Energy Conservation in Academic Institutions: An Application of Theory of Planned Behavior

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Abstract

Energy conservation is a buzzword that cuts across a broad spectrum of stakeholders. It has been widely practiced, developed, and discussed in government, political, and industrial sectors due to its massive impact on tackling issues related to climate change and global warming as well as presenting opportunities to cut energy costs. Despite the active discussion of this topic in the literature, very few papers have discussed it in the context of academic institutions which has one of the most significant impacts in terms of energy consumption. To address the issue, this paper places the topic of energy conservation in the context of academic institutions. Moreover, it adopts the Theory of Planned Behavior to investigate the success of energy conservation initiatives in academic institutions by looking at user behavior and its antecedents. Finally, this paper contributes significantly to the literature as it is one of the very few papers and arguably the first to discuss energy conservation in the context of academic institutions using the Theory of Planned Behavior. Furthermore, this paper will be beneficial for practitioners and other stakeholders in that it provides them with a framework to investigate the success of implementing energy conservation initiatives, especially, in academic institutions by looking at the antecedents of user behavior.

Keywords: Energy conservation, Theory of planned behavior, antecedents of user behavior

1.0 Introduction

Energy conservation is a global trend that involves several sectors such as government, political, and industrial, to name a few. Such a progression is primarily a consequence of the growing issues of global warming and climate change (Ma et al., 2017). As such, scholars and practitioners maintain that one of the ways of addressing such issues is tackling the energy sector. For instance, Pacalza (2004) argue that curtailing activities that consume energy could be the cheapest alternative for stabilizing carbon dioxide (CO2) concentrations below a doubling of pre-industrial concentrations. Moreover, Jia et al. (2018) maintain that addressing energy conservation is a crucial step in tackling climate change and global warming initiatives as excessive energy consumption is responsible for energy shortages, pollutant discharge, and CO2 emissions.

Aside from tackling environmental challenges, energy conservation also presents opportunities for institutions to cut costs related to energy use. Zhang et al. (2015) maintain that for China's cement industry, energy conservation generates technical energy saving that is potentially high and is estimated to be at 4.2 exajoules (EJ) by 2030. The latter then implies the crucial role of energy conservation in tackling climate change and global warming issues in all sectors. Aside from the sectors mentioned above, energy conservation has also cut across academic institutions such as schools, and universities. For instance, Levy (1980) suggested procedures to achieve cost-effective and environmentally acceptable lighting systems that are optimized for energy efficiency, productivity, and satisfaction in the context of academic institutions. To this end, Lo & Wang (2013) maintain that academic institutions are required by the National Development and Reform Commission (NDRC) to establish long-term energy management systems while meeting targets for energy savings.

Scholars point out the need to discuss energy conservation initiatives in the context of academic institutions due to its massive impact in the energy sector (Derenski et al., 2017; Merabtine et al., 2018). For one, academic institutions, mainly, universities comprise of school buildings that utilize a significant amount of energy for computers, air conditioners, lights, electric and electronic equipment, among others. As such, these activities are significant contributors of energy consumption when taken collectively and is expected to increase by 40% in 2003 to 2050 if no action is undertaken (Mustapa et al., 2017). They are essential targets for energy efficiency due to their potential to reduce energy spending and meet energy policy goals (Derenski et al., 2017).

Despite initiatives done in the literature to address the matter, the implementation of energy conservation strategies has not been entirely successful in many academic institutions, especially in developing countries. One of the primary reasons that have been emphasized in the literature is the behavior of the consumers (Alfaris et al., 2016; Ma et al., 2017). For instance, behavioral or social factors such as communication between stakeholders, faculty and student engagement, and management buy-in, are critical success factors that affect the successful implementation of energy conservation initiatives in academic institutions (Alfaris et al., 2016). Similarly, the lack of funding or financial support has also been reported to have negatively impacted the implementation (Alfaris et al., 2016; Meron & Meir, 2017). Moreover, some scholars maintain that these behaviors are influenced by ethnicity and other cultural factors due to their tendency to shape the values, perceptions, beliefs, and ethics of consumers which cause a significant impact (Ma et al., 2017).

Azjen (1991) in his Theory of Planned Behavior argues that users' intention directly causes such behavior. Furthermore, such intention is caused by three behavioral factors namely, attitude toward the behavior, subjective norm, and perceived behavioral control. Attitude towards the behavior is "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Azjen, 1991). Subjective norm pertains to "the perceived social pressure to perform or not to perform the behavior" (Azjen, 1991). Whereas, perceived behavioral control refers to "people's perception of the ease or difficulty of performing the behavior of interest" (Azjen, 1991). Such factors are essential predictors of user behavior and have been strongly supported in the literature to have influenced the choice and preparation of activities, effort expended during the performance, thought patterns, and emotional reactions of new technology users or adopters (Bandura, 1982; Azjen, 1991). In fact, a general relationship between these factors is adopted by scholars in the literature mainly, the more favorable the attitude, subjective norms, and perceived behavioral control, the more likely it is for an individual to perform the behavior under consideration (Azjen, 1991). Hence, such factors are crucial antecedents to be investigated when addressing the successful implementation of energy conservation initiatives.

In the existing literature, there have been very few papers that demonstrate the role of such antecedents in predicting the success of an energy conservation initiative in the context of academic institutions. As such, most of the papers focused on the assessment and evaluation of the energy consumption of school buildings. For instance, Dimoudi & Kostarela (2009) assessed the energy performance based on monitored data of school buildings in Greece. Similarly, Santamouris et al. (2007) evaluated the potential for energy and environmental improvements of school buildings in Greece using an energy classification technique based on intelligent clustering techniques. Despite the efforts made by such papers, they did not focus or even discussed the influence of the antecedents established by Azjen (1991) on the energy conservation behavior of consumers (e.g., students, faculty, and administration).

Moreover, such a discussion is crucial in predicting the success of the implementation of energy conservation initiatives in the context of academic institutions as they can reliably predict the intention of the users which would, in turn, predict the success of implementation (Kaiser & Scheuthle, 2003; Liao et al., 2007). In fact, such antecedents have been applied on several occasions in the relevant literature. For instance, Yazdanpanah & Forouzani (2015) used the theory of planned behavior to investigate students' behavioral intentions concerning their purchase of organic food in Iran. Similarly, Kaplan et al. (2015) adopted the model in exploring behavioral factors that underlie tourist intentions in using urban bike-sharing for cycling while on holiday. Additionally, Paul et al. (2016) used the model in the prediction of Indian consumers' green product purchase intention. Hence, an evaluation or assessment of the success of energy conservation initiatives in the context of academic institutions using the theory of planned behavior will be significant in the literature as well as in practice.

This paper attempts to fill such a gap by demonstrating the use of the theory of planned behavior in predicting the success of energy conservation initiatives in academic institutions. Notably, a case study is performed in the College of Engineering of Cebu Technological University - Main Campus, a state university located at Cebu City, Philippines. The College of Engineering is purposively chosen due to the familiarity of the respondents to the terms used in the study. Moreover, survey research is administered to 216 respondents for which 200 are engineering students, 11 are faculty members, and 5 are administrators. The results of this paper will significantly contribute to the literature as it is one of the few papers to adopt the theory of planned behavior of Azjen (1991) in the context of energy conservation in academic institutions. Furthermore, it will serve as a guide for practitioners especially academic institutions in evaluating their readiness for energy conservation initiatives.

This paper is organized as follows. Section 2 presents the methods, instruments, and techniques used to obtain, analyze, and interpret the data. Section 3 describes the paper's case application. Section 4 discusses important results derived in the study. Finally, Section 5 provides the conclusions as well as the future directions of the paper.

2.0 Methodology

This section presents the methods used to analyze the antecedents of the implementation of energy conservation initiatives as established by Azjen (1991) in the Theory of Planned Behavior.

Theory of Planned Behavior Model

This paper adopts the questionnaire of the theory of planned behavior by Azjen (2006) to obtain the essential antecedents needed in determining the success of the implementation of energy conservation initiatives in academic institutions. The questionnaire is structured as follows.

Table 1. *Theory of planned behavior questionnaire adopted from Azjen (2006)*

Factor	Question	1	2	3	4	5	6	7
Attitude	Implementing energy conservation initiatives would be							
Perceived norm	Those people who value the university would implement the initiatives							
Perceived behavioral control	I am confident that I can personally comply with the energy conservation initiatives guidelines							
Intention	I support the implementation of energy conservation initiatives in the institution							
Past behavior	Prior to knowing about energy conservation initiatives, I have already applied energy conservation practices							

Table 1 is answered by placing a tick mark (✓) in the column corresponding to the choice. The rating scale runs from 1 to 7 such that 1 must be selected if the question is entirely unfavorable, bad, unlikely, or has a negative impression, otherwise higher values must be selected. Moreover, the data collected from the questionnaire will be used to obtain the importance weight of each antecedent as in Figure 1.

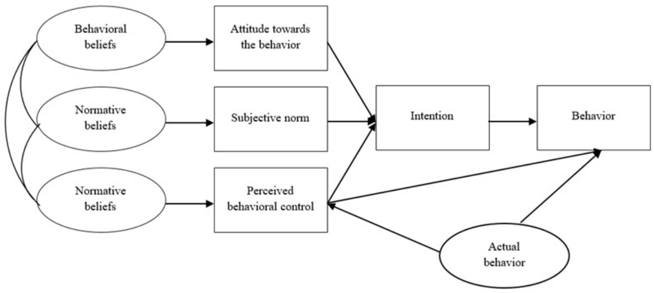

Figure 1. *Path diagram using the theory of planned behavior*

Figure 1 presents a path diagram of the antecedents of user behavior towards energy conservation initiatives in academic institutions. The concepts inside the ellipses are latent variables whereas the concepts inside the rectangles are observed variables. The arrows represent direct causality while the arcs represent the covariance between the concepts.

Simple Statistical Treatment

This section presents the treatment of the data collected from the survey questionnaire. As such, the data are treated using simple statistical treatment, particularly, by using the weighted mean for obtaining the average representation of the sample responses. The weighted mean is obtained using equation 1.

$$\bar{x}=\frac{\sum_{i=1}^{S} f_i x_i}{\sum_{i=1}^{S} f_i},\ T:S\to S,\ i\mapsto x_i,\ i\in S=(1,2,\ldots,7),\ x_i\in X=(x_1,x_2,\ldots,x_s)$$

Where, X is the set epresenting the scale from 1 to 7 of the questionnaire, f is the number of responses corresponding to the scale, and $\bar{x}$ is the weighted mean. In this paper, the weighted mean would be suitable as a representation of the average because the aggregation of the responses are in terms of the frequency of selecting a certain scale.

Case Study

A case study is performed at the College of Engineering of Cebu Technological University – Main Campus, a state university located in Cebu City, Philippines. A survey is administered to 216 respondents from the university. The sample group consists of three sub-groups composed of students (200), faculty members (11), and administrators (5) which were selected according to their awareness of energy conservation. The respondents were selected according to a non-probability sampling technique more particularly using a judgmental sampling method to satisfy the prior condition that respondents must be aware of energy conservation as well as have their positions regarding its implementation (Nadiri et al., 2008). The respondents are given the survey questionnaire presented in Table 1 and are asked to rate according to the scale provided.

3.0 Results and Discussions

This section presents the results in terms of three perspectives: (i) student, (ii) faculty member, and (iii) administrator. As such, this is important in determining if a disparity between the intentions and behavior of the subgroups vary greatly.

Table 2. *Summary of Results*

Perspective	Factor	1	2	3	4	5	6	7	Mean	Normalized Mean
Student	Attitude	1	2	2	59	40	36	60	5.42	0.77
	Perceived norm	24	36	45	50	43	2	0	3.29	0.47
	Perceived behavioral control	36	18	24	78	24	18	2	3.49	0.5
	Intention	12	12	6	78	72	9	11	4.29	0.61
	Past behavior	72	30	40	45	5	4	4	2.55	0.36
Faculty Member	Attitude	0	0	3	8	0	0	0	3.73	0.53
	Perceived norm	0	0	9	0	0	2	0	3.55	0.51
	Perceived behavioral control	0	0	4	0	4	3	0	4.55	0.65
	Intention	2	2	1	6	0	0	0	3	0.43
	Past behavior	0	0	8	3	0	0	0	3.27	0.47
Administrator	Attitude	0	0	0	0	5	0	0	5	0.71
	Perceived norm	0	0	0	2	2	1	0	4.8	0.69
	Perceived behavioral control	0	0	4	0	0	0	1	3.8	0.54
	Intention	0	0	0	2	2	1	0	4.8	0.69
	Past behavior	0	0	0	0	3	1	1	5.6	0.8

It can be observed from Table 2 that variability between the subgroups occurs. For instance, for the factor 'attitude', it can be observed that the students have the most favorable attitude towards the initiative whereas the faculty members have the least favorable attitude towards it. On the other hand, when looking in terms of perceived behavioral control, the faculty members appear to have more confidence in their behavior if the policy is imposed. Drawing inference from that, it can be said that although students are the most enthusiastic of the initiative, they have the lowest confidence on their behavior when the policy is imposed. However, for the faculty members, the latter is completely reversed. A probable reason why faculty members would have the least support (i.e., as evident in Table 2 when looking in terms of 'intention' and 'attitude') on the initiative would be because among the three subgroups they are the most negatively affected by the long-term effects of the policy which may cause them to create negative biases on the policy. For instance, if electronics use is minimized, their task is most affected (e.g., inability to extend the class experience using auxiliary tools such as those that utilize more computer use) in contrast to the other two. Moreover, such negative biases may also be caused by the prior negative experience of faculty members (i.e., as evident in Table 2 when looking in terms of perceived behavioral control).

In this paper, it can be observed that faculty members have the least intention to implement the energy conservation initiatives. On the other end, the administrators have the highest intention to implement the initiatives. Such a result could be due to the goal of the administrators to reduce operational costs. The students' intentions, however, lie in between the two extremities as expected since among the subgroups they would feel the least obligated in implementing the initiatives.

4.0 Conclusion and Future Works

The theory of planned behavior by Azjen (1991) provides an insightful framework in making inferences between the antecedents of user behavior. In this paper, the theory was used to infer how the antecedents would dictate the intentions and behavior of the subjects. Moreover, such inference is extended to compare the behavior of the three subgroups in the attempt to detect a disparity between them regarding their behavior towards the energy conservation initiatives. The methodology adopted in this paper contributes to the literature in that it is one of the very few papers and arguably the first to adopt the theory of planned behavior to analyze user behaviors on energy conservation in the context of academic institutions. Moreover, this paper is beneficial to practitioners in that it provides them with a basis on predicting the success of initiatives under different perspectives that may be possibly conflicting particularly in energy conservation of academic institutions which is a potential target for energy conservation initiatives.

On the contrary, due to the limitations of this paper such as space and resources, the study was only able to use simple statistical techniques to analyze the data which may have inferior statistical power as compared to more advanced techniques. As such, the comparison was not supported by powerful and robust statistical tests but only inferred descriptively. Moreover, the paper did not go further in performing path analyses which may be crucial in making more powerful interpretations of the data such as revealing the characteristics of the latent variables, quantifying the magnitude of the causality, or even verifying the causality established by the theory. Thus, for future works, this paper recommends performing more advanced statistical tests such as path analysis, factor analysis, and other structural modeling methods such as DEMATEL to establish more powerful and robust interpretations.

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