different to conventional methods of teaching and learning is more collaborative (Aitken, 2019). It is critical that the pre-service teachers should be better prepared to provide ES to their potential students so that their application is explicit (Franzen, 2018). If the time required to develop a problem is considered, students will be monitored and assisted throughout the project , students

will be encouraged to be more independent and student success assessments and assessments, it is clear that the role of a teacher is essential for the success of this learning experience. In fact, many teachers believe that PBL needs more work than traditional lectures, but in return it often offers more money (Delisle, 1997). “The teacher plays several roles, including lecturer, facilitator and coach. Moreover, this approach lets students improve their critical thinking skills, analyze and solve complex, real-world problems, work cooperatively in groups, and communicate orally and in written form” (Akçay, 2009).

Table 4. Result of teacher interviews about use of worksheet

Quesionner	A Group	B Group	C Group
This semester, do you use my ward notebook, when teaching class	in Environmental Educatiob learning in class, I use my environmental notebook, as directed. like the use of bingo games. students are very interested	I use bingo games for other subject matter, because the students are very enthusiastic, I also use all the material in my environmental logbook.	teaching environmental education using textbooks commonly used in schools and assisted by science textbooks
After 6 months of attending PBL workshops using the worksheet of "Catatan LINGKUNGANKU"? What teaching method do you use to teach environmental education	Using textbook, Catatan Lingkungan ku, and learning with PBLmodel as instructed in the workshop	Using textbook, Catatan Lingkungan ku, and learning with PBLmodel as instructed in the workshop	learning Environmental education is also done when learning scout. According to the environmental education textbook distributed by the department of education and
after attending the workshop, did you try the PBL learning model with the book	Yes, try to Use PBL as instructed in the workshop	No, just Sometime use the text buku catatan lingkunganku,	N o

Questionner	A Group	B Group	C Group
“My Environmental Notes”?		according the workshop	
How many times use the book "Catatan LINGKUNGANBU" in this semester	Every Environmental education lesson, two hours a week	Every Environmental education lesson, two hours a week	Using textbook environmental education
Is it in accordance with the instructions taught?	Yes, accordance Using "Catatan LINGKUNGANBU" PBL method as instructed in the workshop	Sometime use Catatan lingkungan ku as according to the workshop instruction.	Use of media around the school and Learning is adjusted to the package book
To develop buku catatan lingkunganbu do you have any new ideas	It is good, because every time I use this book for learning activities, there is always significant progress	view from internet	No answers
Worksheet Notes on the book "Catatan LINGKUNGANBU", Do you understand how to use the	The theme of visiting and looking for trees is difficult to understand.	For some material, it is hard to implement	Because I have been using this book for a long time, I really understand how to use the environmental education handbook
Book "Catatan LINGKUNGANBU" with the PBL model is useful to helping environmental	Yes, very useful and makes students more understandable and interested	Useful because, to be add new perception and innovative	No

Questioner	A Group	B Group	C Group
education learning in classroom?			
Do you use it periodically?	Two hours for a week in environmental education subject.	Yes, there is environmental education textbook	No
In your opinion, is there any effect in using the book	The students to remember what ever learned. There are many changes to the students,	Almost, there are some that students like bingo games	No
In teaching environmental education, Is the use of the book, did you combine with other books?	Yes, Combined with a package book, science education from the education dept	Yes, Combined with a package book, science education from the department of education	Just environmental education textbook from school and department of education
When teaching environmental education If you do not understand the learning materials, what do you do?	Discuss with fellow teachers and ask lecturers at the university. Search for answers on the internet	ask teachers at school, ask friends and search on google via the internet	ask teachers at school, ask friends and search on google via the internet or give assignments to students
For material, do you think worksheet at "Catatan Lingkunganku" should be improved?	No improvement, it is perfect, just how to teach it should be told again	Nothing	

Questionner	A Group	B Group	C Group
After you use this book, do you think the book “My Environmental Notes” can be a medium in improving the environmental education process?	yes, I think this is very useful and can be used as an environmental education book. Many other teachers are also interested	It is very possible, but if the teachers want to use this book, must really understand the instruction and the stages of learning.	Do not know
Should there be training for teachers who want to use this book? in order to understand its usage?	of course, it is needed, other material is also neededIt is expected that there will be workshops with other materials, and other methods.	There is another worksheet material again to be innovative.	Want to follow the workshop to get new knowledge and understand about environmental education learning is more fun

Source: Authors (2019)

The test results demonstrate that learning by using more interesting methods can make students become more active, especially in EE learning. Students will be more interested when they see objects directly. Nature is the main media in the learning environment. By using the PBL method students are invited to think about finding problems and solving problems. It was also found, that learning with PBL was not learning to remember but was instead an invitation to think and analyze. The role of the teacher as a guide, monitors students' thinking patterns. So, this learning becomes more interesting. Moreover, more activities are carried out outside the classroom. The results of schools that use traditional learning patterns of listening and remembering produce progress in learning outcomes, but not as high as the results of using PBL.

4. Conclusion

The importance of interactions outside emphasizes that informal and formal teachers need to collaborate. The Environmental Education Assessment assesses the training and organizational impact of the program.

Increased public awareness is strongly supported by environmental education, especially at the school level. Providing environmental education from the early school years is a way to change students' awareness so they love the environment, develop environmentally friendly thinking, and do the best for the environment. Effective environmental education to raise public awareness is possible through the application of the Problem-Based Learning (PBL) method, which enables environmental education by teaching students how to find and solve problems. The trial implementation of the PBL method in three cities, i.e., Bandung, Malang, and Batu, where were presented significant changes after using the PBL method, has proven this result. From the interview results show the teacher's role is also very decisive. The teacher tries to apply the PBL learning model taught in the workshop and uses subtext books. With new learning and making more students become like the lesson, the issue becomes very significant. This research proves that schools that use the PBL method and PLH textbooks have found significant change results and found the value of learning to be increased.

Acknowledgement

I would like to thank the education department in Malang, Batu City and Bandung who have given permission for our team to test the use of sub textbooks. Thank you for all elementary school in Malang city: SDN. Polean 5, SDN 7 Malang, SDN 5 Malang. Bandung city: SD Negeri 7 Dayeuh Kolot, SD Negeri 05 Dayeuh Kolot 05, SD Negeri 14 Dayeuh Kolot and Batu city: SD Pendem 1, SD N Torongrejo, and SD N Telekung. Also, to all school principals from elementary schools who encouraged teachers and students during the trials, not forgetting also, our team is very grateful to all the teachers involved in this study.

Author Contribution

Indriyani Rachman gave an idea to carry out PBL learning trials in Indonesia, then discuss with Prof. Toru Matsumoto, then found things that can be researched, then discuss to make research. The workshop and questionnaire were conducted by Indriyani Rachman, Toru Matsumoto, Sugimaru. Data input and calculation were done by Indri and Sugimaru, then reported to Matsumoto Toru and discussed. Prof, Matsumoto provides direction and improvement. Then Indri and Sugimaru made a journal draft and consulted and discussed the results, made a journal paper then reported to Prof. Matsumoto.

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