A Study of ASU-Students Behaviors towards Energy Conservation for Environmentally Sustainable

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Abstract: - Due to the increasing environmental challenges faced globally, sustainability has emerged as a key focus in the policies and future strategies of various sectors, particularly in higher education institutions. Energy conservation is becoming a vital component of universities' approaches to sustainability, which can be best understood through collaboration between universities and their students. This study investigates students' attitudes toward energy and their reported environmental behaviors related to energy consumption, in addition to their views on their university's energy-saving initiatives, using an electronic survey. The sample included 134 male and female students from the Applied Science Private University, representing different colleges within the university. Female students comprised 59% of the sample, while male students accounted for 41%, with the majority being over 20 years old at a rate of 66.4%. The findings indicated high averages concerning the handling of appliances and light bulbs, routine maintenance of electrical devices, thermal insulation of homes, and the adoption of modern methods for energy conservation. The results did not reveal a statistically significant relationship between students' energy consumption behaviors and the variables of gender, age groups, colleges, or parents' education levels. However, ANOVA analysis indicated statistically significant differences favoring students whose parents had an average income of 500-1000. The university has made considerable investments in the renewable energy sector. Analyzing and understanding elements such as curriculum, community, and campus will assist in evaluating their characteristics to enhance the effectiveness of Education for Sustainable Development (ESD) in achieving the Sustainable Development Goals (SDGs).

Key-Words: - Energy saving, Sustainable Energy, Education for Sustainable Development (ESD), Higher Education Institute, Sustainable Development Goals (SDGs), Electricity Saving Practices.

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1 Introduction

The availability of energy has significantly changed the trajectory of human development since the Industrial Revolution. Following the use of fossil fuels, there has been a shift towards nuclear, hydropower, and various renewable technologies. For at least the past fifty years, primary energy consumption has risen almost every year on a global scale, [1]. Total energy consumption encompasses the energy used for electricity, transportation, and heating. It is essential to recognize that while "electricity" and "energy" are often used interchangeably, electricity represents only one aspect of total energy consumption. Energy efficiency plays a crucial role in addressing climate change at both individual and organizational levels, [2]. Patterns such as consumer behavior and household energy use are identified as crucial elements in the transition toward

lower carbon emissions. Therefore, efforts to promote energy-saving behavior changes form an important part of the policy agenda, [3]. Jordan is working to improve energy efficiency and reduce energy consumption. The annual growth rate of energy consumption was -4.7% in 2021. Negative values indicate that energy consumption was lower than in the previous year, [4], [5], [6], [7].

The role of education in ensuring a more sustainable future is unquestionable. The recent United Nations 'Decade of Education for Sustainable Development' (DESD) (UN 2005–2014) has provided a focal point for the development of various educational initiatives.

the overarching goal of integrating the values of sustainable development into all aspects of learning and, ultimately, encouraging behavior change, [7]. Universities have a key role, as has been highlighted consistently in policy documents, [8], [9]. This suggests that enhancing energy literacy throughout all levels of education has an important role to play in encouraging energy-saving behavior. A successful shift into a stable future will rely on the ability of the average citizen to make appropriate energy-related choices that range from mode of transportation to consumer purchases and voting habits, [10].

There is a clear need for customized strategies to encourage energy-saving habits among university students in areas with extreme weather conditions, such as hot summers and cold winters, regarding subjective norms [10], understanding of energy conservation, and the importance of saving energy. We examined how influencing factors are associated with energy conservation behaviors. Our findings indicate that both the significance of energy conservation and subjective norms significantly drive energy-saving actions; distinct factors impact different forms of energy-saving practices; and the inclination to save energy partially mediates the relationship between comfort choices and the significance of energy conservation.

The objective of this research was to investigate students' practice of energy consumption to explore their attitudes and reported behaviors regarding energy saving, using data collected from an electronic survey. Piloting of the survey instrument has revealed several interesting insights into student energy literacy. Reported knowledge of energy was correlated with actual knowledge on a series of factual questions, and no significant differences were observed across genders.

2 Materials and Methods

A cross-sectional online study was conducted with students from Applied Science Private University through the Microsoft Teams platform. The questionnaire consisted of multiple sections. One section addressed sociodemographic status, featuring questions regarding gender, age, level of study, faculty, parental education level, and family income level. Additionally, the cumulative average was utilized as a common measure of academic achievement. Another section concentrated on environmental behavior related to energy consumption and included 16 questions. The results were analyzed based on demographic characteristics. Data analysis was carried out using SPSS, version 22The Mann-Whitney test will be used to test gender, age, and faculty members, while analysis of variance (ANOVA) will be used to test the source of the income variable and the Kruskal-Wallis test will be used to test other variables.

3 Results

3.1 Participants

The study sample consisted of 134 male and female students from the Applied Science Private University from various colleges of the university. The percentage of students from humanities colleges was 19.4%, and 80.6% from science colleges. The percentage of female students was 59%, and the percentage of male students was 41%, most of them were from the age group older than 20 years, at a rate of 66.4%. The percentage of students who live in the capital, Amman, was 94.8%, and the percentage of students whose average family income exceeded 500 dinars was 80.6%. Nearly half of the parents of the sample students had a bachelor's degree, and one-third of the parents of the sample students had a high school education (Table 1, Appendix).

3.2 Reliability Coefficient

A sample of 47 students was used to calculate the reliability coefficient. All of the statements in this questionnaire have a high Cronbach alpha coefficient of 0.833.Mann-Whitney, Kruskal-Wallis Test, and one-way analysis of variance (ANOVA) were used to compare the data based on demographic factors. The Statistical Package for Social Sciences (SPSS) version

22 was used. The level of significance was set at ($P \leq 0.05$).

There are sixteen questions in this questionnaire related to how students behave in relation to the environment and energy use. The Likert scale used for these items has three points: always = 3, sometimes = 2, and rarely = 1. The means and standard deviations for the statements are presented in (Table 2, Appendix).

We note from Table 2 (Appendix) that the expressions have high averages regarding dealing with appliances and light bulbs, regular maintenance of electrical appliances, thermal insulation of homes, and the use of modern means to rationalize energy consumption (Table 2, Appendix).

The results of the Mann-Whitney test from the previous table showed that there is no statistically significant relationship between students' behavior toward rationalizing energy consumption and the variable of gender, age groups, or colleges. The Kruskal-Wallis test also showed that there is no statistically significant relationship between students' behavior toward rationalizing energy consumption and the variable of the governorate to which it belongs. The student or the education level of the parents, while the results of the ANOVA analysis showed that there were statistically significant differences in favor of students whose parents' average income was 500-1000 (Table 3, Appendix).

4 Discussion

Discussion about our university's role in sustainable development has existed from an environmental perspective. It has engaged in 'campus greening ', sought to develop education for sustainability, and has initiated a range of projects to enhance awareness of and action for sustainable development. The increase in engagement has been driven by higher education targets for carbon reduction and the impact on students' behaviors concerning energy consumption. The university has made a huge investment in the renewable energy sector. This project will cover 100% of ASU's electrical consumption by renewable energy (Awada et al., 2024). In an attempt to study electricity-saving practices in ASU students, we conducted a questionnaire on students from different faculties. Generally, found between attitudes and energy-saving behavior ASU students' behavior is excellent compared to Portuguese students' behavior; there was little correlation. Whereas Portuguese students showed differences between genders in terms of practices. [16], [17], but in ASU students the practices did not depend on gender. The same was also observed across different age groups and faculties, [12]. This was confirmed by a study conducted on German students, [13]. Our findings match those from Europe, where students are already taking part in energy-saving activities, [14], [15]. Our results were in agreement with the results from OECD countries where power saving practices is positively affected by family income. This is in contrast with results from 22 European countries that had no effect on energy-saving practices.

Embedding education for sustainability within the curriculum has strong potential for universities to influence students' energy-saving behavior. In theory, sustainability across the campus and the curriculum is interrelated; students learn not just from the formal curriculum but also from the informal, through social experiences and the campus environment. In practice, sustainability work related to energy saving on campus is rarely integrated with teaching, learning, and the wider student experience. Energy saving will continue to be as critical for universities as for businesses and households worldwide, particularly for standard carbon reduction targets. Other factors, such as social media, news, and family and friends, are the most responsible for providing knowledge, attitudes, and practices to students. Understanding and analyzing the development of elements such as curriculum, community, and campus will help assess their characteristics to maximize the effectiveness of Education for Sustainable Development (ESD) in supporting the achievement of the Sustainable Development Goals (SDGs).

4.1 Recommendation and Values

It is best to use these methods to save energy. Awareness and Education: Hold meetings and local activities to teach people about why saving energy is important, how they can do it, and what good things come from it.

Encourage Energy-Saving Habits: Ask people to do things like turning off lights and unplugging electronics when they are not being used.

Also, suggest using appliances that use less energy and smart home tools that help manage energy use better.

Offer Rewards for Saving Energy: Give people and businesses real and money rewards if they use less energy.

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The authors equally contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

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Conflict of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

APPENDIX

Table 1. Demographic characteristics

construct		frequency	percent
Gender	Male	55	41.0
	Female	79	59.0
Age	less than 20	45	33.6
	greater than or equal 20	89	66.4
Faculty	Humanities	26	19.4
	Scientific	108	80.6
Governorates	north	2	1.5
	middle	127	94.8
	south	5	3.7
Average family income	less than 500	26	19.4
	500-1000	64	47.8
	greater than 1000	44	32.8
Level of study for father	secondary	41	30.6
	Bachelor's	71	53.0
	Postgraduate studies, Master's or Doctorate	22	16.4
Level of study for mother	secondary	53	39.6
	Bachelor's	69	51.5
	Postgraduate studies, Master's or Doctorate	12	9.0

Source: Done by researcher

Table 2. Means and standard deviations for the statements

No.	Environmental behavior towards energy consumption	Mean	Std. Deviation	Attitude
1	Turn off lights and electrical appliances before leaving the house.	2.8209	.40394	always
2	Turn off light bulbs in unused rooms.	2.8209	.43960	always
3	Utilize as much sunlight as possible to illuminate the house during the day.	2.79851	.487125	always
4	Replace incandescent lamps with energy-saving lamps.	2.7388	.53352	always
5	Spread the laundry in the open air, and take advantage of the summer sun to dry the laundry instead of using an electric laundry dryer.	2.7164	.54306	always
6	Regular maintenance of electrical appliances to extend their life, and rationalize their electricity consumption	2.5746	.61774	always
7	Thermal insulation of the house, which is done by calibrating the windows, closing the cracks, placing insulating materials such as silicone around the window frames, using double-glazed windows, and replacing the broken glass	2.5672	.64245	always
8	Avoid frequent opening of the refrigerator; This leads to the exit of cold air, and increases the consumption of electricity to cool it again.	2.5224	.69061	always
9	Choose light colors for furniture and walls; Because it reflects light and reduces the use of light	2.5224	.69061	always
10	Replace small bulbs with one large bulb.	2.5075	.66881	always

No.	Environmental behavior towards energy consumption	Mean	Std. Deviation	Attitude
11	Cleaning light bulbs from accumulated dust that blocks the light	2.4925	.70173	always
12	Use low lighting while watching TV	2.4925	.61002	always
13	Reduce the use of electric heaters and use solar heaters instead of electric ones	2.4478	.76155	always
14	Set the temperature inside the house to 24 degrees Celsius in the summer, and between (20-21) degrees Celsius during the day in the winter	2.4328	.68768	always
15	Use lamps whose operating time can be adjusted; So that it stops working automatically	2.2239	.84641	sometimes
16	Refrain from lighting fences and gardens	2.1194	.78563	sometimes
Alpha Cronbach = 0.833		2.5499	.36102	always

Source: Done by researcher

Table 3. Mean and standard deviation the name of test and the p-value

Variable	**Category**	**N**	**Mean**	**Std. Deviation**	**Sig. of using test**	**Mean Rank**
gender	male	55	2.5591	.38006	Mann-Whitney Test P= 0.757	68.74
	female	79	2.5435	.34947		66.64
age	less than 20	45	2.5222	.38577	Mann-Whitney Test P= 0.677	65.54
	greater than or equal 20	89	2.5639	.34926		68.49
faculty	scientific	108	2.5532	.37008	Mann-Whitney Test P= 0.715	68.10
	humanities	26	2.5361	.32700		65.02
Governorates	North	2	2.5938	.30936	Kruskal-Wallis Test P = 0.394 Chi-Square= 1.865	69.25
	Middle	127	2.5408	.36233		66.56
	South	5	2.7625	.33773		90.60
source of income	less than 500	26	2.4880	.37709	ANOVA F =3.206 P = 0.044	
	500-1000	64	2.6309	.32916		
	greater than 1000	44	2.4688	.37802		
level of study for father	secondary	41	2.5716	.35481	Kruskal-Wallis Test P = 0.735 Chi-Square=0.617	69.51
	Bachelor's	71	2.5299	.35792		65.11
	Postgraduate studies, Master's or Doctorate	22	2.5739	.39464		71.48
level of study for mother	secondary	53	2.6073	.34329	Kruskal-Wallis Test P = 0.147 Chi-Square=3.833	73.18
	Bachelor's	69	2.4900	.36280		61.29
	Postgraduate studies, Master's or Doctorate	12	2.6406	.39719		78.13

Source: Done by researcher