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Research Paper

Students' Perception towards Green Building Practices

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Abstract
Green building practice has been gaining its popularity nowadays due to its significant benefits in protecting environment from threat caused by construction activities. It appears that there is a poor perception among construction players about green building in Indonesia. The students also play an important role in the development of construction especially green building in the future. This study aims to analyze the students' perceptions of civil engineering and architecture students of University of Sriwijaya towards green building practices. The questionnaires were used for data collection which covered the basic understandings, criteria, benefits, and challenges of green building. There were about 240 respondents consisting of 153 from civil engineering and 87 respondents from architecture. The validity and reliability tests were conducted. The results showed that there is a positive impact on the perceptions among students towards green building adoption. Based on the analysis, the major benefit perceived by students was to reduce construction waste with a mean value of 4.67. Therefore, the reduction of construction waste will minimize the environmental damage and conserve natural resources. It was also found that the lack of knowledge from project team members about green building became the most significant challenge towards green building practices based on students' perception. This study could offer valuable information related to benefits and challenges towards green building implementation among university students so that university could improve teaching materials and methods by applying the current issues in the construction sector.

Keywords
Green Building, Benefits, Challenges, Construction Industry, Global Warming

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1. INTRODUCTION

Global warming is an environmental problem that has gained a lot of attention nowadays. The environmental problems have contributed a tremendous impact to the earth because they may cause climate change, global warming and also serious impacts on social, cultural and economic lives (Adi et al., 2019; Rifqi et al., 2021; Herdani, 2020). According to UNEP (2017), buildings contribute around 33% of CO_2 emissions, 25% of wood products, 30-40% of energy use, 17% of clean water consumptions and 40-50% of raw material use during construction and operation stage. Construction project activities are considered to have an important role in changing the environment. The concept of green building began to be applied for buildings to minimize environmental damage (Mansour and Radford, 2014). Green building is a building concept which implementation adheres to the principles of being environmentally friendly or sustainable and has a positive impact on the environmental, social, and economic matters (Sichali and Banda, 2017).

It is clear that the understanding of green building among university students are still very limited (Oluwunmi et al., 2019). Therefore, the research on green building adoption within educational institutions should be given a priority (Akinshipe and Aigbavboa, 2018; Greinert and Mrówczyńska, 2020). Based on previous research from Marseva (2014), it was found that 95% of the total respondents were not familiar with green building, which only 5% of respondents were aware of green building concepts. In addition, according to Wijayaningtyas et al. (2018), the understanding of the millenial generation about green building practices was still very limited, therefore it is necessary to understand the concept of green building for future generations. The students of civil engineering and architecture will play an important role in the development of construction especially green building adoption in the future. This study aims to analyze the students' perceptions towards green building practices. This study could offer valuable information related to benefits and challenges towards green building implementation among university students so that university could improve teaching materials and methods by applying

green building current issues in the construction sector.

2. LITERATURE REVIEW

The concept of green building is a concept towards a healthy, comfortable and energy efficient building (UNEP, 2017). According to Massie et al. (2018), green building is an environmentally friendly building concept that can bring solutions in the field of construction as well as reduce the negative impacts of buildings on the environment. According to Pedini and Ashuri (2010), there are several benefits by adopting green buildings categorized into environmental benefits, health and community related benefits, financial benefits, market-related benefits, and industry related benefits. However, there are also some challenges exposed towards implementing the green building concept such as commodity related challenges, organizational and personal related challenges, and process related challenges (Leung et al, 2013).

Wong et al (2017) investigated the stakeholders' perception on green building practices in Singapore. It was found that more than 90% of public and private homeowners agreed about the benefits of green building in terms of reducing the utility bills and environmental impact, increasing the energy savings and environmental protection. Shillaber et al. (2017) studied the sustainability practices based on students' perception in mechanical engineering. The results showed that there was a lack of knowledge about its practices and there was an urgency to enhance the curriculum related to sustainability skills. Jung et al. (2019) examined the university students' perception on sustainable behaviors and the effect of sustainability courses on students' knowledge improvement. It was found that the students who had taken sustainability courses had better knowledge and sustainable behaviors compared to those who had not. Oluwunmi et al. (2019) studied the built environment students' perception on understanding the principles of green building in Nigeria. The study mentioned that 88% students were aware of the green building principles, however the level of embracing its standards in the university was still very low. The students perceived the benefits of green building adoption which can increase indoor air and water quality, but may decrease pollution and environmental degradation.

The Ministerial regulation PUPR RI No. 2 in 2015 contains green building regulation used as a guideline for building organizers to apply the green buildings concepts towards achieving sustainable green buildings practices. In addition, the Regulation of the State Minister for Environment No. 8 in 2010 concerns about the criteria and certification of green buildings to encourage building practitioners to fully adopt the environmental principles to achieve sustainable construction. In order to support the implementation of green building, each country has an assessment certification body related to building assessment. If a building successfully passes the evaluation or assessment process to obtain green building certification, this indicates that the building has applied the concept of green building. Green building assessment standard in Indonesia is called Greenship. Green Building Council Indonesia, GBCI (2013) divided green building criteria into 6 major groups: 1) appropriate site development, 2) energy efficiency and conservation, 3) water conservation, 4) material resources and cycle, 5) indoor health and comfort, and 6) building environment management.

Table 1 presented variables based on previous research for basic understanding, criteria, benefits and challenges towards green building practices.

3. METHODOLOGY

This study discussed the analysis of perceptions of green building among students of civil engineering and architectural engineering of Sriwijaya University classified into 3 different school yeas of 2017, 2018, and 2019 as seen in Table 2.

There were about 240 respondents consisting of 153 students from civil engineering and 87 respondents from architecture as displayed in Table 2. The probability sampling technique was used. A questionnaire was used to collect data using five Likert scale, in which (1) indicating strongly disagree to (5) strongly agree. The validity and reliability tests were also conducted based on the questionnaires using SPSS. The criteria of validity test is said to be valid if r-count is higher that r-table. Meanwhile, if r count is smaller than r table, then the data is not valid. The reliability tests are above 0.6, indicating the variables are reliable. The results showed that all variables were valid and reliable. Table 3 showed the variables used in this research in terms of basic understanding, criteria, benefits and challenges of green building practices.

4. RESULTS AND DISCUSSION

This section discussed the basic understandings, criteria, benefits, and challenges towards green building practices based on students' perception of civil engineering (CE) and architectural engineering (AE) of University of Sriwijaya.

4.1 Basic Understanding of Green Building

The first variable is the basic understanding of civil engineering (CE) and architecture engineering (AE) students towards green building. There are 8 variables related to the understanding of green building, ideas about green building, and responses to green building. Based on the analysis, most students of CE and AE have understood that the implementation of green building has offered a positive impact on the environment in Palembang as presented in Table 4. The highest mean value is shown by variable P7 with mean values of 4.65 (Civil Engineering) and 4.75 (Architectural Engineering). This indicates that the students of CE and AE are aware of the environmental problems that exist today and realize that green building is important to be applied.

Table 1. Research Variables

Variables	Leung et al (2013)	GBCI (2013)	Pedini and Ashuri (2010)	Putri et al (2019)	Solihin et al (2018)	Sudiartha et al (2015)	Wimala et al (2016)
1. Basic Understanding about standing Building							
a. Understanding of green building	✓	✓	-	-	-	✓	✓
b. Ideas about green building	-	✓	-	-	-	✓	✓
c.Response /acceptance about about building	-	-	✓	-	-	-	✓
2. Criteria of Green Building							
a. Appropriate Site Development	-	✓	-	-	✓	-	-
b. Energy Efficiency and Conservation	-	-	-	✓	✓	✓	-
c. Water Conservation	-	✓	-	-		✓	-
d.Material Resources and Cycle	-	✓	-	-	✓	✓	-
e. Indoor Health and Comfort	-	✓	-	✓	✓	✓	-
f. Building Environment Management	-	✓	-	-	-	✓	-
3. Benefits of Green Building							
a.Environmental benefits	-	-	✓	-	-	-	-
b. Health and Community	-	-	✓	-	-	-	✓
c. Financial matters	-	-	✓	-	-	-	-
d. Markets	-	-	✓	-	-	-	-
e. Industry	-	-	✓	-	-	-	-
4.Challenge of Green Building							
a. Commodity	✓	-	-	-	-	✓	✓
b. Organizations and	✓	-	-	-	-	✓	✓
c. Processes	✓	-	-	-	-	-	✓

Table 2. The number of respondents

Study Program	School Year	Number of Students	Sampling	Respondents
Civil Engineering	2017	130	$\frac{130}{595} \times 240$	53
	2018	115	$\frac{115}{595} \times 240$	46
	2019	134	$\frac{134}{595} \times 240$	54
Architectural Engineering	2017	64	$\frac{64}{595} \times 240$	26
	2018	72	$\frac{72}{595} \times 240$	29
	2019	80	$\frac{80}{595} \times 240$	32
Number of Respondents				240

Therefore, the students think it is important to adopt the green building concept to effectively minimize the environmental damage. It is also known that most students have been familiar with the term of green building as shown as 3rd rank for CE and 2nd rank for AE. The basic understanding is important to determine the level of students' basic knowledge and awareness towards green building practices.

4.2 Criteria of Green Building

The second variable is the perception of civil engineering and architecture engineering students on the green building criteria. There are 10 questions related to land use, energy efficiency and conservation, water conservation, material sources and cycles, health and comfort in space, and building environmental management. Some criteria of green building and its rank based on students' perception are presented in Table 5 and Table 6. According to civil engineering students, it was found that the needs of building design to use sustainable and durable materials has become the most significant variable as seen by the highest mean value (4.69)

Table 3. Research Variables

Variables		Code
Basic Understanding of Green Building	You are familiar with the term of green building	P1
	You have understood about green building through reading articles related to green building	P2
	Green building is much talked and discussed in some of your class	P3
	You understand that Greenship is a green building assessment system in Indonesia	P4
	You have understood about the concept of green building	P5
	You have understood the criteria required for the implementation of green building	P6
	You have understood that the implementation of the green building has a positive impact on the environment	P7
	You have understood that the application of green building is important to be applied in Palembang	P8
Criteria of Green Building (Civil Engineering)	Installation of safety nets around the building during the construction process	K1
	Designed buildings make use of rainwater to accommodate and water plants	K2
	Using green roof as a substitute for asbestos and zinc	K3
	Providing the organic and non-organic bins on the project site	K4
	Cleaning vehicle before getting out from the project site	K5
	Choosing a development area equipped with infrastructure facilities	K6
	Designed buildings should use sustainable and durable materials	K7
	Using local materials	K8
	Using fabricated materials	K9
	Using clean water with the highest amount of 80% of the primary sources	K10
Criteria of Green Building (Architectural Engineering)	Building design should optimize the use of bright natural colors such as the use of glass blocks to obtain natural lighting	K1
	Using recycled materials during design process	K2
	Involving an expert who has been certified by the Greenship professional	K3
	Design the ventilation with openings at least 40% of the room area	K4
	Using green roof garden or vertical garden	K5
	Developing vegetation design on buildings as a noise filter	K6
	Maintain tread conditions by creating designs that follow the shape of existing treads	K7
	Making the design of the building slim and vertical	K8
	Using water saving features such as dual flush on water closet and autostop on water tap	K9
	Buildings designed with solar panels	K10
Benefits of Green Building	Reducing construction waste	M1
	Minimizing the use of new materials during project construction	M2
	Improving the health and comfort of building users	M3
	Improving the quality of human life	M4
	Reducing the operational costs of buildings	M5
	Increasing the productivity of workers	M6
	Increasing the sale price of a building	M7
	Developing new projects	M8
	Improving the development of the construction industry in Indonesia	M9
Challenges of GreenBuilding	Lack of public attention	T1
	Uncertainty and risks in the construction of the green building	T2
	Requires a lot of funds in the construction of the green building	T3
	Lack of knowledge from project team members about green building	T4
	Lack of desire for change to build green building	T5
	Lack of green material	T6
	Lack of measurable requirement setting on green buildings	T7

Table 4. The Basic Understanding about Green Building

Code	Variables	CE		AE	
		Mean	Rank	Mean	Rank
P1	You are familiar with the term of green building	4.1	3	4.7	2
P2	You have understood about green building through reading articles related to green building	3.2	8	4.2	5
P3	Green building is much talked and discussed in some of your class	3.4	6	4.3	4
P4	You understand that Greenship is a green building assessment system in Indonesia	3.3	7	3.6	8
P5	You have understood about the concept of green building	3.5	4	4	6
P6	You have understood the criteria required for the implementation of green building	3.5	5	4	7
P7	You have understood that the implementation of the green building has a positive impact on the environment	4.7	1	4.8	1
P8	You have understood that the application of green building is important to be applied in Palembang	4.6	2	4.6	3

among other variables. One of the criteria required to the adoption of green building is related to the resources and materials cycles so that the use of natural resources can be minimized. Therefore, the building design plays a significant role in determining the use of materials to make the building durable and sustainable.

Based on the architectural engineering (AE) students' perception, designing vegetation as a noise filter in the buildings has to be the most significant criteria with mean value 4.54. One of the criteria required in the application of green building is related to health and comfort space. Planting some shady plants in the building will filter air pollution or minimize the noise generated from public transportation around the building. The AE students perceived that the design of vegetation on the building as a noise filter is an important criterion to be applied in the application of green building (K6). Therefore, the presence of vegetation on the building will increase the productivity of the users of the building.

4.3 Benefits of Green Building

This section aims to investigate the students' perception about the benefits of green building adoption. There are 9 questions about the benefits of green building related to the environment, finance, market, industry, as well as health and community. As seen in Table 7, the most influential benefits of green building perceived by Civil Engineering (CE) students is to reduce construction waste with a mean value of 4.67. The development of construction projects increase significantly, resulting construction waste contributed to the environment. Therefore, it is expected that the project development can use recycled and reused-resources.

Table 5. Perception about Green Building Criteria (Civil Engineering Students

Code	Variables	Mean	Rank
K1	Installation of safety nets around the building during the construction process	4.68	2
K2	Designed buildings make use of rainwater to accommodate and water plants	4.43	4
K3	Using green roof as a substitute for asbestos and zinc	4.39	5
K4	Providing the organic and non-organic bins on the project site	4.63	3
K5	Cleaning vehicle before getting out from the project site	4.26	7
K6	Choosing a development area equipped with infrastructure facilities	4.01	8
K7	Designed buildings should use sustainable and durable materials	4.69	1
K8	Using local materials	3.8	10
K9	Using fabricated materials	3.93	9
K10	Using clean water with the highest amount of 80% of the primary sources	4.31	6

Table 6. Perception about Green Building Criteria (Architectural Engineering Students

Code	Variables	Mean	Rank
K1	Building design should optimize the use of bright natural colors such as the use of glass blocks to obtain natural lighting	4.22	6
K2	Using recycled materials during design process	4.13	8
K3	Involving an expert who has been certified by the Greenship professional	4.21	7
K4	Design the ventilation with openings at least 40% of the room area	4.33	3
K5	Using green roof garden or vertical garden	4.3	5
K6	Designing vegetation on buildings as a noise filter	4.54	1
K7	Maintain tread conditions by creating designs that follow the shape of existing treads	4.32	4
K8	Making the design of the building slim and vertical	3.46	10
K9	Using water saving features such as dual flush on water closet and autostop on water tap	4.41	2
K10	Buildings designed with solar panels	3.99	9

The results also showed the most influential benefit perceived by Architectural Engineering (AE) students is improving the health and comfort of building users with a mean value of 4.69. The next benefit obtained in the application of green building is related to improving the quality of human life. The implementation of green building aims to reduce the environmental impact of development on human and natural health through effective use of water, energy, and other resources. Therefore, it is expected that the implementation of green building will protect health and increase the productivity of building residents.

4.4 Challenges of Green Building

The fourth variable is the perception of civil engineering and architecture engineering on the challenges of green building practices. In this variable, there are 7 questions related to commodities, processes, as well as organizations and individuals. As presented in Table 8, the most influential challenge perceived by students of civil engineering and architectural engineering is the lack of knowledge from project team members about green building with mean values of 4.18 and 4.23 respectively. One of the challenges faced in the implementation of green building is related to organization and personal. There are various criteria required in the application of green building such as land use, energy efficiency and conservation, water conservation, material sources and cycles, health and comfort in space, and environmental management of buildings. Therefore, an understanding of the concept is required. It can be seen that the CE and AE students perceived that the lack of knowledge from project team members about green building is the most influential challenge to increase the adoption of green building in the construction industry. Therefore, it is necessary to increase the knowledge of project team members thorugh a seminar, training, workshop about green building practices.

Table 7. Data Ranking of Green Building Benefits

Code	Variables	CE		AE	
		Mean	Rank	Mean	Rank
M1	Reducing construction waste	4.67	1	4.59	3
M2	Minimizing the use of new materials during project construction	4.04	9	3.92	7
M3	Improving the health and comfort of building users	4.63	3	4.69	1
M4	Improving the quality of human life	4.64	2	4.69	2
M5	Reducing the operational costs of buildings	4.08	8	4.05	9
M6	Increasing the productivity of workers	4.33	7	4.21	6
M7	Increasing the sale price of a building	4.39	5	4.45	4
M8	Developing new projects	4.35	6	4.05	8
M9	Improving the development of the construction industry in Indonesia	4.54	4	4.33	5

Table 8. Data Ranking of Green Building Challenges

Code	Variables	CE		AE	
		Mean	Rank	Mean	Rank
T1	Lack of public attention	4.05	3	3.89	4
T2	Uncertainty and risks in the construction of the green building	3.92	6	3.71	6
T3	Requires a lot of funds in the construction of the green building	3.98	5	3.78	5
T4	Lack of knowledge from project team members about green building	4.18	1	4.23	1
T5	Lack of desire for change to build green building	4.03	4	3.99	2
T6	Lack of green material	3.86	7	3.71	7
T7	Lack of measurable requirement setting on green buildings	4.14	2	3.93	3

5. CONCLUSIONS

The practice of green building within construction industry has been gaining its acceptance among construction players nowadays. It is believed that there is a poor perception towards green building practices not only for general construction practitioners but also for university students. Thus, there is a need to investigate the students' perceptions about green building practices. The students play an

important role in the development of construction especially green building in the future. Therefore, this study aims to analyze the perceptions of civil engineering and architecture students of University of Sriwijaya about green buildings practices. The questionnaires were used for data collection which covered the basic understandings, criteria, benefits, and challenges of green building.

Based on the analysis, most students of civil engineering and architectural engineering in University of Sriwijaya have understood that the implementation of green building has offered a positive impact on the environment. According to Civil Engineering students, it is known that indicators related to the source and material cycle are the main criteria required in the application of the green building concept. Meanwhile, the Architectural Engineering students perceived health and comfort in space is the main criteria required in the application of the concept of green building. The most influential benefits of green building perceived by Civil Engineering (CE) students is to reduce construction waste. The results also showed the most influential benefit perceived by Architectural Engineering students is to improve the health and comfort of building. It was also found that the lack of knowledge from project team members about green building became the most significant challenges towards green building practices based on students' perception. Finally, this study could offer valuable information related to benefits and challenges towards green building implementation based on university students' perception so that the university could improve teaching materials and methods by applying green building issues in the curriculum. This study is limited to a survey of one university only and cannot be generalized to all students' opinions. Further research should be elaborated to many universities by involving more respondents.

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