

Green design application on campus to enhance student's quality of life

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Abstract. Green design becomes an important thing to applied in the building. Green building will provide comfortability and enhance Quality of Life (QoL) for the users. The purpose of this research is to analyze how green design application on campus to enhance student's QoL. This research conducted in three campuses which located in North Sumatera Province, namely Universitas Sumatera Utara (USU), Universitas Negeri Medan (Unimed) and Universitas Medan Area (UMA) which have a lot of vegetation, open space, and multi-mass buildings. This research compared the green design application to QoL from three universities. Green design in this research that become independent variables focus on the energy efficiency and conservation (EEC), indoor health and comfort (IHC) and building environment management (BEM) with dependent variable is QoL. This research uses quantitative methods with questionnaire survey techniques. The population is students from the three universities with the sample of each University is 50 samples. The analysis uses multiple regression analysis. The results show that green design application may enhance QoL of students. The campus should have a good green design application to enhance QoL of students and give them comfortability.

1. Introduction

Green building becomes important things and by using an integrated approach of design, may reduce negative impacts from building to the environment. Green building also reduces operating costs, increases occupants productivity and create sustainability community [1]. Sustainable, green design, green architecture and eco-friendly architecture becomes the important things to create a better life for humans and contain some universal consent [2]. Green design is a collaboration activity in the business which involves human resource, facility, machine investment and training [3].

The architect may create some features in their building that consider to eco-system [2]. Some planners have tried to adopted green buildings policies in their design to meet environmental and sustainability goals. In green building assessment, there are some indicators that need to be investigated, such as sitting, water consumption that may be reduced, building codes and local situation [4].

Based on Fachrudin *et al* [5], universities should be designed to follow the green concept to provide comfort to the users. The campus which designed as green campus may provide comfort to the users, and they will feel their quality of life is getting better. Universities should design as a green campus to provided comfort environment. Student and staff will comfort and get a better quality of life.

Based on the high importance of applying the green concept to the building, the aim of this research is to analyze the influence of green concept on campus to enhance student's quality of life.



1.1. Green Design

Based on Ali *et al* [1], green buildings concepts are energy efficient, water conservation, durable and non-toxic, high-quality spaces and high-recycled content material. In Jordan, green buildings are needed to improve the environmental and economic performance. The variables that used to assess green building are the site, energy efficiency, water efficiency, material, indoor environment quality, waste and pollution and cost and economic. It found that sustainability strategy and goals should be addressed as a major aim.

Green architecture principles consist of Water features and their management; natural building design; passive solar design; green building materials; living Architecture. Passive solar design refers to the use of the sun's energy for the heating and cooling of living spaces. Then, the green building should use renewable material and material that can reduce maintenance and replacement costs. Green building must provide comfort because have an energy efficient, economically may reduce maintenance costs, aesthetically for passive solar features can make buildings bright and pleasant inside and environmentally responsible [2].

The green buildings rating system is consists of the sustainable site; water efficiency; energy and atmosphere; materials and resources; indoor environmental quality and innovation and design process. Green building rating systems are focusing on high-performance; energy efficient and economic and environment-friendly building. Energy efficiency is major components in designing green building [6].

Based on Setyowati *et al* [7], the architectural approaches on green concept consist of land use efficiency, water savings, energy efficiency, application of the building materials used in the construction process to save the waste that occurs (the concept of recycling materials) and maintenance of healthy indoor air quality. For mechanical and electrical may using an alternative energy such as the solar cell generator system; innovation on natural lighting, energy saving in electricity, and the application of information technology (IT) with the concept of High Technology.

Building assessment system is tools used to rank or assess how buildings or neighborhoods concerns compared to typical practice and to ultimate goals. Then, this will be the basis for green building policies and programs. Building assessment system focus on energy efficiency, water conservation, site selection, building materials, waste management, indoor environmental quality, and education. Some building assessment indicates that water and sitting issues are major problems, but the assessed object will show different results according to its characteristics [4].

Based on [8], green building assessment refers to six parts, namely: appropriate site development; Energy efficiency and conservation; Water conservation; Indoor air health and comfort; Material resources and cycle; and building environment management.

Based on Maditinosa *et al* [9] the quality of life refers to current satisfaction. The university which designed with green design concept will provide a good quality of life. Based on [10] Green University is more comfortable and can significantly enhance the quality of life of its students compared to the Non-Green Campus concept. Students at Green University can experience the quality of life than non-green universities. Some universities that are not designed as green building try to reduce energy consumption. They try to reduce the use of air conditioning, but they do not have ventilation. This situation will make users feel uncomfortable. Students agree that university green spaces can improve their quality of life.

Based on previous studies, this study will focus on three variables from the green design concept that is considered most influential on the quality of life of its users, namely: Energy Efficiency and Conservation (EEC); Indoor Health and Comfort (IHC) and Building Environment Management (BEM).

2. Methods

This research is a quantitative method which uses primary data with questionnaire technique. This research was conducted in three universities, i.e Universitas Sumatera Utara (USU), Universitas Negeri Medan (Unimed) and Universitas Medan Area (UMA). The three universities have similarity i.e., have multi-mass buildings and a lot of vegetation (figure 1).



Figure 1. Research Location (from left to right: USU, Unimed, and UMA)

The population of this study was an undergraduate student with total students Universitas Sumatera Utara is 33,000 students, Universitas Negeri Medan is 16,525 students, and Universitas Medan Area is 6,823 students. The sample is 50 respondents for each university. There are three parts on questionnaire form, namely data of respondents, green design concept and quality of life. Green design concept divided into three variables, namely energy efficiency and conservation (EEC), indoor health and comfort (IHC) and building environment management (BEM). The questionnaire using 1 to 5 points of Likert Scale with 1 for strongly disagreed to 5 for strongly agreed. The analysis was using multiple linear regression with alpha 5% and the confident level is 95%.

3. Results and Discussion

3.1. Green Design

Green design concept in this research as independent variables that consists of three variables and each variable has some indicators. The first variable is Energy Efficiency and Conservation (EEC) as X1 that divided into four indicators namely, lighting in the classroom (EEC1), the campus is free from air pollution (EEC2), the campus is free from noise pollution (EEC3) and campus operates on energy-efficient (EEC4). The second variable is Indoor Health and Comfort (IHC) that consists of clean air (IHC1), healthy air (IHC2), comfort in the classroom (IHC3), comfort air in the corridor (IHC4) and comfortable temperature in the classroom (IHC5). The third variable is Building Environment Management (BEM) that consists of campus has many plants (BEM1), healthy campus environment (BEM2) and separation of waste disposal for organic and an organic waste (BEM3).

Based on Table 1, students from USU, Unimed and UMA have same argumentation about the lighting in the classroom that is bright (EEC1), the campus has clean air (IHC1), and the campus has many plants (BEM1). It means that USU, Unimed, and UMA already apply some concept from green design. This result is in accordance with the research by [8] which states that the three variables are part of the green design concept.

Table 1. Mean Value for Independent Variables

Indicator	N	USU		Unimed		UMA	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
EEC1	50	2.96	0.880	4.06	0.867	3.80	0.833
EEC2	50	2.32	0.999	3.72	1.070	3.74	0.986
EEC3	50	2.36	1.208	3.52	1.147	3.48	1.111
EEC4	50	2.78	1.298	3.38	1.105	3.68	0.957
IHC1	50	2.90	1.015	4.22	0.790	4.28	0.809
IHC2	50	2.84	1.017	4.12	0.824	4.20	0.756
IHC3	50	2.30	1.015	3.64	0.875	3.54	0.994
IHC4	50	2.52	0.931	3.56	0.837	3.82	0.800

Indicator	N	USU		Unimed		UMA	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
IHC5	50	2.18	0.962	3.48	0.909	3.22	1.016
BEM1	50	3.76	1.001	4.66	0.798	4.70	0.763
BEM2	50	2.86	0.969	3.88	0.961	4.08	0.853
BEM3	50	1.92	1.047	3.30	1.147	3.52	1.344

3.2. Quality of Life

Dependent variable in this research is quality of life is consists of ten indicators, namely: convenience on campus (QoL1), good mood (QoL2), plants that may provide comfortability (QoL3), happy feeling (QoL4), friendly campus (QoL5), good interaction (QoL6), interaction with lecturer (QoL7), feel good (QoL8), life quality score (QoL9) and optimistic (QoL10). From Table 2, students from USU, Unimed and UMA have same argumentation about optimistic with mean value respectively 4.50, 4.54 and 4.42 and good interaction with mean value respectively 3.88, 4.32 and 4.30.

Table 2. Mean Value for Independent Variables

Indicator	N	USU		Unimed		UMA	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
QoL1	50	2.70	0.909	3.98	0.892	3.90	0.763
QoL2	50	2.86	0.904	3.72	0.927	4.00	0.833
QoL3	50	2.90	1.015	3.92	0.922	4.02	0.937
QoL4	50	2.94	0.818	3.82	0.896	3.84	0.866
QoL5	50	2.86	0.833	3.42	0.906	3.44	0.884
QoL6	50	3.88	0.895	4.32	0.794	4.30	0.863
QoL7	50	3.74	0.803	4.10	0.735	4.22	0.737
QoL8	50	3.28	0.671	3.98	0.820	4.04	0.755
QoL9	50	3.50	0.814	3.98	0.845	4.06	0.793
QoL10	50	4.50	0.580	4.54	0.646	4.42	0.859

3.3. Influence of Green Design to Quality of Life

Multiple regression analysis conducted to find the influence of green design application to enhance student's quality of life. The independent variables are Energy Efficiency and Conservation (EEC) as X1; Indoor Health and Comfort (IHC) as X2, and Building Environment Management (BEM) as X3, and quality of life as dependent variable (Y).

3.3.1. Universitas Sumatera Utara (USU)

The first analysis was conducted to the data from Universitas Sumatera Utara (USU). R square value is 0.536 and the residual has a normal distribution. All of the independent variables has a VIF value below 10 and tolerance value not less than 0.10 (Table 3 and 4). It shows that in this analysis there is no multicollinearity. Glejser test result shows the highly significant level more than alpha 0.05 that means in regression model there are no heteroskedasciticas in the regression model.

In Table 5, there is one variable that has t value less than 0.05. It means that the variables influence the student's quality of life, namely: Building Environment Management (BEM). While Energy Efficiency and Conservation (EEC) and Indoor Health and Comfort (IHC) have t value more than 0.05, it means that the variables do not influence the student's quality of life.

Table 3. One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		50
Normal Parameters ^{a,b}	Mean	.0000000
	Std. Deviation	.36370201
	Absolute	.099
Most Extreme Differences	Positive	.069
	Negative	-.099
		.099
Test Statistic		.099
Asymp. Sig. (2-tailed)		.200 ^{c,d}

a. Test distribution is Normal.

b. Calculated from data.

Table 4. Coefficient Determination Test

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.732 ^a	.536	.506	.37537	1.656

a. Predictors: (Constant), BEM, EEC, IHC

b. Dependent Variable: QoL

Table 5. Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients		t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta				Tolerance	VIF
1	(Constant)	1.806	.220			8.191	.000		
	EEC	-.025	.090	-.038		-.282	.779	.545	1.835
	IHC	.142	.101	.208		1.410	.165	.465	2.150
	BEM	.426	.124	.592		3.435	.001	.340	2.943

a. Dependent Variable: QoL

3.3.2. Universitas Negeri Medan (Unimed)

The second analysis is for Unimed and found the residual has a normal distribution with R square value is 0.580. All of the independent variables has a VIF value below 10 and tolerance value not less than 0.10 (Table 6 and 7) that explain in this analysis there is no multicollinearity. Glejser test result shows the highly significant level than alpha 0.05 that means in regression model there are no heteroskedasticity in the regression model.

From Table 8, there are two variables that have a t value less than 0.05. It means that the variables influence the student's quality of life, namely: Energy Efficiency and Conservation (EEC) and Indoor Health and Comfort (IHC). While Building Environment Management (BEM) have t value more than

0.05, it means that the variables do not influence the student's quality of life. This analysis is opposite with the first analysis which conducted in USU.

Table 6. One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		50
Normal Parameters ^{a,b}	Mean	.0000000
	Std. Deviation	.38825023
	Absolute	.074
Most Extreme Differences	Positive	.061
	Negative	-.074
Test Statistic		.074
Asymp. Sig. (2-tailed)		.200 ^{c,d}

a. Test distribution is Normal.

b. Calculated from data.

Table 7. Coefficient Determination Test

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.762 ^a	.580	.553	.40071	2.289

a. Predictors: (Constant), BEM, IHC, EEC

b. Dependent Variable: QoL

Table 8. Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.156	.365		3.164	.003		
	EEC	.229	.105	.297	2.179	.034	.493	2.029
	IHC	.371	.117	.396	3.177	.003	.587	1.702
	BEM	.145	.102	.189	1.415	.164	.514	1.945

b. Dependent Variable: QoL

3.3.3. Universitas Medan Area (UMA)

The third analysis is for UMA that found the residual has a normal distribution with R square value is 0.407. All of the independent variables has a VIF value below 10 and tolerance value not less than 0.10 (Table 9 and 10) that explain in this analysis there is no multicollinearity. Glejser test result shows the highly significant level than alpha 0.05 that means in regression model there are no heteroskedasticas in the regression model.

Based on Table 11, there is one variable with t value less than 0.05. It means that the variables influence the student's quality of life, namely: Building Environment Management (BEM). Energy Efficiency and Conservation (EEC) and Indoor Health and Comfort (IHC) t value more than 0.05, it means that the variables do not influence the student's quality of life. This analysis has the same result with the first analysis which conducted in USU.

Table 9. One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		50
Normal Parameters ^{a,b}	Mean	.0000000
	Std. Deviation	.44305739
Most Extreme Differences	Absolute	.075
	Positive	.058
	Negative	-.075
Test Statistic		.075
Asymp. Sig. (2-tailed)		.200 ^{c,d}

a. Test distribution is Normal.

b. Calculated from data.

Table 10. Coefficient Determination Test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.638 ^a	.407	.369	.45728	1.861

a. Predictors: (Constant), BEM, IHC, EEC

b. Dependent Variable: QoL

Table 11. Coefficient

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1							
(Constant)	1.425	.475		2.999	.004		
EEC	.162	.119	.199	1.362	.180	.605	1.652
IHC	.173	.124	.193	1.393	.170	.669	1.496
BEM	.328	.108	.396	3.045	.004	.763	1.311

a. Dependent Variable: QoL

3.4. Finding

The concept of green design is very appropriate if applied on campus. Students have a good response to buildings and environments in the campus. Although not all green design concepts significantly influence student's quality of life, this research found that the concept of green design that applied on campus may enhance the student's quality of life. This three campus already have a good lighting in the classroom because supported by good ventilation, have clean air and have many plants. Students from Unimed give high appreciation about the application of green design concept in their campus. While UMA students have a high value for quality of Life. It means that they feel that their quality of life is good.

Overall, students have felt their quality of life is good enough, they have good interaction with friends and lecturers and always feel optimistic in life. The findings are appropriate with research by [1], [5], and [10] who stated that green design concept might provide sustainability community and enhance the quality of life of its users.

4. Conclusions

Building assessments that apply green concepts based on several variables. This study only focuses on three variables that are considered important and have a great impact on the building and quality of life of its users. The three variables are energy efficiency and conservation, indoor health and comfort and building environment management. These three variables were found influence the quality of life of students on the campus of USU, Unimed, and UMA. In USU and UMA, building environment management is influence student's quality of life. While in Unimed, energy efficiency and conservation and indoor health and comfort influence student's quality of life. The campus should apply the concept of green design on the building and its environment to enhance the quality of life of its users consisting of students, staff, and lecturers. This study is expected to be a reference for further research using a complete variable.

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