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Case Study: Future Home Design Project for Developing Pro-Environmental Attitudes

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abstract

The results of the learning evaluation indicate that many students do not apply to pro-environmental attitudes. This case study research investigated the potential of making future home designs to develop a pro-environmental attitude. The study was conducted in two stages and involved thirty-five students. In the first stage, the students discussed plants, water, electricity, and garbage at home. The results of the discussion were formulated to be future home designs. In the second stage, the students designed future homes. The results show that the students can implement their ideas into 2-dimensional (2D). The results indicate that most of the students can implement their ideas as much as 86%. The students enthusiastically participated in the learning process. The results show that all students have plants, 11% use Light Emitting Diode (LED), 6% use solar lighting, 71% use proper water sanitation, 54% apply waste management, and 81% have bio pores. It can be concluded that future home design project has the potential to develop a pro-environment attitude.

1. Introduction

In recent years, there has been a rapid growth of property business, as indicated by the increasing number of real estates (Maoludyo & Aprianingsih, 2015). The growth also has an impact on Semarang, the capital city of Central Java. Based on the 2010-2030 Regional Spatial Plan, Semarang has two regions that will be developed into education centers (Tembalang) and industrial center (Ngaliyan). The growing number of new houses will decrease the green space in both urban and rural areas (Prihanto, 2015). Urban green space has a significant positive impact on proximate residential properties, especially the price (Mccluskey et al., 2014). There have been no strict regulations, causing the housing growth to be faster, and even tend to be uncontrolled (Monkkonen, 2013). Housing in Semarang becomes narrower, denser, and monotype. Because of that reason, the more expensive the land and the materials for a house, the homemade is (Aryani et al., 2015).

For Newly Married couple, having a house is a dream. Therefore, land preparation, design, shape, location, color, layout, plants, air circulation, lighting, raw materials, and water

resources are considered in developing a simple house based on their dreams (Agung et al., 2015). The government seeks various ways to improve housing supply, one of which is the subsidized mortgage policy (Kusuma, 2012).

A dream house is wanted not only by newly married couples but also by teenagers. However, a future house design often does not meet the rules of eco-friendly houses. Some aspects which must be considered include electrical energy usages, lighting sources, materials, water management, land area, heating, cooling, air circulation, and management of waste produced (Vilcekova et al., 2016). A large number of demands for housing will undoubtedly exploit to absorb the surrounding natural resources. Over-consumption of resources hurts the urban environment (Latif et al., 2013). Based on the results of research, the construction sector consumes 40% of global energy, and it causes 30% emissions of the worldwide total of greenhouse gases (Brejnrod et al., 2017). This impacts on the decreasing environmental quality and climate change (Abimaje, & Akingbohungbe, 2013). Therefore, these impacts should be reduced.

The increasing number of houses built should be planned from the beginning to be developed into sustainable dwellings. If a developer does not consider this aspect, it will cause negative impacts. There are fewer water catchment areas (Prihanto, 2015), increasing amounts of organic waste, increased energy use, and increased use of fossil fuel electricity. Those have an impact on increasing CO_2 gas emissions (Iyer-raniga & Dalton, 2017). Therefore, it is necessary to educate the younger generation in designing sustainable houses or eco-friendly houses.

The existence of eco-friendly houses is expected to be able to maintain house function. For example, the availability of water managed waste, and adequate air circulation, adequate oxygen supply, and fertile soil conditions. However, at the moment, housing development is contrary to the efforts to reduce carbon emissions (Iyer-raniga & Dalton, 2017; Song & Ye, 2017; Filippín et al., 2018). It is a challenge for architects to create eco-friendly buildings or sustainable housing (Iyer-raniga & Dalton, 2017; Zhu & Lin, 2004). The problem of sustainable building improvement must be addressed by several institutions: industry, faculty, curriculum, teaching, and architectural associations (Iyer-raniga & Dalton, 2017).

The models developed by architects largely determine the development of eco-friendly home designs. Therefore, it is necessary to provide assistance or education to the community to build eco-friendly buildings. Adults need to educate teenagers, especially students. The

main objective of environmental education is to support a sustainable lifestyle by promoting values that are less needed in everyday life. Besides, teachers face difficult challenges in educating students, especially about social-scientific topics (Castéra et al., 2018).

The university should educate the students. One value of education that can be given about social norms at the university is saving water and energy, and this done by signing the petition of pro-environmental (Liu et al., 2016). University students are one of the young generations who have a strong motivation for having a dream home. So, proper student education teaching them how to design the dream homes should follow pro-environment rules. In this research, the participants were students of the statistical department at Muhammadiyah University Semarang. In introducing environmental science, the students took part in lectures to design eco-friendly homes. In this case, they developed eco-friendly home designs. Therefore, there is a need for activities that can develop their knowledge to make the design of eco-friendly homes independently.

A person's ability to implement a pro-environment attitude must begin with having pro-environmental knowledge. Then, it will foster pro-environment values and ultimately foster a pro-environment attitude (Latif et al., 2013). Besides, the environmental benefits a person receives are shaped by the level of knowledge, perception, and recognition of environmental problems, natural exploration, ecological trust, the emergence of consequences of ecological threats, and empathy. If students have better knowledge about environmental issues, they will better understand the implications of environmental problems for their own lives. Moreover, education has an important role and complex challenges in educating students (Slavoljub et al., 2015).

This research involved several students with the following steps. 1) students prepared for learning by getting an explanation from the lecturer; 2) students discussed the problem in groups with the following topics: a) farmhouse plants, b) waste management c) water treatment d) electricity use, and d) designing houses; 3) students carried out the drawing process based on the results of the discussion at the previous meeting and the input from the lecturer to become the blueprint for making a dream house.

In this research, students are expected to be able to address problems about housing and to find solutions. Based on the results, the quality of a sustainable or eco-friendly housing environment is a core aspect of welfare humans should support (Astuti et al., 2015). Proper planning starts from one person (student), then the community, and eventually grows bigger

in an area. Thus, the students are expected to be the forerunner in managing the housing environment so that they can work together with other citizens to make a pro-environment housing environment massively. Indeed, this also supports the achievement of SDG's goals, which is a healthy and prosperous environment.

The future home design created by the students will be analyzed. The results, made by each student, are expected to develop knowledge or even the values that they will use in making a real home in the future. Besides, it is expected that the discussion on the case of future home design can help instill the values of pro-environment attitudes applied in their small families. Indicator of pro-environment attitudes was using environmental materials, using electricity economically. Besides that, the attitudes include increasing lighting from the sun, using water-wise, minimizing the production of plastic waste, making biopore holes, and producing compost to grow plants in the home environment. Thus, a house with a pro-environment concept can improve the quality of life, provide a healthy environment, and increase social, economic and environmental qualities (Akadiri et al., 2012); it is efficient and comfortable to live in and support the Sustainable Development Goals (SDG's).

2. Method

This research is a case study (Harrison et al., 2017). It was conducted from November 2018 to January 2019, involving 35 students. The research was carried out to develop the students' pro-environment attitude. This research was done through the following stages: 1) the lecturer explained the purpose and series of learning activities; 2) students discussed issues in groups on the following topics: a) farmhouse plants, b) waste management; c) water treatment; d) electricity use, and d) designing houses; 3. the students drew future home designs based on the results of discussions (problems and solutions) to make a design based on the meeting. During the discussion process, the lecturer gave criticism and suggestions to become the blueprint in creating a future home design.

In each meeting, the students discussed and resolved the problem toward an eco-friendly settlement. The discussion materials are presented in Table 1. At the beginning of the student meeting, they were very enthusiastic, especially female students who were more enthusiastic than male students. It shows that they "really" want an ideal home. Here, they still ignored various challenges in the future, such as land prices, material prices, the location of the house, the final condition, and where they will stay. The positive expectations were expressed. The

results of the initial discussion are summarized in Table 1, which shows that they do not understand eco-friendly houses.

Table 1. The topic of student's discussion

Meeting	Topic	Problems for Student	Students' solutions toward Problems
1	Ideal Home	How does your ideal home look alike?	Making design and submit it to the husband or I make it
2	Plant	. Should I add plants to my home? . What kinds of plant? . Why should you plant?	In general, students want their houses to have plants. Students add a plant for aesthetic purposes.
3	Waste	. What is the solution for managing waste in your home? . Do you know the biopore hole?	Two paradigms arise in the minds of students; burning and hiring of garbage officers. At first, there is one student who knew the biopore hole.
4	Water	. What is the source of water in your house? . Where is dirty water dumped? . If bathing is more comfortable using a shower or bathtub?	Their water sources that live in the country side using dug wells, while those in the city use PDAM or bore wells. They flow their water into a ditch or river. Most of them prefer to use the bathtub for more freely.
5	Electricity	. What is the electrical power of your house? . Does each room use AC (Air Conditioner)?	Most of them do not understand electric power, while most air conditioners do not use it
6	Home Design	How does their home design?	Most of them enthusiastically made their home designs based on their wishes. At the beginning of the discussion, the class atmosphere was very crowded because of their enthusiasm to discuss their home plans.

3. Result and Discussion

There have been several studies indicating that students who study in the environmental field. They do not necessarily have a consistent commitment to prioritize pro-environment attitudes, although it is clear that they have more knowledge than other students. Therefore, it is necessary to reflection to improve the method and the curriculum. It will familiarize students with environmental responsibility, not only knowing ecological problems. Education needs to be emphasized on environmental sustainability education because global environmental issues are increasingly complex. Education is the central pillar that can change people's values to care more about the environment (Chuvieco et al., 2018). One of the education programs carried out by educators is providing learning about the environment.

In the learning process, understanding and the implementation of pro-environmental education are influenced by many factors. One example of the applications in pro-environment learning is the culture of consumption. Several values change the culture of use.

A reasonable consumption pattern is a pro-environment consumption environment or a sustainable consumption culture. Benefits such as love, acceptance, universalism, tradition, are strictly related to sustainable consumption behavior (Sharma & Jha, 2017). It is necessary to insert these values into learning on campus. It is because children will change the lifestyle of their parents, as well as on-campus (Nagel & Lemel, 2019). The consumption patterns in our lives do not only include eating and drinking, but they also include houses. Thus, it is necessary to implement a pro-environment attitude, which is building a house, such as a house with wood materials, which is more environmentally friendly and saves energy (Takaguchi et al., 2014).

The development has a significant contribution to environmental damages. So, it is necessary to learn about building a pro-environment or sustainable home. Besides, eco-friendly buildings start from the planning, renovation, and use of recurrent materials to reduce waste during destruction (Akadiri et al., 2012). The surrounding culture indeed immensely influences the application of the pro-environment attitude in building a house. Therefore, to find out the background of the students, there is a data. In general, the characteristics of the case study participants are presented in Table 2.

The condition of their house will affect the mindset of the students (Nagel & Lemel, 2019). Most of the students come from rural areas, and their house mostly comprises permanent walls of sand and cement. In general, rural houses have sufficient land for their homes, on average measuring 160.6 m^2. The house area, according to standards in Denmark, is approximately 52.1 m^2/person (Brejnrod et al., 2017). Compared to houses in urban areas, the houses of students can be categorized as quite large. This condition is different from that in the city. The students were given sustainable housing development, so that, in the future, they will have eco-friendly houses. Eco-friendly buildings in the implementation process include several things: reducing hazardous substances, reducing waste production, using reusable materials, and applying waste management.

Table 2. The Characteristic of Student

Category/characteristics	Total (n = 35)
Male	14%
Female	86%
Home in City	28.1%
Home in Countryside	71.9%

The application of pro-environment values was taught through the education process. One of which is lecturing on campus. To examine the implementation of a pro-environment

attitude at the university, research needs to be conducted. This research aims to identify the benefits of dream house design for developing pro-environment attitudes. The study employed methods of discussing problems and implementing eco-friendly future home design projects. The research was conducted in two stages. First, students examined the topics of discussion: plants, water, electricity, and garbage in their homes.

Figure 1. Students discussing environmental problems

The results of the discussion were formulated to be an eco-friendly house. There are several ways to minimize the impact of housing development on the environment by reducing environmental impacts during construction, reducing energy use, reducing building areas, or using alternative energy such as wind power, solar cells, biofuels or hydropower (Brejnrod et al., 2017; Elias & Khai, 2015) and housing construction, design, use and demolition (Bakar et al., 2011). During the discussion, the students found many problems, such as why there should be plants, how to save electricity, how to dispose of waste water, how to manage sound waste, how to compost organic waste, and how to design a pro-environment house.

Second, the students designed future homes based on the pro-environment attitude. The students implemented their ideas into the future home design in the form of 2-dimensional (2D) images; 86% of the students have designed their houses well. During the learning, the students were enthusiastic about making pro-environment house designs. The performance indicator was: 100% of future homes having plants, and 11% of future homes using Light Emitting Diode (LED) lights. Besides that, 6% of future homes use solar lighting, 71% of households use proper water sanitation, 54% of future homes apply waste management, and 81% of future homes have biopore holes.

At first, they experienced some difficulties in finding the concept of a dream house based on the environment. The discussion in each group was active, and the class atmosphere

crowded. It indicates that they were very enthusiastic in talking about their future dream home; 81.3% of the students stated that learning "future dream homes" was exciting.

Based on the discussion, the students were asked to make a house design according to their preference and measure it in detail. If the size of their house compared to real conditions in Semarang, they draw an average of> 100m^2. Homes with an area of > 100 are said to be large houses. Even though some students live in the village, they still drew > 200m^2. There was one student who created home designs using android software. The results were good, although they were not too complete. However, most of them drew 2D home designs with 2D techniques on a piece of drawing paper. The results of their drawing are presented in Figure 2.

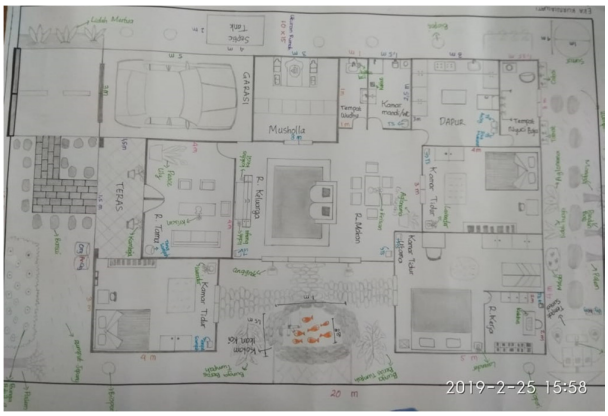

Figure 2. The home design by students

The lecture process produced several things that can be discussed to become learning instilling a pro-environment attitude in building a dream home. The design of the dream house obtained data as follows. Based on 2D image data, the student dream house received views data as present in Figure 4. Based on the drawing, 100% of the students want their home to have a garden, having 80% biopore holes, and having 71% water sanitation. The distance of wells and septic tanks is far enough so that it will make cleaner water sources. However, only 54% of the students understand that a home needs to have a waste processing location and waste management. It shows that 6-11% of the students designed their houses using solar lighting or by using LED lights. The student knowledge is limited that is drawn into 2D images but not yet in reality. So, this will be the starting point for the students to understand the concept of a house with a pro-environment idea or a sustainable home.

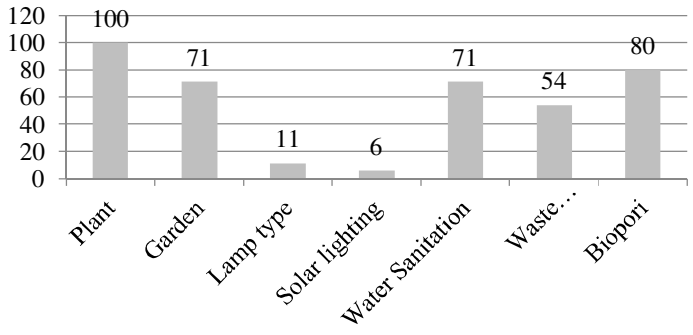

Figure 4. The components of future home design (%)

The discussions generated several solutions:

a. Plant

The characteristics of a pro-environment house include water quality, temperature, visual, and sound in a pleasant building environment (Akadiri et al., 2012). Plants are one way to refresh a room or land (Park & Mattson, 2009). Plants can produce oxygen (O_2), which is inhaled by humans.

Moreover, it will also improve the visual quality of a house. In addition to adding lighting, there is also a gap in the roofless building. It is possible because they also has applied at home. The survey results showed that 71.9% of the students planted crops, and after attending the "future dream house" study, 100% described their house as having plants.

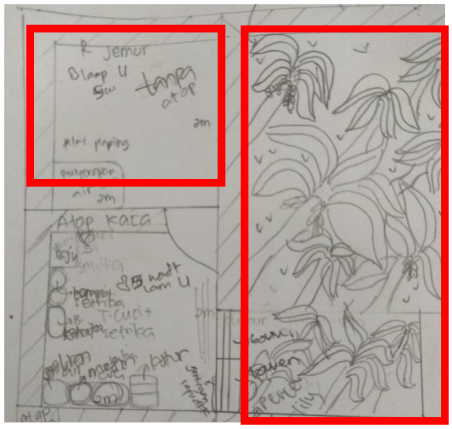

Figure 5. Example of plant mapping by the students

b. Water

One of the environmental attitudes in building a house is being wise in using water or minimizing water use (Akadiri et al., 2012). Reducing does not mean not using water,

but being wise in handling, treating, and disposing of it. One way to use water is by combining the use with ponds, fish, and plants, which is commonly called aquaponics. Aquaponics offers a solution to limited water availability, environmental pollution, and depletion of fertile soil (Yep & Zheng, 2019). The concept of aquaponics is used by students who want a pond in their house.

Moreover, they also drew decoration and facilities for fish farming. In this way, they found how to maintain the quality of water by keeping the waste storage (septic tank) and how to clean water well away. Several parameters such as pH, turbidity, conductivity, total suspended solids (TSS), total dissolved solids (TDS), and heavy metals such as Cu, Zn, Mg, Fe, Cd, Pb, Cr, As, Hg, and Sn are used as indicators of water quality. One way to maintain water quality is by managing wells (Rahmanian et al., 2015).

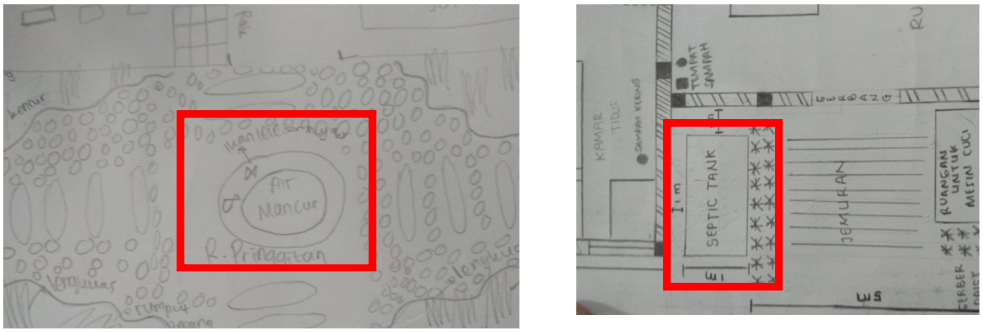

Figure 6. Fish pond and septic tank

c. Electricity,

Electricity is the most common source of energy in Indonesia. LED (light-emitting diodes) lights have high energy efficiency, low maintenance cost, and longevity (Singh et al., 2015). Students decided to use LED lights by marking the location of the lights. However, there are also some students who did not complete the lighting design, or they provided a mass signal "5 watts" or 10 Watts, and so on. LED is one of the innovative lights that save energy and has bright lighting. LEDs reduce 50% of global electricity consumption (Ahemen & Amah, 2014).

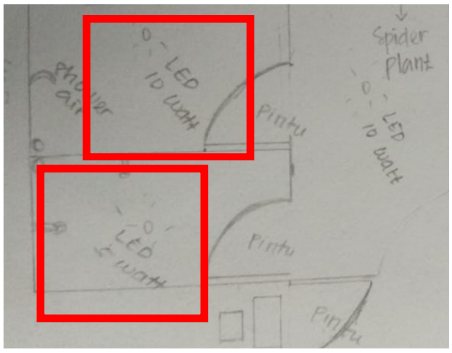

Figure 7. Lighting using LED(Light Emitting Diode)

d. Waste Management

One of the pillars in building eco-friendly homes is the biophysical pillar: waste management (Akadiri et al., 2012). Waste management is essential to create a healthy home. Before they discussed waste management, most of them said that the waste was burned or they hired a garbage man, in which waste disposal was charged ± Rp. 30,000/month. However, after group discussions guided by the lecturer, they discovered the concept of biopore hole holes and waste management.

More than 30% of the students' homes have garbage processing sites. After they followed the lectures, 54% of the students described their dream homes as having waste processing, whereas biopore holes ownership based on the original questioner was only 20%. After attending conferences and designing houses, 80% of the students' homes were described as having biopore hole. The following is one of the students' designs that has biopore infiltration holes.

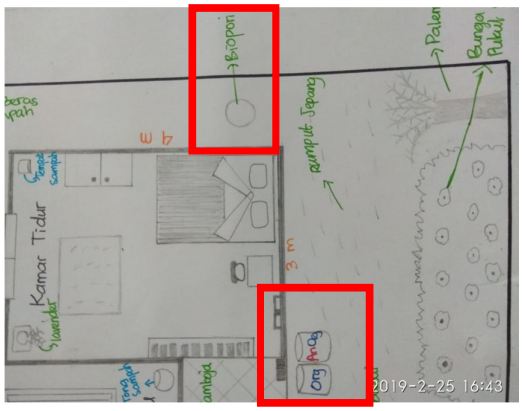

Figure 8. Biopore hole and waste management

Biopore hole has double advantages. Biopore hole absorption holes can help absorb water into the soil, and they can be used as a means of composting on a small scale. The existence of these biopore hole shows that students care about water and garbage. Thus, it is expected that the students can design their dream homes equipped with a biopore hole and routinely compost organic waste.

Students can describe eco-friendly homes or sustainable homes. Some essential components that were described by the students in 2D plans are the use of solar lighting, electrical energy efficiency, water sanitation including wastewater treatment, septic tanks, rarely well-septic tanks, water use, waste management, biopore hole making and greening around housing. After the students' learning process, 85% of the students stated that the learning of future house design was fascinating. So, it can be concluded that future home design education has the potential to increase knowledge. It is expected it will be the value applied in building a real house. Here are some students' testimonials at the time of learning

> *"Fun, exciting if you discuss the future. It grows the spirit of Introduction to Environmental Sciences course."*

Based on the student's responses, discussing the future was enjoyable. In this study, the students examined the future house so that the students were very enthusiastic. Observations also support this, and the atmosphere of the discussion was perfect.

> *"The exciting thing was when I was told to make a dream house; I had not thought of making a house because the plan to settle down still extended. moreover, because this assignment knows more about a good home and how to manage a right home and home environment."*

The students said that they had never been thought about house design before getting this course. Through this course, the students know obtained knowledge about the design of a house that considers the environment. It is a positive response that supports the usefulness of this course.

> *"When the design of the house continues to prayed."*

The students were required to make future home design. The design results had been discussed and consulted; they finally prayed together. This phenomenon shows that students were earnest in making future home design ideas. Overall, the method of learning through future home design attracts students to learning environmentally friendly homes.

4. Conclusion

Eighty-six percent of students can implement the idea of a dream home into a good 2-dimensional (2D) future home design. During the learning, the students were enthusiastic about making eco-friendly home designs. The indicators were 100% of future homes having plants; 11% of future home designs use Light Emitting Diode (LED) lights, but 6% of future homes use solar lighting. Besides that, 71% of future homes using proper water sanitation, 54% of future homes apply waste management, and 81% of future homes have biopore holes. It shows that the students understand the concept of environment in the essential aspects of plants, water, electricity, lighting, garbage, and biopore hole. It can be concluded that the introduction of environmental science using future home design has the potential to develop a pro-environment attitude among students.

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