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# Exploring students' pro-environmental knowledge and behaviour perceptions: a mixed methods investigation

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**ABSTRACT**

This study explored university students' pro-environmental knowledge and self-reported pro-environmental behaviours, and the influence of environmental education on their knowledge, beliefs and behaviour. This study also investigated the difference in forming pro-environmental behaviours across gender types and academic majors. The Theory of Planned Behaviour was used to frame the study and to understand if knowledge and beliefs translate into pro-environmental behaviours.

A mixed-method approach was taken to achieve the research objectives. The participants comprised of 226 undergraduate students from a leading university in Saudi Arabia. A questionnaire and interview protocol were used to collected data. Descriptive statistical analysis, t-tests, One-way ANOVA, post-hoc tests and thematic analysis were used to analyse the data sets. The results of the study showed that knowledge gained from formal environmental education does not translate to pro-environmental behaviours. This study highlights the need to promote pro-environmental behaviour in university settings by eliminating obstacles to pro-environmental actions.

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## Introduction

Human actions largely influenced by social norms, beliefs, and values, has resulted in current environmental problems which greatly undermine long-term sustainability (Lange & Dewitte, 2019; Li et al., 2019; Carvalho et al., 2018; Thondhlana & Hlatshwayo, 2018). Humans that control this rapidly evolving world, for instance rapid industrialisation, overexploitation of natural resources and consumerism, as well as human error are having an adverse impact on the environment (Campbell, 2021). Some of the environmental problems include air and water pollution and the availability of water, global warming, improper waste disposal, depletion of natural resources, increase in human population, stratospheric ozone layer depletion, overconsumption, food wastage, logging and decline or disappearance of biological diversity (Schmidt & Matthies, 2018; Singh & Singh, 2017). Public health threats from the lack of valuable resources will be great unless nations are able to adapt. Averting household food waste and overconsumption of food as well as managing water resources are important for the promotion of global environmental sustainability and pro-environmental behaviours (Schmidt & Matthies, 2018; DeNicola et al. 2015).

The most prevalent environmental issues in Saudi Arabia are desertification, air quality deterioration, water pollution, littering, sewage pollution and food wastage (Almahasheer & Duarte,

2020; Baig et al., 2019). In a recent government report, Saudi Arabia ranked number one in the world for food waste (Ministry of Environment, Water, and Agriculture, 2018). According to the report, the country squanders 30 percent of the total food produced which is equivalent to US$13 billion in losses. Another recent study found that food waste posed a serious threat to sustainability as the citizens of Saudi Arabia discard about 78% of food purchased every week (Baig et al 2019). It is evident that food loss and waste are among the biggest sustainability challenges in Saudi Arabia.

Saudi Arabia which is heavily reliant on oil exports was until recently claimed to be a resource-cursed economy (Ali et al., 2020; Anser et al., 2020). In resource cursed economies, there is the tendency of people to avoid consumption of resources in a sustainable manner as they believe that everything is available and there is no motivation to conserve energy and protect natural resources and ecosystems. In Saudi Arabia, this problem is exacerbated by the fact that 35% of the Kingdom's electricity is still generated by the combustion of crude oil which is considered very expensive and results in the loss of approximately 900,000 barrels of oil per day (Zotin, 2018). Moreover, recycling and conservation efforts have typically failed to gain traction (Al Ghamdi & El-Hassan, 2019). Nevertheless, Saudi Arabia provides a good example of how to manage scarce water resources through adaptation and mitigation (DeNicola et al. 2015).

The Kingdom is trying to avoid or reverse the resource curse by reassessing its economic planning and moving away from a resource-dependent economy. The Vision-2030 resource conservation agenda, which focuses on protecting its precious natural resources, is also expected to raise awareness of sustainability practices (Al Surf & Mosafa, 2017). Environmental sustainability has been recently introduced as a topic in Saudi educational policy (Alsharif et al., 2020; Khan et al., 2020; Baig et al., 2019). One of the visions is to undergo social changes and such changes among teachers and students are seen as crucial for changing the mindset which remains under the sway of the resource curse effect (Anser et al., 2020). This implies that, in order to instil in the minds of students the notion that resources can be rapidly depleted by excessive use and must be used wisely, environmental education is essential for ensuring sustainability.

The urgency of the current environmental crisis requires the support of a higher education curriculum and pedagogy to better understand and address ecological problems and issues (Marouli, 2021). However, higher educational institutions and its leaders around the world are ill-equipped to address the global environmental crisis and environmental education has not been adequately implemented (Glavic, 2020). Most importantly, environmental education has not changed beliefs or generated more sustainable attitudes and behaviours among students around the world about various environmental issues (Komatsu et al., 2020). Thus, questions persist about the role of environmental education in creating environmental awareness and in promoting pro-environmental behaviours. The aim of this study was to investigate students' perceptions of their environmental knowledge, and the role of higher educational institutions in initiating environmental awareness and promoting pro-environmental behaviours of students. Specifically, the objectives were:

1) To assess students' self-reported knowledge on environmental topics, energy sources and pro-environmental behaviours.

2) To explore students' perceptions about their institution's environmental programmes/on-campus environmental activities and its role in promoting sustainable pro-environmental behaviours.

3) To determine the effect of gender and students' academic major on pro-environmental behaviour.

4) To identify the challenges facing students in taking part in these activities.

The research questions this study addresses are:

1) What are students' self-reported knowledge on environmental topics, energy sources and pro-environmental behaviours?

2) What are students' perceptions about their institutions' environmental programmes/on-campus environmental activities and its role in influencing sustainable pro-environmental behaviours?

3) Is there a significant difference in the pro-environmental behaviour of: (a) male and female students, and (b) students belonging to various academic majors?

4) What are the challenges facing students in taking part in environmental education and on-campus environmental activities (compulsory or voluntary activities)?

## Literature Review

### *Role of Environmental Education*

Global warming has reached 'worst case scenario' levels but the COVID-19 pandemic has shown that compulsory and voluntary restrictions on travel, on-campus learning and work can result in reductions in carbon emissions and air pollution (Botzen et al., 2021; Forster et al., 2020). Ironically, we cannot wish for a pandemic to emerge to save the earth and keep it green and healthy. An understanding of the nature of ecological problems is needed to address the environmental crisis (Rhead et al., 2015).

Environmental education is focused on knowledge, skills, and behaviour development and provides students with the opportunity to participate in real world issues, understand complex environmental issues facing the world, act more pro-environmentally and minimise the problems (Alsaati et al., 2020; Pizmony–Levy & Michel, 2018; King & Franzen, 2017; Monroe et al. 2017; Okur-Berberoglu, 2015). Environmental education programmes and activities are claimed to produce positive results in terms of environmental knowledge, beliefs, and in cultivating energy conservation behaviours (Janmaimool & Khajohnmanee, 2019; Ardoin et al. 2018; Akitsu et al., 2017; Ajaps & McLellan, 2015). Recent research shows that if formal environmental education is imparted to just 16% of students there could be a massive reduction in carbon dioxide (approximately 19 gigaton) by 2050 (Cordero et al., 2020). Environmental education is essential for achieving sustainable development (Hanifah et al., 2020). Addressing environmental problems require heightening people's awareness and knowledge of issues surrounding sustainability. Therefore, environmental education programmes have to be effective. They can be personally relevant and meaningful to the students if the teaching strategies are engaging and include experiential activities, and if they encourage discussions on debateable issues, address myths and fallacies, and include on campus activities (Monroe et al. 2017). These strategies include creating awareness of mitigation and adaptation behaviours (Schrot et al., 2020). While mitigation strategies involve taking steps to reduce risks, for example reducing greenhouse gases by using fuel efficient vehicles for transportation and using renewable energy sources such as solar energy, adaptation strategies help people to prepare for and adjust to the present and future problems caused by global climate change, such as drought, variations in ecosystems, and rise in sea levels (Reid, 2019; Monroe et al. 2017; Bofferding & Kloser, 2015).

### *Pro-environmental Beliefs and Behaviours*

Environmental education is also said to raise students' concerns for ecological problems. Although people are concerned about the environment, concerns alone are not enough to ensure prompt and consistent actions to avert environmental harm (Inkpen & Bailey, 2020; Ajaps & McLellan, 2015). This suggests that other drivers are needed to translate concerns into actions. One of the key drivers is environmental education which is aimed at developing ecological awareness and for the promotion of pro-environmental behaviours (Cordero et al., 2020; Pizmony-Levy & Michel, 2018; Okur-Berberoglu, 2015). This supports the claims made by previous researchers that environmental education plays a determining role in increasing students' knowledge of environmental issues and in developing sustainability-conscious behaviours (Ntanos et al., 2018; Chankrajang & Muttarak, 2017; Meyer, 2015).

Pro-environmental behaviours, also referred to as sustainable behavior, is the responsible behaviour of an individual to engage in and minimise the negative environmental impact of human activities (Stern, 2011). Examples of these behaviours include the use of clean fuels (e.g., solar and wind energy) instead of fossil fuels, proper disposal of waste and recycling, conservation of power and water, etc. Cleveland et. al. (2012) identified six types of pro-environmental behaviours inherent in an individual: engaging in activism as an environment campaigner; avoiding purchase and use of environmentally harmful products; being a green consumer who is concerned about environmental degradation and uses eco-friendly or bio-degradable products; being a green passenger who prefers public transport or uses bicycles; being a recycler who uses recycling knowledge to buy recycled products; and as a utility saver who acts to minimise consumption of energy (oil, electricity), water etc.

The factors that influence one's pro-environmental behaviors are either external or internal. While the external factors involved in the process of behaviour change include learning in educational institutions and cultural influences, internal factors comprise of beliefs which include knowledge, attitudes and values (Ntanos et al., 2018). In other words, environmental beliefs are associated with environmental knowledge, values, and behaviour attitudes. Emotions and feelings such as moral obligation, responsibility and ecological conscience also influence environmental behaviours (Si at al., 2020; Xu et al., 2020; Yadav & Pathak, 2017). Cultural values and beliefs are also deemed to have a strong influence on environmental concerns and actions and are therefore vital for understanding how an individual reacts to ecological challenges (Komatsu et al., 2020). Shifts in pro-environmental behaviours can be achieved by changing cultural values and beliefs and that education can bring about desirable changes (Inkpen & Baily, 2000; Ntanos, et al., 2018).

While research demonstrates that environmental education provided through a formal education which can enhance learners' knowledge and develop pro-environmental behaviours, there are also claims that it may not contribute to students' engagement in direct impact of environmental behaviours, for example recycling and energy-saving behaviours (Hoffmann & Muttarak, 2019; Janmaimool & Khajohnmanee, 2019; Marouli & Duroy, 2019; Chankrajang & Muttarak, 2017). This suggests that knowledge alone cannot influence behavioural change.

### *Student Characteristics and Pro-Environmental Behaviours*

Students' behaviours are not only influenced by environmental education but also by personal characteristics, namely demographic factors, and internal human factors (Runhaar, et al., 2019). Therefore, gender and academic majors (demographic factors) as well as perceived pro-environmental attitudes and intentions (internal human factors) were included in this study.

Many studies have revealed that socioeconomic characteristics are key for understanding the determinants of pro-environmental behaviours (Hansmann et al., 2020; Inkpen & Bailey, 2020; Vicente-Molina et al., 2018; Xiao & McCright, 2015). These socioeconomic factors included gender, age, educational level, or academic majors. There is evidence that women have better basic energy knowledge, slightly stronger intention and demonstrate relatively stronger environmental concern and behaviour than men (Hansmann et al., 2020; Akitsu et al., 2017; De Leeuw et al., 2015; Xiao & McCright, 2015; Rideout, 2014) although they are underrepresented in higher education and fields of study that are considered as male domains such as an engineering (Stoet & Geary, 2020). Women's knowledge, beliefs and perceptions are important as females and males play different roles in protecting the environment and so there are disparities in their pro-environmental behaviours, for instance females who study science majors are likelier to act pro-environmentally (Vicente-Molina et al., 2018). Research has also shown that although there exists a significant relationship between gender and environmental knowledge, gender differences in pro-environmental behaviour was not statistically significant (Nzengya & Rutere, 2021; Akitsu et al., 2017; De Leeuw et al., 2015; Gifford, 2014). This suggests that research on the relationship between gender and pro-environmental behaviours has yielded mixed results. As there is inconclusive evidence on whether gender

differences exist, potential gender differences were examined in this study to explain if males and females have different worldviews on environmental issues.

Likewise, academic major or sub-disciplines is another socioeconomic characteristic which has an effect on pro-environmental behaviours. Hansmann et al., (2020) investigated the environmental behaviour of students at a Swiss University and found that positive environmental behaviours increased with higher education level of students. Furthermore, females and members of strongly environmentally oriented disciplines exhibited higher levels of pro-environmental behaviour. The results of the study validate Rideout (2014) who found that environmental behaviours varied with academic major.

### *Challenges Facing Students in Taking Part in Educational Programmes*

The challenges facing students are partly because higher education does not fully support students and the very purpose of environmental education has often been compromised. Instructors are finding it difficult to provoke behaviour change in students (King & Franzen, 2017). They also lack knowledge of appropriate pedagogical approaches, for instance transformational teaching that includes active learning and collaboration, which is required to change the mindset of students and determination (Glavic, 2020; Wamsler, 2020). Research has therefore questioned the role of higher education in shaping environmental norms (Harring et al., 2020). Academics also argue that environmental education cannot promote a higher level of environmental awareness, especially awareness of renewable energy sources (Edsand & Broich, 2019). According to Janmaimool and Khajohnmane (2019) environmental knowledge provided in universities could foster environmental attitudes, but education itself cannot enhance students' pro-environmental behaviours. Educators and administrators in higher education not only lack strategic direction and supportive leadership, but also lack knowledge and awareness of environmental sustainability (Alsharif et al., 2020). There is no attempt made to respond to the needs and interests of students or to arouse their interest in the issues of environmental protection (Al Ghamdi & El-Hassan, 2019).

In the context of Saudi Arabia, higher education is unable to continue imparting rigorous environmental and sustainability education because of the lack of students' presence in on-campus activities (Abubakar et al., 2016; Alsaati et al., 2020). One study found that universities lacked adequate on-campus activities and that only 38% of the students took part in such events (Khan et al., 2020). Previous studies show that in Sweden and Taiwan where transformational teaching methods are being used, students join environmental sustainability projects voluntarily (Wamsler et al., 2018; Olsson, 2018). Moreover, the students who participated in the voluntary activities perceived that the sessions had a positive influence on environmental learning (Wamsler, 2020). Alsaati et al., (2020) evaluated students' level of consciousness and awareness for a sustainable environment in seven universities in Said Arabia and found that they lacked knowledge of sustainability and that their engagement in pro-environment related activities was low. While most students (66%) did not take part in compulsory and voluntary recycling activities in on-campus projects or elsewhere many (65%) reported that the universities did not have any recycling bins. These results corroborate the findings of another study conducted at a university in the Eastern Province of Saudi Arabia. The researchers found that there were no campus sustainability initiatives and that students lacked interest and did not have the inclination to take part in environmental activities (Abubakar et al., 2016). Al Ghamdi and El-Hassan (2019) examined students' attitudes, behaviours and factual knowledge of energy-related issues in Saudi Arabia and found that they lacked understanding of appropriate usage of energy. The researchers observed that the students were very poor in energy literacy and therefore are predisposed to develop a negative attitude towards environmental issues. Moreover, they were unwilling to take part in voluntarily activities.

Alsharif et al., (2020) confirms the aforementioned findings by claiming that the universities had not adopted elements of the sustainability concept and that even the decision makers lacked knowledge and awareness of sustainable development. Moreover, instructors were tentative in calling

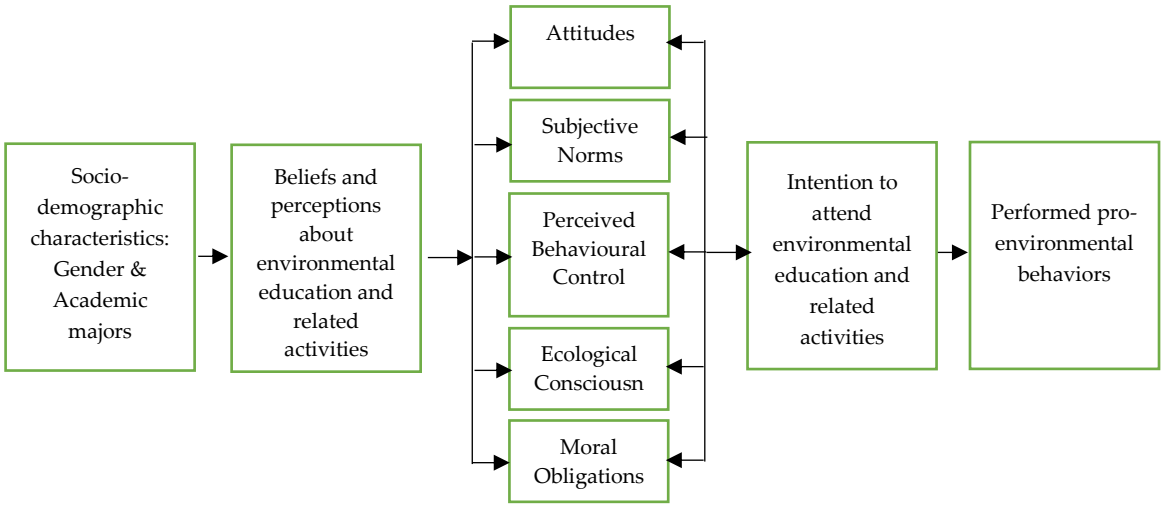
students to action. These results indicate why students do not immerse themselves in compulsory and voluntary and suggests that both teachers and students lacked a sense of personal responsibility. A denial of personal responsibility is considered to be a major barrier for developing pro-environmental behaviours (Blankenberg & Alhusen, 2019). It appears that education policy makers are only focusing on providing information on the causes and consequences of climate change instead of educating, encouraging, and preparing students for contributing to the environmental cause (Diaz et al., 2020). Alsharif et al., (2020) argue that if universities are keen on organising on-campus activities then educators should play a key role in the transition towards sustainability by addressing energy and water consumption and waste management, and by adopting recycling initiatives (Alsharif et al., 2020).

## Theoretical Framework

The Theory of Planned Behaviour (TPB) was used as it has been widely applied to understand change of behaviour in sustainability research (e.g., De Leeuw et al., 2015). It posits that an individual's behaviour can be predicted by understanding one's intention to engage in a particular behaviour (Ajzen, 1991). The four constructs associated with this theory include (a) subjective norms or perceived social pressure and expectations of others to engage in a behaviour, (b) attitudes toward an object or a phenomenon, (c) perceived behavioural control or perceived ability to change behaviour indirectly, and (d) intention or an individual's readiness to perform a behaviour (Ajzen, 2015;1991). Later Ajzen and other researchers have added ecological conscience and moral obligation as additional constructs (Si at al., 2020; Xu et al., 2020; Yadav & Pathak, 2017; Ajzen, 2015). While ecological consciousness reflects an individual's environmental commitment, moral obligation is the responsibility to perform a certain behaviour.

**Figure 1**

*Theory of planned behaviour constructs*




In the current study the socio-demographic characteristics were gender and academic majors. By using TBP, this study examined students' beliefs and perceptions about environmental education, to understand their attitudes, subjective and personal norms, perceived behavioural control, ecological consciousness, and moral obligations as well as their intentions to take part in prop-environmental activities. The objective was to know if environmental education and related activities had influenced their pro-environmental behaviours.

The rationale for drawing on the TPB was to identify gender-related and academic-major related differences in the pro-environmental behaviours of students. Although most studies that have

adopted this framework have used a quantitative design to predict behaviours, a qualitative lens provides a better understanding of beliefs associated with behaviours (Ajzen, 1991). In the current study, the TPB was used to frame how students perceive the importance of environmental education, to assess their knowledge and attitudes, and to determine if these translate into pro-environmental behaviours.

## Methods

This exploratory mixed methods study was conducted at a university in Saudi Arabia where environmental programmes, co-curricular and extracurricular activities were used as an extension to formal learning. An embedded mixed methods research design was used, and priority was not given to either quantitative or qualitative elements (Creswell & Plano Clark, 2017). The qualitative data provided additional knowledge related to the main objectives of the study and was critical to the present study (Plano Clark et al. 2013). Qualitative data was collected after gathering quantitative data to avoid bias and to ensure internal validity (Plano Clark et al. 2014). The rationale to start the research by collecting quantitative data followed by qualitative data was to help explain or elaborate on the quantitative results.

### Sample

The university was purposefully selected purposefully which has a well-established track record in environmental programmes and on-campus activities. The recruitment of participants was managed through collaboration with the respective academic departments at the university. From a pool of approximately four thousand undergraduate students, a total of 301 students agreed to participate in the study. The final sample consisted of 226 students, including 103 males and 123 females, representing diverse academic sub-disciplines such as science, engineering, humanities education, and computer science. Notably, the majority of participants were affiliated with the science department, constituting 36% of the sample. The characteristics of the students are summarised in table 1.

The selection of participants for interviews involved a targeted approach. Twelve students who had completed the survey were purposively chosen for in-depth interviews, ensuring a balanced representation of both genders (Male=7 and Female=5). These interviewees provided valuable insights into the research questions and complemented the quantitative data gathered through the survey.

The research prioritised ethical considerations to safeguard the rights and well-being of the participants. Informed consent was obtained from each participant, clearly outlining the purpose, procedures, and potential risks involved in the study. Confidentiality measures were strictly maintained, ensuring that the collected data was anonymised and securely stored. Participants were assured of their right to withdraw from the study at any stage without consequences. The study also adhered to principles of fairness and equity in participant selection, ensuring diverse representation across genders and academic disciplines.

**Table 1**

*Demographic characteristics*

| Demographic characteristics | | Questionnaire | Interview |
|---|---|---|---|
| Gender | Male | 103 | 7 |
| | Female | 123 | 5 |
| | *Total* | *226* | *12* |
| Academic majors | Science | 81 | 3 |
| | Engineering | 20 | 2 |
| | Humanities | 31 | 2 |
| | Education | 55 | 3 |
| | Computer science | 39 | 2 |
| | Total | *226* | *12* |

## Research Instrument, Reliability, and Face Validity

### *Questionnaire*

The research instrument was developed by adapting the Environmental Behaviour Questionnaire (Ntanos et al., 2018). It consists of three sections: (1) Socio-demographics (gender and academic sub-disciplines); (2) Dichotomous questions that assessed students' understanding of various environmental concepts, students' pro-environmental knowledge and environmental behaviours; and (3) Questions on students' attitudes towards environmental education and willingness to participate in ecological activities. The items in sections 3 were measured with a 5-point Likert scale. Cronbach's alpha was used to evaluate the internal reliability and the alpha coefficient was 0.72 suggesting that the items have relatively high internal consistency. The items in section 2 comprised of dichotomous questions about environmental behaviour and focused on simple actions that students could take to alleviate environment issues.

The self-administered questionnaire was created using Google Form and sent as an email and as a link along with participant information sheets, consent forms. Google Forms allowed sharing the forms via email, as a direct link, and through social media sites such as Twitter and WhatsApp. The respondents were asked to provide their email address in Google Form when completing the survey. Participation in the research was voluntary.

Descriptive statistics were used to analyse the survey data (sections 2 and 3). Then, gender differences in students' knowledge, beliefs, attitudes, and pro-environmental behaviours were examined using independent t-tests. A One-way ANOVA (Kruskal-Wallis H-test) using the Dunn's post-hoc test with Bonferroni correction were also performed to analyse cross-discipline differences.

### *Interviews*

Semi-structured interviews were used to understand students' views on environmental education, the role of university in promoting pro-environmental behaviours, the reasoning on the self-reported pro-environmental behavior, as well as the challenges facing students in taking part in ecological activities. The interview protocol was developed based on literature, the TPB constructs and survey items. The interviews were conducted by making video calls using Blackboard. The calls were audio-recorded, with the consent of participants. The transcripts were translated from Arabic to English and thematically analysed using the procedures suggested by Braun and Clarke (2006). A peer researcher reviewed the interview transcripts, codes, and analyses.

# Results

## Quantitative Results

The data obtained from dichotomous scales were subjected to analysis through descriptive statistics, and the results are summarised in Table 2. The responses from a total of 226 students were considered for all items in the questionnaires. The outcomes of the Yes/No dichotomous questions were computed based on the responses gathered from all participants.

**Table 2**

*Descriptive statistics: Students' self-reported knowledge and pro-environmental behaviours*

| Dichotomous questions | Yes | No | N* |
|---|---|---|---|
| Have you taken part in environmental education programmes? | 40% | 60% | 90 |
| Have you taken part in on-campus environmental activities? | 33% | 67% | 75 |
| Are you knowledgeable about Renewable Energy Sources? | 66% | 34% | 149 |
| Are you knowledgeable about non-Renewable Energy Sources? | 67% | 33% | 151 |
| Do you know what "Ecology" means? | 46% | 54% | 104 |
| Are you aware of global warming or climate change? | 89% | 11% | 201 |
| Do you know what the term "Energy Crisis" means? | 77% | 23% | 174 |
| Are Renewable Energy Sources used at your university? | 76% | 24% | 172 |
| Do use internet at home to access environmental information? | 34% | 66% | 77 |
| Do use computers or mobile devices to access environmental information? | 36% | 64% | 81 |
| Do use the library to acquire pro-environmental knowledge? | 14% | 86% | 32 |
| Do you turn off classroom lights during breaks? | 47% | 53% | 106 |
| Do you use public transportation for school to reduce pollution? | 13% | 87% | 29 |
| Do you walk to school to reduce pollution? | 11% | 89% | 25 |
| Do you use a bicycle to reduce pollution? | 4% | 96% | 9 |
| Do you use recycle bins in your university? | 88% | 12% | 199 |
| Do you use stationery supplies made from recycled materials? | 55% | 45% | 124 |
| Are you familiar with energy efficient devices and appliances? | 78% | 22% | 176 |
| Would you buy energy efficient devices and appliances? | 72% | 28% | 163 |

*Note:* N**=positive responses*

The descriptive data (Table 2) suggests that only 40% of the students attended environmental education programmes and a mere 33% took part in on-campus environmental activities. A vast majority of the students were aware of global warming or climate change (N=201), used recycle bins at their university (N=199), and understood what "Energy Crisis" meant (N=174). Most students reported being informed about various types of renewable (66%) and non-renewable energy sources (67%), with an additional majority indicating that renewable resources were being utilised at their university (72%). On the contrary, only 46% were familiar with the word "ecology".

With regard to pro-environmental behaviours, 47% of the students switched off classroom lights during breaks. However, many did not demonstrate pro-environmental behaviours. Only 13% used public transportation for school while a mere 11% walk to school to reduce pollution. The use of bicycles was very meagre (4%). Conversely, more than half (55%) used stationery supplies made from recycled materials. As regards reducing energy consumption, a vast majority of the students affirmed that were familiar with energy efficient devices and appliances (N=176) and they had purchased such products (N=163).

A very low percentage of the students (34%) responded positively that they used the Internet for gaining knowledge on environmental issues and 36% used computers or mobile devices to access environmental information. On the contrary, only 14% answered positively about using the school library for environmental information.

**Table 3**

*Descriptive statistics – Gender differences in students' perceptions*

| Beliefs about environmental education | | Male | | Female | |
|---|---|---|---|---|---|
| | | M | SD | M | SD |
| 1 | Lecturers and professors often mention and discus environmental issues in class | 3.40 | 1.35 | 3.43 | 1.24 |
| 2 | Lecturers and professors discuss ways for students to protect the environment | 3.13 | 1.45 | 3.49 | 1.40 |
| 3 | Lecturers and professors mention and discus sustainable development in class | 2.36 | 1.45 | 2.21 | 1.34 |
| 4 | There are compulsory and voluntary activities on and outside campus | 3.75 | 1.31 | 3.75 | 1.33 |
| 5 | My environmental knowledge level has increased | 3.01 | 1.45 | 3.81 | 1.16 |
| 6 | The environmental education I receive is adequate | 2.13 | 1.25 | 1.83 | 0.98 |
| 7 | My participation in on-campus ecological activities has increased environmental awareness | 4.09 | 1.01 | 4.19 | 0.79 |
| 8 | I learnt that renewable energy sources can help solve ecological problems facing earth | 4.03 | 1.04 | 4.11 | 0.90 |
| 9 | My university's contribution is important for shaping environmental conscience | 3.88 | 1.08 | 4.16 | 0.84 |

Descriptive data on gender differences in students' perceptions show (Table 3) that female students have positive dispositions towards environmental programmes and on-campus environmental activities and their university's role in shaping environmental consciousness. Similarly, most female students have better basic energy knowledge than males with regard to the benefits of renewable energy sources. The positive attitude of the female students is likely due to their participation in environmental programmes and compulsory and voluntary activities. However, students of both genders agreed that educators often discussed environmental issues (Male M=3.40; Female M=3.43) and about ways to protect the environment (Male M=3.13; Female M=3.49). Although both genders agreed that the environmental education, they were receiving was inadequate (Male M=1.13; Female M=1.83) and believed that their knowledge on environmental issues had increased (Male M=3.01; Female M=3.81).

**Table 4**

*Descriptive statistics – Students' perceptions across academic majors*

| Beliefs about environmental education | | Science | | Education | | Engineering | | Computer Science | | Humanities | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M | SD | M | SD | M | SD | M | SD | M | SD |
| 1 | Lecturers and professors often mention and discus environmental issues in class | 2.98 | 1.35 | 3.89 | 1.15 | 3.45 | 1.43 | 3.54 | 1.19 | 3.55 | 1.03 |
| 2 | Lecturers and professors discuss ways for students to protect the environment | 2.84 | 1.50 | 3.96 | 1.15 | 3.20 | 1.58 | 3.44 | 1.27 | 3.39 | 1.41 |
| 3 | Lecturers and professors mention and discus sustainable development in class | 2.26 | 1.33 | 2.31 | 1.55 | 2.50 | 1.50 | 2.28 | 1.39 | 2.13 | 1.23 |
| 4 | There are compulsory and voluntary activities on and outside campus | 3.27 | 1.44 | 4.07 | 1.15 | 3.95 | 1.23 | 3.97 | 1.20 | 4.00 | 1.15 |
| 5 | My environmental knowledge level has increased | 2.99 | 1.51 | 4.07 | 1.10 | 3.10 | 1.48 | 3.33 | 1.22 | 3.90 | 0.79 |
| 6 | The environmental education I receive is adequate | 1.94 | 1.04 | 1.87 | 1.12 | 2.20 | 1.40 | 2.08 | 1.24 | 1.90 | 0.98 |
| 7 | My participation in on-campus ecological activities has increased environmental awareness | 3.95 | 1.13 | 4.29 | 0.74 | 3.90 | 1.07 | 4.23 | 0.58 | 4.42 | 0.50 |
| 8 | I learnt that renewable energy sources can help solve ecological problems facing earth | 3.81 | 1.18 | 4.25 | 0.80 | 3.75 | 1.25 | 4.23 | 0.58 | 4.42 | 0.50 |
| 9 | My university's contribution is important | 3.89 | 1.13 | 4.25 | 0.80 | 3.50 | 1.32 | 4.15 | 0.54 | 4.23 | 0.76 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| for shaping environmental consciousness | | | | | | | | | | |
| Weighted mean scores | 3.10 | 1.29 | 3.67 | 1.06 | 3.28 | 1.36 | 3.47 | 1.03 | 3.55 | 0.93 |

Descriptive data on differences in students' perceptions across academic majors show (Table 4) that students from all disciplines have positive dispositions towards their educators' role in imparting environmental education. However, they were not satisfied with the adequacy of the programmes and activities. However, students across all majors were satisfied with the university's role in raising environmental awareness. This is evident in the overall weighted mean for all the academic majors.

In order to compare the students' perceptions, independent samples t-test was conducted, and the results are presented in Table 5.

**Table 5**

*Gender differences*

| Gender | N | Mean | t | Sig.(2-tailed) |
|---|---|---|---|---|
| Male | 103 | 3.31 | -1.118 | 0.265 |
| Female | 123 | 3.44 | | |

The results indicate that there was no significant difference in pro-environmental behaviours of male and female students, t (202) = -1.118, p = .265. That is, the pro-environmental behaviours of female students (M = 3.44, SD = 1.11) was not significantly different from that of male students (M = 3.31, SD =1.27).

In order to analyse cross-discipline differences a series of One-way ANOVA tests were carried out. Responses from each of the five academic majors (science, engineering, humanities education and computer science) were compared statistically to assess whether, in fact, two or more of these sub-disciplines differed significantly from one another.

**Table 6**

*Difference across academic majors*

| *Source* | *SS* | *df* | *MS* | *F* | *P-value* |
|---|---|---|---|---|---|
| Between Groups | 12.079 | 4 | 3.011 | 4.041 | 0.003 |
| Within Groups | 165.170 | 221 | 0.747 | | |
| Total | 177.250 | 225 | | | |

The results of the One-way ANOVA detected a significant difference in the perceptions and pro-environmental behaviours of students belonging to different academic majors ($p <= 0.05$). Therefore, the Bonferroni post hoc test, which is one of the multiple comparison tests, was used to see which group caused the difference.

**Table 7**

*Post hoc mean comparison results*

| Groups | p-value |
|---|---|
| Science vs Education | 0.00* |
| Science vs Engineering | 0.003 |
| Science vs Computer science | 0.002 |
| Science vs Humanities | 0.002 |
| Education vs Engineering | 0.003 |
| Education vs Computer science | 0.000 |
| Education vs Humanities | 0.001 |
| Engineering vs Computer science | 0.003 |

*Note:* *p<0.01

*Post hoc* comparisons using the Bonferroni test indicated that there was no statistically significant difference (p<.01) between pro-environmental behaviours of students across disciplines.

## Qualitative Findings

The interview data was carefully examined and coded for the possible presence of any of the TPB constructs. Thematic analysis using Microsoft Word yielded 9 themes. Important pro-environmental behaviour specific themes emerged for attitudes, subjective norms, perceived behavioural control and behavioural intentions as well as ecological consciousness and moral obligation. The themes provided critical insight into understanding students' perceptions of environmental education and the challenges they face in traditional learning environments.

The students were asked how environmental education had shaped their environmental conscience or awareness and attitudes and motivated them, the students reported that the university was a harbinger of change but claimed that substantial changes are required to better influence pro-environmental behaviours.

### *Attitude*

The themes associated with this TPB construct were positive mindset, negative dispositions, environmental concerns, and environmental responsibility. Students shared overwhelmingly positive attitudes about the activities. Their attitudes prompted participation in on-campus and voluntary activities, and it was evident that they wanted to gain new experiences.

> The environmental awareness programmes facilitate better understanding of environmental protection. It provided new resources and it was an opportunity that I did not want to miss out on. (Male Student 2)
>
> It was fun and enjoyable. I mean the recycling activities. (Male Student 5)
>
> It gave use the platform to discuss important issues like recycling and sustainable consumption practices, for example recycle plastic, soda cans and paper, bringing our own coffee mugs instead of using plastic cups, using less paper, and using lights with sensors. (Female Student 8)
>
> Our university plays a moderate role in raising awareness of environmental challenges and in shaping our attitudes and behaviours. It helps build knowledge necessary to address complex environmental issues. (Female Student 10)
>
> I am able to make changes to my lifestyle so I can help the environment. (Female Student 11)
>
> I have become passionate, and I do something because of what I learned. (Female Student 12)

All the participants agreed that there should be improvements in the EE content. There was a general endorsement of activities but that more could be done to motivate students:

> I learnt that natural resources are depleting fast. But I am not really impressed about the programmes. (Male Student 2)

> Teachers must organise more activities even during the pandemic and encourage students to participate in campaigns. At the least they should call out to those who have been vaccinated (COVID-19) and motivate us to take part in these events. (Female Student 12)

The above response show that some students were keen on learning more about environmental sustainability, but also want to see action by their educators and institution. When asked how well or in what way the voluntary and compulsory activities had helped in making pro-environmental decisions, few students expressed that they had developed a sense of environmental responsibility.

> I feel personally responsible for the behaviours of some at the university and people in the neighbourhood. Some of my suggestions fell on deaf ears. More and more people are using cars, and no one wants to walk. Many do not use dustbins. (Female Student 8)
>
> I am worried about my family and the people; I mean their well-being. I started thinking about the environment, when I heard that fuel was being burnt to obtain energy, I was shocked and so I feel this should be changed. (Female Student 10)
>
> People, including some of my friends, are more focused on buying new products and no one wants to recycle stuff. I feel that environmental education in schools and universities can change this mindset. (Male Student 7)

The argument was that if everybody would be responsible, one would not question or discuss the actions as such actions would be considered as the norm. There were interesting responses from two students who believed that environmental issues never affect their lives:

> Climate change does not affect my life, because I take care of myself and my family and keep the environment clean. Eating meat not effect environment. No one in my family has contracted the virus, or other diseases. (Male Student 3)
>
> I don't fully understand global warming. But I feel that people and the media are overreacting. (Male Student 4)

The above responses show that some students are still under the influence of the resource curse effect and that education alone can bring about change.

Overall, the respondents identified a range of educational and social experiences that had influenced them to believe and act pro-environmentally. Some had changed their attitudes and behaviours and developed sustainable practices.

### *Subjective Norms*

The theme associated with this TPB construct was social pressure. When asked where they got their inspiration from, respondents indicated that the learning occurred in real-life situations, outside of formal education. According to them subjective norms had influence their actions.

> I learnt a lot about environmental sustainability in online videos posted by my lecturer. My lecture and peers influenced me and helped me understand the effect of waste on the environment. (Male Student 2)
>
> The programmes and activities that I have taken part in had little influence on my knowledge about the environment. I gained this through my interactions with overseas friends via social media and from my family. (Male Student)

Social relationships seemed to have dictated subjective norms. They were influenced by social pressure from lecturers, friends, family, and peers. This finding demonstrates that subjective norm in TPB was a significant factor which encouraged the students to participate in an activities and develop pro-environmental behaviours.

### *Perceived Behavioural Control*

The students perceived that they had noticed changes in the way they behaved since taking part in the environment programmes. The theme associated with this TPB construct was self-awareness.

> I chose to participate in on-campus and voluntary activities although I had to attend online science lectures because I wanted to learn how to reuse materials and plant trees. (Male Student 1)
>
> I always use reusable eco bags for shopping instead of disposable plastic bags. (Female Student 8)
>
> Although the activities clashed with my studies I chose to involve in recycling and waste segregation as I wanted to demonstrate it to other students. (Male Student 7)
>
> The programmes taught me to act in a simple way every day. When I go for a walk on the beach, I have made it a habit of asking people to throw trash and waste in bins. (Female Student 12)

The aforementioned excerpts show that perceived behavioural control allowed them to introduce recycling and waste segregation approaches to others and learn how to reuse materials.

> After taking part in activities, I have recycled almost anything I can and started encouraging friends and family to save energy and water. I always tell my younger brothers and sister to switch off the electric fan when not in use or close the faucet immediately after use. (Male Student 1)
>
> Previously, when I watched tsunamis and flash floods devastating different parts of the world on TV, I could do nothing. Although I am just a human and cannot fight nature, I now do small things like not wasting food, or keeping the surroundings clean or taking part in recycling or buying recycled products. (Female Student 10)

This shows that environmental education had influenced students' attitudes and affected them emotionally. It had also helped them transfer this learning to real life. It shows that the students' perceptions of their abilities to implement changes. Overall, the students' perceived behavioural control had increased, for example conserving water and energy to create a greener and healthier planet. They realised that even small actions could make a big difference.

### *Behavioural Intention*

The activities had a big impact on the students as suggested by two themes 'ecological conscience' and 'moral obligation'. Environmental education had not only shaped students' attitudes but also their behavioural intention. For instance, their concerns had positive and significant effect on their intention to use energy sparingly, buy energy efficient appliances and devices etc. Students' concern for the environment had an impact on their behavioural intention to purchase green products.

> Once I complete my degree, I intend to buy a hybrid electric car. (Male Student 2)
>
> I have always been a green consumer. (Female Student 9)

Environmental conscientiousness and moral obligation had exerted greater influence on students' intention to buy green products.

> I always buy appliances that are energy efficient, for example air conditioner with an inverter or electric fans that work on solar energy. (Male Student 2)
>
> My friends had installed automatic sensor faucets at home to save water. I persuaded my dad to do the same. (Female Student 10)

The students viewed that conserving water and energy would lead to reduction in water and electricity bills. This results further shows that attitude, subjective norm, and perceived behavioural control had a substantial effect on behavioural intention.

It is also evident from the responses that simply learning about environmental issues or taking part in activities might not lead to changes in students' pro-environmental behaviours. It is social

pressure, empathy for citizens' well-being or moral obligation, personal responsibility, self-awareness or ecological consciousness and the belief that they can influence the situation that made them to act pro-environmentally. They appeared to do so by focusing beyond themselves and showing concern.

### *Challenges*

One of the challenges facing students was that the lecturers did not have professional development or training to provoke behaviour change. Another challenge was lack of time, which prevented some students from volunteering for the activities. The third challenge was commitment or reluctance to take part in the activities.

> Instructors support teaching climate change more in theory than in practice as it is outside their subject area. In other words, they had insufficient knowledge of environmental education, an understanding of contemporary and dynamic environmental issues and lacked training. (Female Student 10)
>
> Some instructors say that they lack adequate knowledge and so they avoid topics related to environment. (Male Student 2)
>
> The programmes are good, but not many students take part in it. They say that they do not find time as it clashes with classes. (Male Student 7)
>
> The online videos and activities are informative and can change one's attitudes. However, not all students are committed. Some lecturers are also not committed and do not encourage us to take part in activities such a recycling. (Female Student 9)

This study found various challenges to implementation of environmental education in higher education in Saudi Arabia.

## Discussion and Conclusion

### Key Findings

The main aim of this study was to investigate the role of environment education in influencing students' pro-environmental behaviours at a university in Saudi Arabia. A mixed- methods research design was adopted, and the quantitative and qualitative data were subjected to triangulation and findings relating to the research questions are discussed below.

The findings suggest that environmental education is being welcomed by students in higher educational institutions in Saudi Arabia. However, further integration of the principles of environmental education may be meaningful. The quantitative findings showed that most students did not attend environmental education programmes. This was not what was expected. The students were also not very well informed and did not demonstrate thorough understanding of environmental concepts. The current study also found that although the students were aware of climate change, they did not use public transportation or walk or use bicycles. This suggests that they do not have greater concern for environmental problems. Further research is required to examine how and why different factors play a role in turning intention into behaviour in these kinds of situations. However, both quantitative and qualitative data suggest that only a few students were environmentally responsible and practiced environmentally friendly habits. These results paralleled those obtained in previous studies from Saudi Arabia (Alsharif et al., 2020; Abubakar et al., 2016; Alsaati et al., 2020).

Although it is possible that the students had joined these programmes and activities with a greater disposition towards environmental issues, and their knowledge on environmental issues had increased, the students were not happy with the programmes. The reason behind this problem is lack of encouragement from lecturers. A with previous studies, this study found from the interviews that lecturers lacked commitment and failed to trigger behaviour change (Glavic, 2020; Wamsler, 2020; King & Franzen, 2017). This shows that environmental education and awareness of ecological problems does not necessarily translate into environmentally responsible behaviour (Harring et al.,

2020; Janmaimool & Khajohnmane, 2019). However, the problem can be addressed by implementing faculty training sessions on the significance of such initiatives and integrating environmental topics into the curriculum. Additionally, establishing open communication channels, recognising and rewarding lecturer involvement, and advocating for institutional policies supporting educators' engagement in extracurricular environmental activities can contribute to fostering a more encouraging academic environment.

The results obtained from the *t*-test and One-way ANOVA show that there were no significant differences in the beliefs of males and females as well as student belonging to five academic sub-discipline. However, post hoc tests revealed that there were no significant differences in the knowledge and pro-environmental behaviours of students across disciplines. One of the interesting findings was that female students had better basic energy knowledge than males with regard to environmental concepts. This finding is congruent with previous studies (for example Hansmann et al., 2020; Akitsu et al., 2017; De Leeuw et al., 2015; Xiao & McCright, 2015; Rideout, 2014).

Qualitative results suggest that attitude, subjective norm, and perceived behavioural control were important constructs that helped understand students' intention to attend environmental education. The students' attitudes included positive mindset, negative dispositions, environmental concerns, and environmental responsibility. The students' normative beliefs or increased "social pressure" to attend on-campus activities indicates a strong positive subjective norm. The students' perceived behavioural control also played a key role in influencing pro-environmental behaviours. They were environmentally conscious and committed and perceived that they had the ability to recycle and manage waste. The students' moral obligation to patronise green products and reduce the environmental impact of energy and water usage played a significant role in understanding their intention to engage in pro-environmental behaviours. This is congruent with previous research such as Si at al. (2020), Xu et al. (2020) and, Yadav and Pathak (2017).

## Limitations

This study has limitations. The evidence is limited to students from only one university and therefore may not be generalisable. However, the results provide a rich and detailed picture of students' perceptions, experiences and expectations of environment education and its role in promoting pro-environmental behaviours. Future studies should consider larger samples from multiple universities in order to have a better basis for comparison. Another limitation is self-report bias which may have occurred when students responded to survey items and rated their level of knowledge.

## Originality and Value

This study offers quantitative and qualitative findings that affirm the significance of environmental education for higher education students. Although previous research has used TBP and examined students' environmental knowledge and pro-environmental behaviours, very few studies have used qualitative or mixed methods research design.

## Implications

The results of this study are crucial to university administrators, educators and policy makers, to help them detect inappropriate practices. This study is of particular relevance for educators and policymakers who can use the findings to design effective programmes and on-campus activities aimed at promoting environmental consciousness and enhancing environmental protection. This study could also sensitise the policymakers to make a conscious effort to infuse principles of environmental education in teacher preparation programmes so that its usage would be part of a holistic approach that promotes students' pro-environmental behaviours.

## Recommendations

Programmes and on-campus activities should be designed in such a way that it can contribute to developing and encouraging critical thinking, problem-solving, awareness, motivation, and sensitivity amongst students to promote action toward environmental improvement.

Policymakers should give more emphasis to environmental education in primary , intermediate
and secondary schools and offer professional development opportunities for teachers so that they can deliver environmental education curriculum effectively.

Workshops and seminars should be organised to encourage educators to stay up to date on environmental issues.

Educators should give more emphasis to on-campus and outdoor programmes and activities. Since students are learning from home, due to the pandemic, videos should be used to educate them. The students could be encouraged to post their pro-environmental habits or practices on YouTube and the university website.

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