

Understanding College Students' Perception of Green Building Products

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Abstract: Sustainability continues to gain traction in all industry sectors as people become aware of the advantages of green products. The voluntary use of green products in buildings in the United States continues to grow due to long-term cost saving and the ecological benefit to nature. The voluntary installation of green products is associated with end-users' expectations and perceptions including cost saving, sustainable behavior, and social responsibility. Although involuntary use of green products has similar expectations and perceptions, the installation decision is not based on the goodwill from end-users. This paper surveys college students to capture current experience levels, expectations, and perceptions in regard to green products and/or sustainability and to understand their attitudes about involuntary use of a green product. The installation of low water pressure showerheads in a dormitory provides data to support perception, expectation, and future direction of adoption of green products in public buildings. This information may be used to facilitate sustainable behaviors among involuntary groups regarding to the adoption of green products. The primary objective of this paper is to investigate the college students' perception of a green product, particularly when the students are involuntarily exposed to the green products. As a secondary objective, the paper also attempts to address the college students' general understanding on sustainability and green products. The findings of this study could support the growing importance of sustainable behavior among higher education beyond social responsibility and provide a benchmark against which to improve future change while fostering sustainable behaviors over time among the public.

Keywords: Green Product, Sustainability, Perception, Involuntary Use, College Student

I. INTRODUCTION

Over the past decades, concern over the environment has been increasing around the world. Considerable effort has been made to address various environmental issues in different subject areas: human overpopulation, natural disaster, intensive farming production, excessive waste, water contamination, nuclear technology, sustainable manufacturing and green products. Green products are closely related to everyday human life. Diverse illustrative words are being used to effectively describe the nature of green products such as recyclable, sustainable, ecological, biodegradable, environmentally-friendly, eco-friendly, earth-friendly, planet-friendly, or going-green, but the implications of every descriptive word are essentially alike in the sense that the green products are manufactured with consideration of healthier living for the planet and its inhabitants.

Much research has been done to explore green products and the relevant consumer purchasing behavior or green consumerism. Follows and Jobber [1] tested a consumer model of environmentally responsible purchase behavior and concluded that an environmentally negative product can be disadvantaged by consumers when they consider the environmental impact of products more seriously. In contrast, an environmentally positive product may not be purchased, despite its environmental benefit, if negative consequences for the individual result from its use.

For example, a relatively less functional green product may not be purchased, in contrast to a counterpart conventional

(non-green) product that provides superior functionality. It is interesting to observe this conflict perception between the consumers' attitude toward the environment and individual consequences in their purchasing behavior. Gupta and Ogden [2] more extensively explored this attitude-behavior gap in green consumerism. Their study indicated that the green product purchasing behavior is greatly influenced by not only the consumer's attitude toward environment, but the consumer's self-interest. Aligned with the previous example, if the cost of a green product is not within the consumer's expected price range, it is highly unlikely that the consumer would buy it, despite his/her environmentally positive attitude. Young et al [3] also conducted a comparable study in the United Kingdom (UK) addressing the attitude-behavior inconsistency among consumers, showing that there are several important and unique factors that force the self-declared green consumers to buy more green products. For these referenced studies on green product purchasing behavior, it should be noted that one of the underlying assumptions is that the green consumers voluntarily make decisions on their purchase.

Although a considerable amount of work has been done and is available in the literature with respect to consumer's voluntary behavior in regards to green products (purchase and use), there is a lack of studies addressing the people's perception of green products when the products are not purchased by the end-users, but provided by others (i.e., involuntarily use of a green product). For example, it is commonplace in the United States (US) for universities to mandate that undergraduate students live in a campus

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dormitory during their freshmen year. Even if living in a dormitory is not required, some students choose to live in a dormitory for their own reason. The dormitory buildings are usually furnished with fixtures, some of which may be energy saving products. These types of energy saving fixtures may include light bulbs, showerheads, plumbing fixtures (toilet and urinals), etc. While the voluntary purchase and consumption of green products are directly associated with end-user's perception on the environment (e.g., sustainable behavior or social responsibility as so-called an Earth Citizen), the involuntary use of green products may provide different perception and insight from the end-user's standpoint.

With this background, the primary objective of this paper is to capture the perception of green products, purchasing behavior, and sustainability in general among college students. To accomplish the objective, the study surveyed college students using a structured questionnaire. For example, a water-saving showerhead installed in dormitory buildings at a university is employed as a green product; students living in the selected buildings use this product involuntarily. The water flow rate, water volume, and water pressure of the water-saving showerhead are relatively less than those of a regular showerhead for a water-saving purpose, and consequently its level of serviceability or functionality may be considered inferior to regular showerheads to some students.

II. SURVEY DESIGN

A. Sample Collection

To accomplish the objective of this study, sample data was collected using a questionnaire survey administered during randomly selected regular classes at two regional universities located in the US. A total of 242 students participated in the survey. The entire sample was used to determine the college students' perception of green products, purchasing behavior, and sustainability in general. Forty seven students from the sample were identified as having the experience of using a water-saving showerhead in the dormitory. Those 47 survey responses were used for investigating a college students' perception of the involuntary use of green products to accomplish a part of the research objective.

B. Questionnaire Design and Sample Measure

The questionnaire is designed in two parts. The first part of the questionnaire provides general demographic data about the respondents such as the current year at the university, gender, major, academic standing, and age group. This data was employed to explore the perceptions of green products and sustainability among the students by specific groups: gender, academic standing or grade point average (GPA), and educational background or major. The second part of the questionnaire is further divided into three subgroups; each of the subgroups deals with the

following subject: 1) general perception of sustainability, 2) sustainability education, and 3) green product purchase behavior.

Most of the questions were based on five-point Likert scales (e.g., 1=strongly disagree to 5=strongly agree; or 1=not confident to 5=strongly confident, depending on the type of question). Two yes-or-no questions (Questions #1 and #4 under Part II) were also asked. Table 1 summarizes the questionnaire content and wordings.

TABLE 1
 SUMMARY OF QUESTIONNAIRE CONTENT AND WORDINGS

<p>Part I: Demographic Questions</p> <ol style="list-style-type: none"> 1. Year in the university (Freshman, Sophomore, Junior, Senior)^a 2. Gender (Male, Female)^a 3. Major^a 4. Grade Point Average^a
<p>Part II: Questions related to Sustainability and Green Products</p> <ol style="list-style-type: none"> 1. Have you ever heard about the concept of sustainability?^b 2. Are you familiar with sustainability?^c 3. What is your level of knowledge in sustainability?^c 4. Have you ever taken any courses related to sustainability?^b 5. Do you think the classes of sustainability affect your attitude toward the environment and sustainability?^c 6. I believe that higher education must teach sustainability for a complete undergraduate curriculum.^c 7. I consider sustainability when I purchase products.^c 8. Do you think you should pay extra money for sustainable building products?^c 9. Do you have any experience installing or using any green products such as energy-saving bulbs?^c 10. I believe that it is very important to use green products instead of conventional products?^c 11. How concerned are you about saving water in your daily activities?^c
<p>Note: ^a Categorical question, ^b Yes-or-no question, ^c Five-point Likert scale (1, Unfamiliar or Not confident or Poor or Strongly disagree, Very concerned, Very dissatisfied, ... 5, Very familiar or Very confident or Excellent or Strongly confident or Strongly agree or Not concerned at all or Very satisfied).</p>

III. RESULTS AND INTERPRETATION

A. Part I: Demographic Information and General Sustainability Concept

The sample was evaluated using current academic year, gender, major, and GPA. Although the research team attempted to collect random sample data, the gender sample distribution was found to be skewed toward male participants. The male sample group accounts for about two thirds of the entire surveyed data. This is attributed to the fact that more than half of the samples were collected from Engineering College classes in which male students are predominant at the surveyed universities. Under the "Major" category, it was of specific interest for the research team to explore the difference in sustainability perception between the construction related student group, and other major student group. This analysis is interesting because it is hypothesized that the construction related students would be more knowledgeable and concerned about green building and green building products. This hypothesis is statistically tested and the result is discussed in a later section of this paper. In terms of current academic

year of the survey respondents, the freshman and graduate students have the lowest participation in the survey (4.2%) in comparison to the sophomore, junior, and senior students (95.8%). The academic standing or GPA data of the sample was also collected and showed normally distributed samples.

B. Part II: Perception of Sustainability

Table 2 presents the results of Part II of the questionnaire which includes: discover students' perception of sustainability knowledge, sustainability education, and green product purchase behavior. As indicated, Part II has three sections and each section consists of three to five questions that are designed with a different perspective. In the table, it is to be noted that the number of respondents varies slightly for each question because a blank response was not included in the data analysis.

In the first section of the questionnaire that deals with the level of familiarity/knowledge of sustainability, 86.4% of the students responded that they have heard of the sustainability concept (Question #1) and about 35% of the students positively express their familiarity with sustainability selecting the Likert scales 4 and 5 on Question #2. The average scale (3.02/5.0) indicates the familiarity level over the entire sample is mediocre. Interestingly, however, the students seem to be less confident about their knowledge of sustainability relative to their level of familiarity, as evidenced by only 18.2% of the students selecting scales 4 and 5 on Question #3 where the students were asked about their sustainability knowledge level. The scale average (2.52/5.0) also supports this finding. This result could be interpreted that a number of students are exposed to the so-called "green" concept via media, internet, book, conversation, etc., and thus they believe they are quite familiar with the concept, but rarely exposed to a formal type of sustainability education where they would be intensively educated about sustainability. It is supposed that they feel less confident about their knowledge level on sustainability. This conjecture is supported by the result of the second section of Part II.

The second section of Part II investigates students' thoughts on sustainability education. On Question #4, about two thirds of the respondents (70.5%) said that they had not taken any sustainability-related courses at the time of the survey, which is aligned with the response of the Question #3 result in the first section of Part II. 46.1% of the respondents select scales 4 and 5 on Question #5, indicating that the sustainability education influences their attitude toward the environment, whereas only 16.9% of the students select scales 1 and 2 expressing that the education does not. The average scale for this question is found to be 3.41 leaning toward a positive opinion about sustainability education. For Question #6 that asks the need for a sustainability course under the undergraduate curriculum, 42.7% of the students select scales 4 and 5 with the scale average of 3.32. This result is in agreement

with the positive perception found in Question #5. However, the same portion of the students (42.7%) also select the mediocre scale (scale 3) and only 14.5% of students select scales 1 and 2. This result may suggest that a sustainability course be developed as an elective or part of a certificate program in lieu of incorporating a required sustainability course in the curriculum. These options could be viable alternatives for students to learn about sustainability topics.

The third section under Part II consists of five questions exploring the green product purchase behavior of students. For Question #7, the scale average of 3.30 indicates that the students tend to consider sustainability when they purchase products. However, the result of Question #8 suggests that they would not spend extra money to purchase green products. A scale average of 2.88 is found for this question. This attitude-behavior dilemma is comparable with the findings from previous studies (Follows and Jobber, 2000; Gupta and Ogden, 2009; and Young et al, 2009) as described in the introduction. More than half of the respondents (57.7%) on Question #9 indicate that they have had an experience using energy-saving products. Consistent with this response, the result of Question #10 is also positive in regard to the level of importance of green products. The respective scale average for Questions #9 and #10 is found to be 3.42 and 3.63 indicating their positive attitude about green products. Question #11 seeks the student perception on concern about saving water. The response to this question reinforces the attitude-behavior gap issue once again because the scale average of 3.01, which is mediocre, indicates that the students tend to have conflict, between using enough water for self-satisfaction and saving water for sustainability, when they use water in daily activities (e.g., showering, washing, cleaning dishes, etc.).

TABLE 2
 SUMMARY OF SURVEY RESULT OF QUESTIONNAIRE PART II

II	N	1	2	3	4	5	Avg.	Std.
Section 1. Awareness and Knowledge								
Yes: 209 (86.4%), No: 33 (13.6%)								
1	242							
2	236	27 11.4%	43 18.2%	84 35.6%	55 23.3%	27 11.4%	3.02	1.15
3	242	39 16.1%	82 33.9%	77 31.8%	32 13.2%	12 5.0%	2.57	1.06
Section 2. Sustainability Education								
Yes: 71 (29.5%), No: 170 (70.5%)								
4	241							
5	230	15 6.5%	24 10.4%	85 37.0%	64 27.8%	42 18.3%	3.41	1.10
6	241	8 3.3%	27 11.2%	103 42.7%	87 36.1%	16 6.6%	3.32	0.88
Section 3. Purchase Behaviour								
7	241	6 2.5%	35 14.5%	93 38.6%	95 39.4%	12 5.0%	3.30	0.87
8	241	21 8.7%	66 27.4%	81 33.6%	67 27.8%	6 5.0%	2.88	0.99
9	241	15 6.2%	33 13.7%	54 22.4%	114 47.3%	25 10.4%	3.42	1.05
10	240	4 1.7%	15 6.3%	59 24.7%	102 42.7%	26 10.9%	3.63	0.84
11	239	21 8.8%	52 21.7%	92 38.3%	53 22.1%	22 9.2%	3.01	1.08

C. Part III: Involuntary Use of a Green Product

The third section of the survey explored college students' perceptions of the involuntary use of a green product. Among the 242 students who responded to the survey, 47 were identified as residing in a dormitory and thus having experienced using the water-saving showerheads. The results for Part III are presented in Table 3.

TABLE 3

Summary of the Survey Results: Questionnaire Part III

Part III Question No.	N	Proportion (%)
1. Awareness of the showerhead		
Yes	32	68.1
No	15	31.9
Total	47	100.0
2. Amount of shower time		
< 5 min.	5	10.6
5 – 10 min.	18	38.3
10 – 20 min.	23	48.9
> 20 min.	1	2.1
No answer	0	0.0
Total	47	100.0
3. Satisfaction with the showerhead*		
Very dissatisfied	1	2.1
Dissatisfied	10	21.3
Neutral	17	36.2
Satisfied	8	17.0
Very satisfied	4	8.5
No answer	7	14.9
Total	47	100.0
Likert Scale Average: 3.10		
4. If not satisfied, the reason		
Water pressure	22	46.8
Appearance	2	4.3
Control	4	8.5
Cleaning	8	17.0
Other	5	10.6
No answer	6	12.8
Total	47	100.0
5. Favourite feature		
Massage function	5	10.6
Appearance	3	6.4
Cleaning	8	17.0
Other	9	19.1
None	15	31.9
No answer	7	14.9
Total	47	100.0

Note: *Five-point Likert scale (1=Very dissatisfied, ... 5=Very satisfied)

In Question #1, the students were asked whether they were aware of the green characteristics of the showerhead. One third of the students had not even realized that the showerhead in the dormitory was an energy-saving green product. In Question #2 which asked about the average shower time, about half of the students thought that they took 10 to 20 minutes, while 38.3% and 10.6% of the students responded that they took 5 to 10 minutes and less than 5 minutes, respectively. Only one person claimed to take a shower that was longer than 20 minutes. Questions #3 and #4 dealt with the most important aspect of this part of the survey. An average score of 3.1 was reported for Question #3, indicating that the students' level of satisfaction with the water-saving showerhead leaned very slightly towards favorable, with about a quarter of the students (25.5%) selecting 4 and 5, and a similar portion

(23.4%) selecting 1 and 2. When asked for reasons for their dissatisfaction, 22 of the 47 students (46.8%) singled out the water pressure, indicating that it is the water-saving showerhead's lower water pressure that diminishes the users' satisfaction and the perceived serviceability level of taking a shower with the green showerhead product. A number of other minor reasons were also mentioned by the students, including the showerhead's appearance, controls, and cleanliness. In the final question, Question #5, when students were asked to name a favorite feature of the showerhead, 31.9% said they had no favorite feature, reflecting the earlier complaints about the showerhead.

IV. SUSTAINABILITY PERCEPTION BY GENDER, MAJOR, AND ACADEMIC STANDING

The survey results and interpretation presented in the previous section are primarily discussed on whether the responses on each question are toward negative opinion (i.e., scales 1 and 2) or positive opinion (i.e., scales 4 and 5). This section explores the association of the responses with the survey participants' characteristics, specifically students' gender, educational background, and academic standing by a statistical means.

A. Gender Difference in Sustainability

Zelezny et al. [4] studied gender differences in general environmental attitudes and behaviors across 14 countries and concluded that there was strong evidence to claim that the environmentalism was dependent upon gender and that the female gender has stronger attitudes and behaviors than the male gender. Zelezny's finding [4] is in agreement with the finding of our study on Questions #2 and #3 of Section 1. The p-values on these questions are less than the threshold value of 0.05 as shown in Table 4.

Table 4

P-VALUES FROM THE CHI-SQUARE TEST AND ASSOCIATION DECISION

II	Gender		Major		GPA	
	P-value	Assoc-iated	P-value	Assoc-iated	P-value	Assoc-iated
Section 1. Awareness and Knowledge						
2	0.005	Yes	0.988	No	0.007	Yes
3	0.006	Yes	0.020	Yes	0.091	No
Section 2. Sustainability Education						
5	0.174	No	0.064	No	0.152	No
6	0.403	No	0.007	Yes	0.859	No
Section 3. Purchase Behaviour						
7	0.042	Yes	0.831	No	0.000	Yes
8	0.428	No	0.080	No	0.026	Yes
9	0.769	No	0.891	No	0.480	No
10	0.441	No	0.308	No	0.371	No
11	0.052	No	0.479	No	0.300	No

For Question #2, the analyzed data indicates that 70% of the female students select the positive answers (scales 4 and 5), while only 46% of the male students express the

positive answer; similarly for Question #3, 21% of male students select the positive answers, while 42% of female students select them.

In regard to the Sections 2 and 3 topics (sustainability education and green product purchase behavior), no statistical evidence was found to claim the positive or negative opinions on the questions differ by the student gender with the exception for Question #7: I consider sustainability when I purchase products. For this particular question, the analysis result by proportion indicates that male students tend to consider sustainability more when they purchase products. Except for Question #7, the result turned out to be against the findings from many of the previous studies [4-7] where they concluded that there were gender differences in similar topics such as environmental attitude, responsibility, peer influence, and green purchasing products. However, a few other studies claim that there is no difference in those topics [8, 9]. Based on the findings on this gender issue on environment, it appears that the result depends largely on the characteristic of the sample population used for each study.

B. Educational Background Difference in Sustainability

A similar analysis was carried out for the educational background. As mentioned in the introduction section, the entire sample group is divided into two subgroups: students whose major is Construction related are assigned a subgroup; and the rest of the students a counterpart subgroup. The results show that for all questions except for Questions #3 and #6, there is no evidence of a difference between Construction related and other major students with respect to the topics being asked. For Question #3, it is interesting to see the results. Only 14% of the Construction related students say that they are confident or very confident about their knowledge of sustainability, while 28% of the other major students expressed their confidence on the level of sustainability knowledge. For Question #6, 89% of the Construction related students positively say that the sustainability course needs to be incorporated into undergraduate curriculum, while 68% of the other major students have the same opinion.

C. Academic Standing Difference in Sustainability

Under this category, students who have a less than 3.0 GPA are assigned in a subgroup; and students who have an equal or over 3.0 GPA a counterpart subgroup. Students' responses of three out of nine questions under Part II were found to have an association with the students' academic standing or GPA. For Question #2, the better GPA student group show more familiarity (63%) than the academically less performing group (41%). For Question #7, the better performing group (75%) seems to consider sustainability more when purchasing products than the opposite group (43%). For Question #8, 53% of the better GPA students present the positive expression when spending extra money

on buying green products. Only 35% of the counterpart students express the same opinion.

V. CONCLUSION

Understanding college students' perception of green building products is important because they soon become the generation driving the economy and building and maintaining a sustainable society in the future. The findings of this study could support the growing importance of sustainable behavior among higher education students beyond social responsibility and provide a benchmark against which to improve future change to sustainability education while fostering sustainable behaviors over time among the public. The study presented shows different insight on given sustainability topics. As shown in the findings, it is quite challenging to draw a concrete conclusion on the subject based on limited number of regionally constrained sample data. However, we believe that the survey results would provide evidences that support some of the previous study results and could be references for the future studies on similar subjects.

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