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Development of Green Building Evaluation for Capacity Building of Civil Engineering Students to Realize Sustainable Development

Rina Marina Masri[1*], Iskandar Muda Purwaamijaya[2], Irma Widianingsih[3], Btari Mariska Purwaamijaya[4]

[1,2,3,4]Program Studi Teknik Sipil, FPTK, Universitas Pendidikan Indonesia

Email: rinamasri@upi.edu

ABSTRACT

The purpose of writing this article is to determine the level of capacity of Civil Engineering students in the development of green buildings to realise sustainable development. Civil engineering considers advances in transportation technology, environmental changes such as climate, soil structure and natural disasters, and the development of green buildings. However, the facts on the ground show that many still think that the construction of green buildings is not civil engineering personnel's responsibility but spatial planning personnel's responsibility. The problem of needing to be accommodated in green buildings by civil engineering personnel of UPI Bandung gave rise to the author's idea to evaluate the development of green buildings to increase the capacity of Civil Engineering students. The activity method used is descriptive quantitative. The population is civil engineering students FPTK UPI Bandung. The data analysis technique used is the analysis of participants' understanding, attitudes and skills as well as spatial analysis. Based on the results of the study that the application of green building evaluation to realise sustainable development can increase the capacity of Civil Engineering students. Thus, it is necessary to make efforts to improve teaching materials in developing green buildings.

Keywords*: civil engineering, green building, sustainable development*

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INTRODUCTION

Civil Engineering is one of the study programs incorporated in the Faculty of Engineering. Civil engineering will continue to be needed because it relates to the availability of facilities and infrastructure that support human life. Civil engineering is used to design and oversee infrastructure development. Civil engineering will technically evaluate the design of the architecture in accordance rules and determine the materials to be used. Civil engineering will greatly consider advances in transportation technology, environmental changes such as climate, soil structure and natural disasters, as well as the development of green buildings to realize sustainable development (Widyawati, 2018). The expected building concept now is a building concept that meets the criteria of green architecture and green building (Teng et al., 2018). These two things have different meanings even though they are still in one goal. Green here is not

defined as an all-green built environment but emphasises harmony with the global environment, namely air, water, land and fire. The definition of green building is an environmental awareness that includes not only the main aspects of architecture (strong, functional, comfortable, low cost, aesthetic) but also includes environmental aspects of a green building, namely energy efficiency, the concept of sustainability and a holistic approach to the environment (Li et al., 2021). Green building has an understanding as a term that describes economic, energy efficient, environment friendly and can be developed into sustainable development (Guo et al., 2021). Green building includes harmony between humans and their natural environment. Green building also contains other dimensions such as time, natural environment, socio-cultural, space, and building techniques. Green building is also defined as a building that is environmentally sound and based on concern for the conservation of the natural global environment with an emphasis on energy efficiency (energy-efficient), sustainable patterns (sustainable) and a holistic approach (holistic approach). Starting from ecological design thinking which,h emphasises dependencies and interconnectedness between all systems (both artificial and natural) with their local environment and the biosphere. The form follows energy credo was expanded to become a form follows environment based on the recycle, reuse, reconfigure principle (Hainsch et al., 2022). Green building is a design concept to produce a built environment that is built and runs sustainably or sustainably. Sustainability is a condition where all the elements involved during the process of utilising a system can mostly function alone, have little experience in replacement or do not cause other sources to decrease in quantity and quality (Wang, 2021). A Green building is defined as a building that minimises environmental impact through conserving resources and contributing to the health of its occupants. Broadly speaking, green building emphasises comfort and strength (Zang et al., 2021). The government's role in implementing the green building concept has been carried out in various ways, starting with the making of regulations issued by the Governor, Minister, the President and the National Action Plan issued with various targets every year. In addition, the government, through the Ministry of Environment (KLH), promoted the concept of a sustainable city with the Bangun Praja Program in 2002 to encourage local governments to pay full attention to important issues in the environment (Ruhenda et al., 2016).

Based on the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 02/PRT/M/2015 concerning Green Building, it is necessary to implement a building that integrates technical, economic, social and environmental aspects effectively to totalise sustainable development. Implementation of sustainable buildings that are efficient in the use of resources and contribute to the reduction of greenhouse gas emissions, it is necessary to fulfil the requirements of green buildings at every stage of implementation to achieve significant, efficient energy and water saving, healthier, more comfortable building

performance, and by the carrying capacity of the environment. The concept of the designed building is not as expected, not like the green building concept that is being promoted today (Zhang et al., 2021). The development concept includes environmental awareness, which includes the main aspects of architecture in the form of strength, function, comfort, low cost, aesthetics, efficiency, and energy. The concept of the building being built does not follow the percentage distribution between land and the size of the building. In addition, the materials used have not used green building materials. So it can be used individually and reduces electrical power. The building also cannot accommodate sunlight in the morning to be reflected on the lamp. Building materials still use materials from concrete and steel, only some. Only materials from wood will produce lower energy disposal than buildings whose building materials use bricks, concrete or steel.

Civil Engineering students are prospective workers in the field of civil engineering who work in the fields of education, consultants, contractors and others to build road infrastructure, bridges, water structures and buildings in the real world. Civil engineering students are given materials on mapping measurements, technical, financial and environmental feasibility studies, geometric design and calculations, calculations of certain and indeterminate static structures, hydrological analysis, construction operation and maintenance. The theme of green building has been included in the Environmental Science course in semester 5 of the Civil Engineering study program curriculum, FPTK UPI Bandung. The green building theme is also equipped with structured tasks using Google Earth Pro applications, Arcview GIS or ArcGIS, Sketchup and Microsoft Office. Cognitive and psychomotor domains on structured tasks are expected to increase after learning. The fact shows that the theme of green building for civil engineering students has yet to be accommodated by the academic community of the Civil Engineering study program. The indicators appear at proposal seminars, results seminars and Civil Engineering undergraduate trials. Some lecturers, assistants and students think that the theme of green building is not the responsibility of civil engineering personnel but is the responsibility of spatial planning personnel. Civil engineering personnel are only responsible for the calculation and design of civil engineering buildings without focusing on green building and sustainable development of green building evaluation to increase the capacity of civil engineering to realise sustainable development. The purpose of this activity is to determine the level of Civil Engineering student's capacity in the development of green buildings to realise sustainable development.

RESEARCH METHOD

The method of developing green building evaluation activities to increase civil engineering capacity to realise sustainable development is a descriptive quantitative method carried out through online and offline, and face-to-face activities. The location of the activity on the UPI Bandung Campus. The

population is civil engineering students of FPTK UPI Bandung who are still active as students. The sampling technique is random. The activity instruments are computer hardware and software, tests, questionnaires and observation sheets. The primary data taken is the data of the activity participants, and the secondary data is the satellite image of the location of the residence. The data analysis technique used is the analysis of the understanding, attitudes and skills of the activity participants and spatial analysis.

The research instrument used in the development of green building evaluation activities to increase civil engineering capacity to achieve sustainable development is a data collection instrument in the form of tests (green building evaluations to increase civil engineering capacity to realise sustainable development) and non-tests (student observation format, interview and documentation format). The learning instrument is in the form of lesson plans or lecture designs prepared based on the competency standards and basic competencies set to achieve the objectives of the lecture. Paired sample t-test is used to compare the mean of a paired sample. The paired sample is a sample group with the same subject but experiencing two different treatments or measurements.

Paired sample t-test formula:

$$t = \frac{Md}{\sqrt{\frac{\Sigma x^2 d}{N(N-1)}}}$$

Provision:

Md = mean from the test magnification 1 with test 2 (test 2 – test 1)

xd = deviation of each subject (d –Md)

Σx2d = sum of squares of deviation

N = subject on sample

db = determined by N-1

The t count is compared to the t table to interpret the significance level. The paired sample t-test is used for calculations using SPSS 21.0 software as a comparison.

RESULTS AND DISCUSSION

The observations during eight meetings showed an increase in Civil Engineering capacity regarding the development of green building evaluations for Civil Engineering. This can be seen from the values obtained from the pre-test and post-test results.

Pre-Test Value of Green Building Evaluation Development for Civil Engineering Capacity Building Realizing Sustainable Development

The average pre-test score of 74 respondents in increasing the capacity for developing green building evaluations before being given treatment is a level of understanding a percentage of 62%, the rest with a level of understanding that is quite understanding with a rate of 22% and with an understanding of very understanding the number of percentages 16%. The level of understanding of the respondents is depicted in Figure 1.

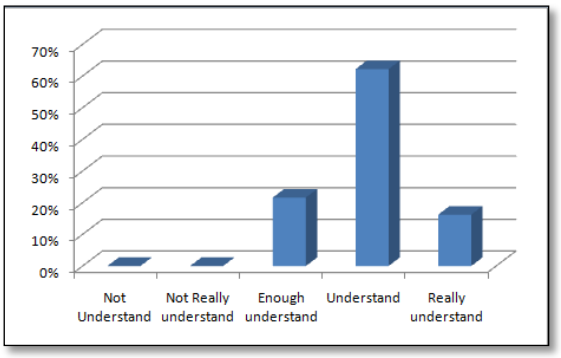

Figure 1. Understanding Level of Pre-Test Development of Green Building Evaluation

Post-Test Value of Green Building Evaluation Development for Civil Engineering Capacity Building Realizing Sustainable Development

The average post-test score of 74 respondents in increasing the capacity for developing green building evaluation after being given treatment experienced an increase in understanding, namely very understanding with a percentage of 54%, understanding level of understanding at 39% and quite understanding at 5%. The level of understanding of the respondents after being given treatment is depicted in Figure 2.

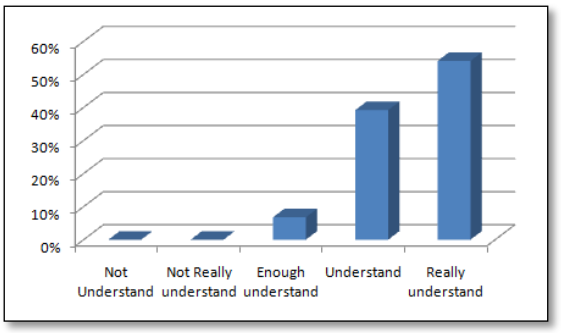

Figure 2. The Post-Test Understanding of Green Building Evaluation Development

Based on the explanation above, it can be concluded that the level of understanding of respondents in the development of green building evaluations for increasing the capacity of Civil Engineering to realise sustainable development has increased, illustrated in Figure 3.

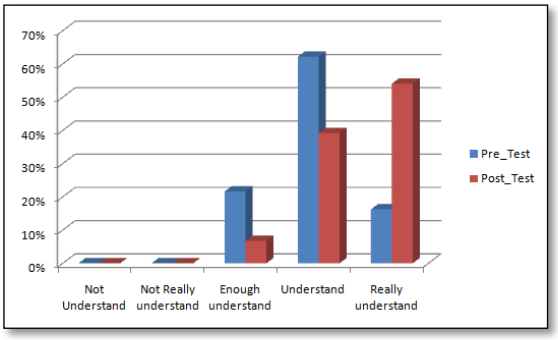

Figure 3. Comparison of Levels of Understanding of Green Building Evaluation Development

Comparison of Pre-Test and Post-Test Results with Paired Sample T-Test

Based on the results of the analysis, a conclusion can be drawn. The average result of the pre-test before treatment was 70.13, while the average post-test after treatment was given to green building evaluation learning was 80.10. the results of the two learnings differ quite significantly (significantly), as illustrated in table 1.

Table 1. Paired Sample Statistics

		mean	N	Std. Deviation	Std. Error Mean
Pairs 1	Pre_ Test	70.1351	74	10.30803	1.19828
	Post _Tes t	80.1081	74	14.34847	1.66798

Table 2, Paired Samples Correlations, describes the correlation values that show the relationship between the two variables in the paired sample. This is obtained from the bivariate Pearson correlation coefficient (with a two-tailed

significance test) for each pair of variables included.

Table 2. Paired Samples Correlations

		N	Correlation	Sig.
Pairs 1	Pre_Test & Post_Test	74	.232	.047

The analysis results can be obtained from more than the average value of the sample. It can also be obtained from the t value in the Paired Sample T-test table compared to the t table. The significance value (2-tailed) was 0.000 ($p < 0.05$). So the pre-test and post-test results experienced a significant (meaningful) change. Based on descriptive statistics, the pre-test and post-test scores proved higher post-test scores.

Table 3. Paired Samples Test

		t	df	Sig. (2-tailed)
Pairs 1	Pre_Test - Post_Test	-5.496	74	.000

The data processing results show that the number of respondents is as many as 74 people. Calculation of the results of increasing the capacity of Civil Engineering, there is a very significant difference between the pre-test and post-test which shows that there is an increase in understanding before being given the development of green building evaluations to realise sustainable development and after being given green building evaluation development materials to realise sustainable development.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The conclusion from the activities that have been carried out is that the capacity building of Civil Engineering with the material for developing green building evaluations to realise sustainable development can run well. This is viewed from the level of understanding with material that can be better understood, more interesting, fun and not boring because the analysis of the development of green building evaluation is relatively easy.

Recommendations

Based on the results of the study that the application of green building evaluation to realise sustainable development can increase the capacity of Civil Engineering students. Thus, it is necessary to make efforts to improve teaching materials in developing green buildings.

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