University Student's Knowledge Toward Energy Conservation and the Implementation on Their Design Project

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Abstract Energy conservation performed important role on responding the climate changes on personal and organizational position. Personal responses are known as crucial part toward lower carbon emission, energy consumption, water usage, etc. Nowadays every architecture students in the world has responsibility to design more green building or environment friendly city during their study at campus so they will become agent of change on their future world. However there is less evidence of the on those global movement such endeavors on the student's behavior and actions. This study objective is to analyze the knowledge of energy conservation from architecture students and their implementation on design project. Literature studies, questionnaires, and statistical analysis were performed to pursue the objective. In the result, we can summarize that student energy conservation awareness and design project were related in unique ways.

Keywords Energy conservation · Perception · University student · Design project

1 Introduction

Energy issues play the role on daily life topic of social, technical, economic, environment as the limited fossil fuel resources and worse world conditions. The worlds were faced with defining new ways to respect the energy consumption, energy resources and alteration toward energy freedom. This new ways will be determined by every citizen who participated in societies. Through the energy choices that are integral to decisions of daily life. A well information and energy literate people will be a good start to make more responsible and meaningful energy-related decisions and actions.

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Energy literacy becomes an important life skill to empower this generation students as well as the common public [1]. Similar to technological literacy [2] and environment literacy [3–5], the component of energy literacy defined into three domains of cognitive (knowledge), affective (attitude, values) and behavior [6].

Combination of social environment and education problems include the public's inadequate access to proper information, people apathy and misunderstanding of external costs of fossil fuel resources, and psychological factors such as resistance on behavioral change are slowing the energy conservation efforts [7]. Effective energy education programs that improve energy literacy play important role on improving this situation, because childhood education may bring strong formula about energy awareness and how to respond the current issues [8–10].

This study purpose is to investigate the knowledge of energy conservation from architecture students at several university in Indonesia and how they implementation the energy literacy on design project. After a brief of literature, the questionnaires have been spread to obtain the student cognitive-affective-behavior on their daily life and during designing, and statistical analysis were performed to pursue the objective. In the result, we can summarize that student energy conservation awareness and design project were related in unique ways.

2 Materials and Methods

2.1 Survey Instruments

The instrument for measuring energy conservation literacy is a written questionnaire which designed for architecture students in Indonesia. The instruments were developed as an important part of this study. The instruments contained three parameters of cognitive-affective-behavior on two subscales of student habit (4 items) and their implementation on project design (5 items). The response scales were using modification of three part likert's which could be coded as −1, 0, 1 to evaluate their habit and implementation on design. The energy conservation literacy questionnaire was managed to established psychometric principles and methodologies in the sociology and architecture education [11, 12].

In this research, I coded the likert −1 into 1, 0 into 2, and 1 into 3. The score 1 is indicated no effort of energy saving, 2 is shown low effort and 3 is more effort and updated the knowledge of energy saving.

The instrument's content objectives were guided by a framework that established comprehensive criteria for energy conservation literacy based on a literature review, educational standards [6] and input from a diverse panel of experts in architecture energy and buildings.

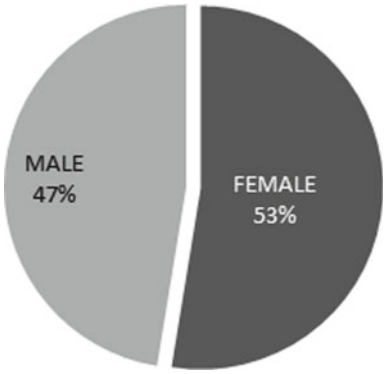

Fig. 1 Overall survey results

2.2 Samples

The samples were taken from the architecture student from several universities in Indonesia. The number of the participants is 100 with random distribution. The composition of 50:50 on gender couldn't be reached since the participants were not limited by gender basis. The participants were 52% female students and 48% male students from four Indonesia architecture campuses (see Fig. 1). The participating professors were encouraged their student to fill the questionnaire after finished the energy conservation based design studio projects.

2.3 Data Collection and Analysis

The students recorded their questionnaire answers through online goggle form, which automatically transposed into excel tabulations for analysis. The responded items were converted into code of numerical points to represent cognitive-affective-behavior on their habit and design. The modificated likerts of three scale (−1, 0, 1) were designed to represent implementation of energy conservation on their habit and design, such as: wasting energy (−1), neutral (0), saving energy (1). However in the excel charts presentation the alteration code of −1 into 1, 0 into 2 and 1 into 3 were performed to show the rank hierarchy. The statically analysis were performed and visualized using Undip's campus facilities of Microsoft (MS) Excel and Statistical Package for Social Sciences (SPSS).

3 Result and Discussion

3.1 Subject Characteristics

The respondences were 47 males and 53% females from four Indonesia architecture campuses (Institut Teknologi Bandung, Universitas Diponegoro, Universitas Mercubuana, and Universitas Parahiyangan). All of them were final year students (at least 3rd year) who have finished 80% of the course subjects and already learn about building physics or furthermore green building courses. Those conditions may reflect the energy literacy already being studied by the respondences during the questionnaire filling [1]. Regarding to the gender (male and females) proportion didn't reflect of any condition that may result energy conservation value, since this study was not to determine the gender criteria but only the student habit and their implementation in the project design related to energy conservation criteria's [12, 13].

The domain and parameters of energy conservation defined on questionnaire through selected questions. The purposive samples and closed questions were applied to focus the energy conservation studies on academic people [14]. Nine questions were representing the habit and design implementation of the architecture students (see Table 1). Later on, the definitions would be describing this study analysis.

Table 1 Domain, parameter and definition of the energy conservation questions

Domain	Parameter	Definition
Habit	Transportation preference	Identify carbon footprint moda
	Preparation leaving home	Identify potential unused energy
	Energy saving advocacy	motivate energy saving campaign
	Energy saving effort	Identify energy saving acts
Design implementation	Score energy saving	calculate energy saving
	AC system	understand AC consumption
	Artificial lighting system	Understand lighting energy consume
	Glassing type	Understand the energy saver glass

3.2 *Energy Saving Habit*

Summary of student transportation preference shown that 77% were using personal moda (1), 6% were hitchhiking their friends (2), and 17% were using mass transportation (3) or just walking (see Fig. 2). The usage of personal moda indicated the preference of students to choose high carbon footprint transportation and also the students didn't understand about the concept of energy conservation in transportations. Regarding to the knowledge they have, the result was also response of the pressure of unproper mass transportation on the Bandung and Semarang. Social effect of norms pressured student to conform to desired habits [15] as a result of feelings of a social problem adaptation [16].

Summary of student before leaving home habits described that 55% were locking the door (1), 45% were also checking the unused gas/bulbs (3), and 0% were got their laundries (2) before left (see Fig. 3). This situations shown that energy saving was not become common habit before leaving the room/home. In the university course the campaign to save energy by turning off the light/gas on unused condition is a must do actions. However these results showed the other way. There is no significant influences of social messages on energy conservation [17] seems realistic in this situations. The majority of participants were choosing to act a common safety

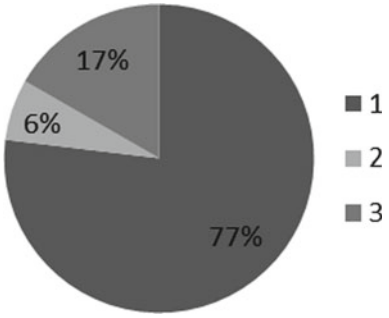

Fig. 2 Student's transportation preference habit

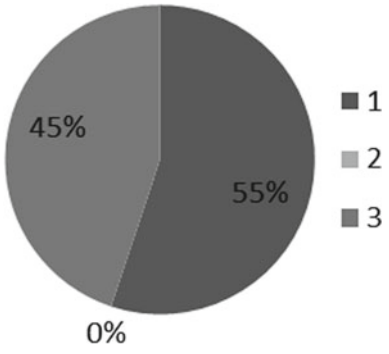

Fig. 3 Students leaving home habit

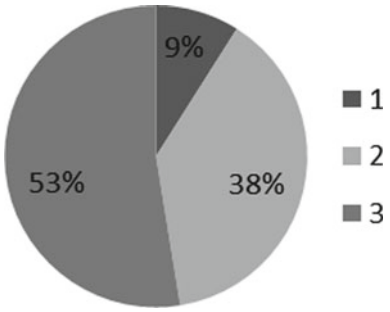

Fig. 4 Student habit for advocating energy conservation

procedure as locking the door and slightly lower participants were ready to save the unused electricity and gas.

Student tendency to provoke their friends and relative to save energy reflected on Fig. 4. The 53% students were rarely campaigned (2), followed by 38% of them who often persuade their inner circle to understand energy conservation strategies (3), and 9% never explain (1) about it (see Fig. 4). Since the unclear connection between energy conservation policy and information amongst people, the motivation to support this campaign might be influenced [14].

The limit of information about energy conservation in Indonesia was still on the reduce consumption shown on Fig. 5. The above charts shown 83% students try to reduce consumption (2) and 17% already understand that using renewable energy (3) is the next phase of energy saving effort, while none of student who didn't understand the terminology of energy conservation concept of reduce and produce from the course they had [14].

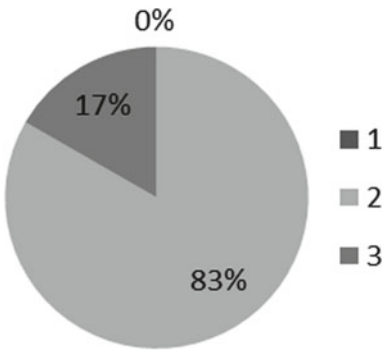

Fig. 5 Student's energy saving efforts

3.3 Energy Saving Implementation Design

The next variable of energy saving is the action in implementing the concept on their design projects, since von Goethe said "Knowing is not enough, we must apply. Willing is not enough, we must do" [14]. The Fig. 6 described that 50% students were applied the energy conservation concept (3) until they got "plus indicators on energy saving" which means they make more efficient energy consumption rather than the standards. However the 38% of them were didn't use the concepts (1) and 12% try to calculate the energy consumption (2) then found that they wasted more energy rather than the proper building model. This energy saving behavior demanded more advocacy and supporting environment to widen the impact on the academic people [13].

The site analysis about solar-chart on building physics class affect massive basic knowledge of passive design. The application of the building orientation theory in architecture students (see Fig. 7) showed that 74% of them were designed the building orientation is North–South (3) which lowered the building exposure from the solar heats. 21% of students forced their building to consume more energy by designed the orientation toward sun directly on the west-east (1), while 5% didn't apply the orientation analysis (2). The memorable education may bring rigid response toward current issues [9]. Curriculum and continuously task to analyze the site and building toward solar chart bring the architecture student's passive design is energy conservation based.

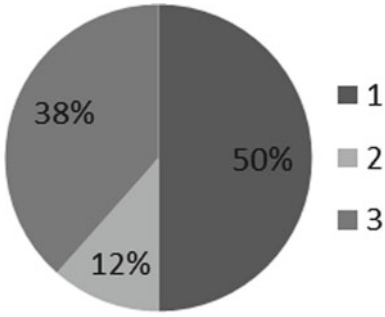

Fig. 6 Student energy saving on last project

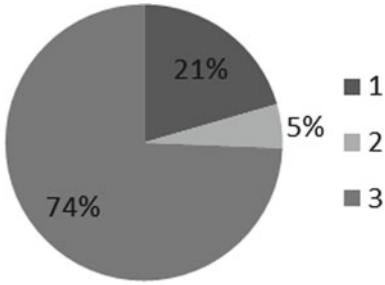

Fig. 7 Students building orientation on last project

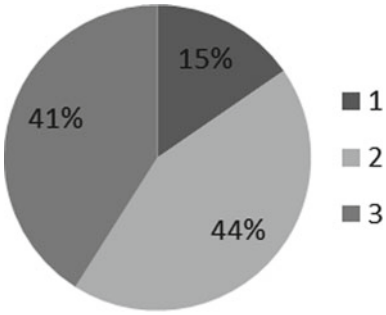

Fig. 8 Student AC system on last project

The usage of AC system of centralized and split showed that even in tropical area, the building user demanded a stable temperature. However the AC central system was more energy efficient rather than split one is a technology improvement which not be followed by students [2]. The 44% of student choose centralized (3), 41% use AC split (2) and 15% didn't designed the air conditioner system (1) for their buildings (see Fig. 8). Technology is a thing that academic people must update every time as their agent of change role and sometimes the improvements is very exponential which make people could adapt quickly.

The glass and lighting application were related closely since the proper (transparent and reflective) glass appliance may reduce the artificial lighting installment. From Fig. 9, 80% students use LED (3), 14% neon lighting (2) and 6% didn't designed it (1). While Fig. 10 shown 50% use low e glass (3) which saving more energy rather 32% chosen tinted glass (2) that bring anti-glare effects and 18% didn't understand about glass technology (1). The situations showed that LED is better campaigned rather than low-e glass system amongst students. In another side the result of 6 and 18% students who didn't understand about energy saving technology brought big challenges for lecturers to attract student to understand it.

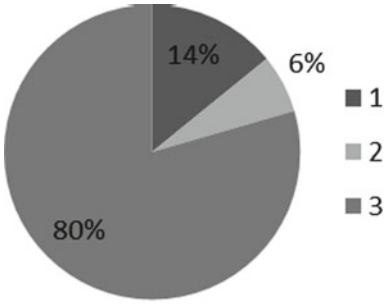

Fig. 9 Student artificial lighting on last project

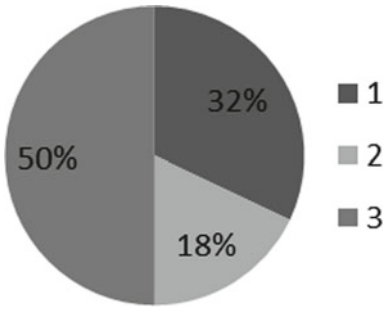

Fig. 10 Students glass type on last project

3.4 Relationship Between Habit and Implementation Design

In the method sections, the conversion codes from likert scales −1, 0, 1 were transformed into 1, 2, 3 code to explain about the degree of energy saving in habit and design preferences. In SPSS this conversion being used to make the calculation formula works in proper.

From the parameters student's habit result, we make statistic calculation using Pearson correlation on SPSS software to analyze the habit relations to the building design implementation of energy conservations. The four habits of transportation preferences, leaving home habits, energy saving advocating and the efforts correlation to the energy saving design is mentioned on Table 2 shown that advocating efforts (0.360), saving energy efforts (0.189), transportation preference (0.141) and before leaving room habit (0.028) were close related to the project design respectfully.

The advocating in energy saving is the nearest relation to the energy conservation design (0.36) and the farthest is before leaving the room/house habits (0.028). Those conditions warned the motivators, lectures or persuaders to give more campaign in "before leaving home habit". Furthermore we could innovate the technology that automatically turnoff the energy device after detecting that no one are in the house/room under the term of smart building.

The statistic also reflect that marginally significant formula of $(0.05 < p < 0.1)$ may indicated that the habit of before leaving home is not significant while the others were significant especially advocating efforts. The transportation preferences and energy saving efforts shown the middle score that affect the energy conservation design based appliance.

4 Conclusion

In this study, we investigated the knowledge of energy conservation from architecture students and their implementation on design project. We specifically found that simple term of energy conservation habits like reduce the energy consumptions, promote energy conservation were easy to understand and applied in student's life rather than

Table 2 Correlation of habits and energy conservation design

Correlations						
		Energy saving	Transportation	Habit	Advocating	Saving effort
Pearson correlation	Energy saving	1.000	0.141	0.028	0.360	0.189
	Transportation	0.141	1.000	−0.085	0.012	0.036
	Habit	0.028	−0.085	1.000	0.204	−0.051
	Advocating	0.360	0.012	0.204	1.000	0.169
	Saving effort	0.189	0.036	−0.051	0.169	1.000
Sig. (1-tailed)	Energy saving	.	0.141	0.417	0.002	0.074
	Transportation	0.141	.	0.259	0.463	0.394
	Habit	0.417	0.259	.	0.059	0.349
	Advocating	0.002	0.463	0.059	.	0.099
	Saving effort	0.074	0.394	0.349	0.099	.
N	Energy saving	60	60	60	60	60
	Transportation	60	60	60	60	60
	Habit	60	60	60	60	60
	Advocating	60	60	60	60	60
	Saving effort	60	60	60	60	60

next phase of usage of renewable energy and turnoff the energy devices if we don't use it. While environment pressure to use own car/motorbike might the hardest.

Problems to be solved since it related to mass transport supplies and policies. We concluded also the knowledge of energy saving need to be applied and informed quickly after delivered on architecture course. We found that most of students didn't update the information on air conditioning and glass technologies. And lastly, we suggest that the energy saving knowledge were urgently applied in our habit and design requirement if we want to make this architect generation become more agent of energy conservation.

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