"Exploring Business Students' Sustainability Awareness, Knowledge, and Attitudes: A Case Study from College of Management And Technology, AASTMT, Alexandria, Egypt"

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Abstract

This study explores business students' perceptions regarding sustainability awareness, knowledge, and attitudes within the College of Management and Technology (CMT) at the Arab Academy for Science, Technology and Maritime Transport (AASTMT), Alexandria, Egypt. As business education evolves to address global

sustainability challenges, understanding how students internalize and respond to sustainability-oriented curricula and initiatives is vital. Using a quantitative, descriptive research design, data were collected from 281 undergraduate students through a structured, self-administered questionnaire. The study employed descriptive analysis, confirmatory factor analysis (CFA), and structural equation modeling (SEM) to examine the relationships among awareness, knowledge, attitude, and sustainability concerns. The findings revealed that while students exhibited moderately high levels of awareness and knowledge, only attitude significantly influenced sustainability concerns. Furthermore, the moderating effects of gender, year of study, and academic program are partially supported, particularly in the relationship between attitude and sustainability concern. The results highlight a persistent gap between knowledge and action, emphasizing the importance of emotional engagement and practical learning experiences. The study concludes with targeted recommendations for CMT to enhance sustainability education and foster behavioral change among future business leaders.

Keywords: Sustainability, Business Education, Awareness, Knowledge, Attitude, CMT, Education for Sustainable Development (ESD)

الملخص العربي

تستهدف هذه الدراسة تحليل تصورات طلاب كلية الإدارة والتكنولوجيا ـبالأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري، الإسكندرية، مصر. فيما يتعلق بالوعي والمعرفة والمواقف تجاه قضايا الاستدامة. ومع تطور التعليم في كليات الأعمال لمواجهة التحديات العالمية للاستدامة، يصبح من الضروري فهم كيفية استيعاب الطلاب للمناهج والمبادرات المرتبطة بالاستدامة واستجابتهم لها. وقد استخدمت الدراسة منهجًا كميًا وصفيًا، حيث جُمعت البيانات من ٢٨١ طالبًا جامعيًا من خلال استبيان منظم ومُدار ذاتيًا. تم تحليل البيانات باستخدام التحليل الوصفي وتحليل العامل التأكيدي CFA ونمذجة المعادلات الهيكلية (SEM))) لفحص العلاقات بين الوعي، والمعرفة، والمواقف، والانشغال بقضايا الاستدامة. أظهرت النتائج أن الطلاب يتمتعون بمستويات معتدلة إلى مرتفعة من الوعي والمعرفة، إلا أن المواقف وحدها كانت العامل المؤثر بشكل كبير في الانشغال بقضايا الاستدامة. كما أظهرت النتائج وجود تأثيرات تعديلية جزئية لكل من النوع، والسنة الدراسية، والتخصص الأكاديمي، وخاصة في العلاقة بين المواقف والانشغال. وتسهم هذه النتائج في الكشف عن فجوة قائمة بين المعرفة والسلوك، مما يؤكد الحاجة إلى تعزيز التفاعل العاطفي وأساليب التعلم العملي. وتختتم الدراسة بتوصيات موجهة لكلية الإدارة والتكنولوجيا لتعزيز تعليم الاستدامة وتحفيز التغيير السلوكي بين قادة الأعمال المستقبليين.

الكلمات المفتاحية :الاستدامة، التعليم في كليات الأعمال، الوعي، المعرفة، المواقف ، كليه الاداره والتكنولوجيا، التعليم من أجل التنمية المستدامة(ESD)

1. Introduction

As the global community confronts increasingly complex sustainability challenges—ranging from climate change and biodiversity loss to widening social inequalities—higher education has assumed a critical role in shaping the knowledge, values, and

behaviors needed to foster sustainable societies. Universities are not only sites of knowledge production but also strategic actors in promoting sustainable development through curriculum design, institutional practice, and engagement with local and global communities (Leal Filho et al., 2022; UNESCO, 2020). Within this context, business education is undergoing a paradigmatic shift. Business universities , once primarily focused on profit-maximization and market efficiency, are now expected to cultivate future leaders who are ethically responsible and sustainability-minded (Starik et al., 2020; Godemann et al., 2014).

 This shift is reflected in the adoption of frameworks such as the United Nations Sustainable Development Goals (SDGs) and the Principles for Responsible Management Education (PRME), which advocate for the integration of sustainability into all aspects of business education—from core curriculum and research to leadership development and community engagement (PRME, 2022). In response, many universities have introduced interdisciplinary sustainability courses, ethical business modules, and service-learning initiatives that aim to enhance students' sustainability awareness, deepen their knowledge, and shape pro-sustainability attitudes and behaviors (Alonso-Almeida et al., 2022; Lambrechts et al., 2018).

The College of Management and Technology (CMT) operates under the Arab Academy for Science, Technology and Maritime Transport (AASTMT) in Alexandria, Egypt, a specialized

institution established by the Arab League to advance education in maritime transport, logistics, and business disciplines. CMT delivers industry-aligned undergraduate business programs : Marketing, Accounting , Finance, Business Information Systems, Media Management, Political Sciences, Hotels and Tourism. The CMT has made deliberate efforts to integrate sustainability education into its business programs, positioning itself as a leading institution in the Arab region for advancing Education for Sustainable Development (ESD). CMT - as a principles for responsible management education (PRME) signatory and UNESCO recognized center for Education for Sustainable Development (ESD)- integrates sustainability across curricula, experiential learning initiatives, and community engagement projects, positioning itself as a regional leader in responsible management education. These efforts aim to equip students with the knowledge and analytical competencies necessary to understand sustainability concerns in business contexts (AASTMT, 2024).

 The research objective is specifically to explore students' perceptions of these efforts within the CMT environment. By analyzing how students report their levels of awareness, knowledge, and attitudes toward sustainability concerns—within the context of the business education they receive—this contributes to a deeper understanding of the effectiveness and relevance of sustainability-oriented educational strategies. The

CMT case offers a unique lens for examining the intersection between curriculum structure, institutional practices, and learner response, and aligns directly with the core purpose of this research.

Problem Statement

Despite, the growing institutional commitment to sustainability in higher education, there remains a need for empirical research on how students actually perceive, comprehend, and respond to sustainability issues, particularly in under-researched contexts such as Egypt and the broader Middle East and North Africa (MENA) region (Leal Filho et al., 2022; Konuk & Altuntaş, 2021). While curriculum reforms may be underway, the extent to which they influence student attitudes and knowledge acquisition remains uncertain. Understanding this relationship is essential to evaluating the effectiveness of sustainability education and informing future strategies.

Although many universities, including the College of Management and Technology (CMT) at AASTMT, have begun integrating sustainability concepts into business education curricula, it remains unclear how effectively students internalize these efforts. Awareness of sustainability issues may be present, but awareness alone does not necessarily translate into deep knowledge or behavioral commitment. Similarly, students may hold positive attitudes toward sustainability but still demonstrate

limited action or concern in practical settings. In addition , there is a lack of empirical data, especially in the context of Arab or Egyptian business universities , that systematically examines the interrelationship between awareness, knowledge, and attitudes, and how these shape students' sustainability concerns. Furthermore, limited attention has been given to how demographic variables moderate these relationships.

This research addresses this gap by investigating the levels of sustainability awareness, knowledge, and attitudes among business students at CMT, and examining how these factors influence sustainability concerns. Additionally, the study explores whether gender, year of study, and academic program act as significant moderators, providing new insights into the effectiveness and inclusiveness of sustainability education in a leading Arab business university.

This research is addressed through seven sections including: Section one: introduction, section two: literature review, section three is dedicated to research methodologies. Moreover, section four is dedicated to the results and findings of the study, and section five is concerned with discussion and conclusions. The sixth section addresses the recommendations, and seventh section includes the research limitations and future research.

2. Literature Review

Awareness and Knowledge of Sustainability in Universities' Education

Awareness is "an understanding of the activities of others which provides a context for your own activity" (Dourish& Bellotti, 1992). The definition of awareness here is positioned upon the level of understanding. Furthermore, Gafoor (2012) defined awareness as " the state or ability to perceive, to feel or to be conscious of events, objects and patterns", and it is indicated as the level of consciousness.

Sustainability awareness is the first step in encouraging environmentally responsible behavior, especially in business students who are future decision-makers. Sustainability awareness refers to the extent to which individuals recognize environmental and social challenges such as climate change, inequality, and resource depletion. In business education, awareness has gained momentum through initiatives like corporate social responsibility (CSR), green marketing, and sustainable finance (Lozano et al., 2013). Therefore, awareness means knowing that sustainable issues exist and important. However, studies have shown that awareness alone does not lead to sustainable behavior or deep engagement (Kollmuss & Agyeman, 2002). In Egypt, studies have shown that while university students demonstrate reasonable awareness levels,

gaps remain in critical thinking and application skills regarding sustainability (Abdelrahman & Hassan, 2021). This suggests a need for improved curriculum design that merges theory with hands-on experience.

On the other hand, Knowledge involves a more in-depth understanding of sustainability frameworks, principles, and their applications in business contexts. knowledge is the information understanding and skills that students gain through education or experience. Business students may be exposed to sustainability topics through courses, case studies, and experiential learning, but the depth and consistency of this exposure vary widely across institutions (Stubbs & Schapper, 2011).

Recent studies indicate that university business students generally possess moderate to high awareness and knowledge of sustainability concepts. Ghosh (2025) reports that Indian business undergraduates are "very familiar with sustainability related terms and their meanings" and have a high understanding of the 17 SDGs. Similarly, Chou and Vun (2025) found Malaysian university students scored on average 70–91% on sustainability knowledge/awareness measures . By contrast, a U.S. survey of Gen Z undergraduates showed only moderate knowledge (mean 66% correct) (Teather & Etterson, 2023). These studies suggest that sustainability knowledge varies across countries. Furthermore, research's indicate that while students may recognize the importance of sustainability, their knowledge

often remains superficial and fragmented unless reinforced through intentional curriculum design (Cebrián et al., 2015; Cebrián, Grace, & Humphris, 2015; (Sidiropoulos, 2018; Lozano et al., 2020).

Attitude Toward Sustainability : Affective Emotional Engagement

A consistent theme in the literature is that attitudes—not just awareness or knowledge—are more directly associated with sustainability-related behavior. The Theory of Planned Behavior (Ajzen, 1991) stated that attitudes are strong predictors of intentions and actions. A study by Boeve-de Pauw & Van Petegem (2017) across multiple European universities showed that students who received sustainability-infused education exhibited significantly more positive attitudes and pro-environmental behaviors. Similarly, a 2020 study in Asia found that students with hands-on sustainability projects showed greater empathy and concern for long-term environmental impacts (Lee & Kim, 2020).

Despite mixed knowledge levels, most studies find business students hold broadly positive attitudes toward sustainability. Ghosh (2025) observes "very positive" student attitudes toward sustainability and the SDGs, with respondents overwhelmingly agreeing that higher education should prioritize sustainable development . Teather and Etterson (2023) similarly report very

high attitudinal scores (88% on average) among U.S. undergraduates . Cotton et al. (2020) found that institutions that embedded sustainability into their entire academic culture—not just elective courses—produced students with higher sustainability literacy and behavioral alignment. Moreover, Mohiuddin et al. (2018) demonstrated that greater environmental knowledge (e.g. of green technologies and policies) is significantly associated with business students' positive sustainability attitudes . students with a favorable attitude toward sustainability are more likely to support ethical decision-making, environmental stewardship, and inclusive growth (Kaiser et al., 1999).

 However, this affective engagement often does not translate into action: For example, Yücel (2025) found that students exhibited strong sustainability attitudes, although practical engagement was still limited. Chang et al. (2019) similarly identified a discrepancy between students' stated attitudes and their actual behavioral intentions in a Taiwanese university context. Moreover, Maoela et al. (2024) find student involvement in SDG-related activities to be "marginal to non-existent" despite strong interest . Likewise, Teather and Etterson (2023) document that, while attitudes were high, corresponding engagement was low, particularly among business students who scored lower on sustainability than other majors . In short, students tend to care about sustainability, but practical engagement often lags behind

their positive attitudes. Understanding these attitudinal distinction is crucial for tailoring educational interventions that go beyond lectures, to build emotional engagement.

The Interplay Between Awareness, Knowledge, and Attitude

The relationship between sustainability awareness, knowledge, and attitudes is complex and multidimensional. While each construct plays a role in shaping sustainability concern, their impact is not always linear or equal. Several studies have emphasized that awareness provides a foundation, knowledge deepens comprehension, and attitude determines the likelihood of action (Barth et al., 2007; Mohiuddin et al., 2018). Thus, higher knowledge and awareness tend to predict more favorable attitudes.

On the other hand, Khalil and Mostafa (2013) explored Egyptian students' perceptions of sustainable development and found a general awareness and positive perception, yet noted that such awareness did not always lead to active concern. Similarly, Ramos et al. (2020) and Alsaati et al. (2020) examined the level of sustainability awareness among university students, they found that students expressed support for environmental principles but their in-depth knowledge and practical engagement were limited, largely due to a lack of infrastructure and institutional support on campus. Some studies revealed that students may possess high awareness but lack positive attitudes

or possess knowledge-driven instruction without attitudinal engagement leading to disengagement and fail to see the relevance to their careers (Cotton & Winter, 2010 ; Michelsen & Fischer, 2020; and Ali & El-Shamy, 2022). This disconnect underscores the importance of designing educational strategies that integrate awareness, knowledge, and affective engagement rather than treating them as isolated elements.

Furthermore across other studies, it is clear that business students are often well-aware of sustainability and hold positive attitudes toward it, yet translating this into action remains challenging. Maoela et al. (2024) reported that virtually students' attitudes can exceed what knowledge alone would suggest, and attitudes alone do not guarantee action. Teather and Etterson (2023) highlighted that students' attitudes often exceed their actual knowledge levels, yet neither necessarily results in sustainability behavior, illustrating a value–action gap . Similarly, Ghosh (2025) noted a "commitment gap": students express high support for sustainability but perceive a gap in actual campus practices, this "value-action" gap is often attributed to insufficient practical engagement during university years. Therefore, these studies highlight a clear gap between awareness/knowledge and attitude.

Studies revealed that this gap is due to universities sustainability content is limited to isolated modules rather than being embedded across disciplines. This fragmented approach can lead to student confusion about the relevance of sustainability to their

field of study (Ali & El-Shamy, 2022). Furthermore, faculty members may lack the training or confidence to incorporate sustainability themes into their teaching, thus impeding curriculum integration (Cebrián et al., 2015). Kopnina (2014) and Kagawa (2021) both argue for participatory approaches—where students co-create solutions, participate in green campus initiatives, or engage in policy simulation games—to help them internalize sustainable development. Beamond et al. (2024) argue for "holistic, interdisciplinary pedagogical methods" so that business education effectively "shapes the mindsets and skill sets of the next generation of socially conscious practitioners". Therefore, To overcome these gaps scholars recommend interdisciplinary collaboration, participatory curriculum design, experiential learning and institutional commitment at all levels. Universities must not only teach sustainability but also model it through operations, governance, and culture (Michelsen & Fischer, 2020).

Influence of Demographics on Sustainability students' Perceptions

literature highlighted the importance of demographic factors—particularly gender, year of study, and academic program specialization—in shaping students' sustainability-related attitudes and concerns in higher education.

Gender has been frequently studied as a determinant of environmental and sustainability attitudes. Research indicates that female students tend to express stronger environmental values, greater concern for sustainability issues, and higher emotional engagement in sustainability-related topics compared to their male counterparts as female business students showed significantly greater sustainability commitment and readiness to engage in eco-friendly behavior (Vicente-Molina et al., 2013; Tikka et al., 2000; and Zsóka et al. 2013).

 Academic year also plays a significant role in shaping sustainability orientation. Alattar et al. (2021) found that students in higher academic years reported more mature attitudes toward sustainability, likely due to prolonged exposure and greater curriculum integration. However, early exposure can also be effective if supported by practical engagement (Barth & Rieckmann, 2012).

 Academic program specialization has also been linked to varying degrees of sustainability perception. Students enrolled in programs that explicitly incorporate environmental and ethical dimensions—such as sustainable business, tourism, environmental economics, or CSR—tend to report higher awareness and concern (Lozano et al., 2013). By contrast, traditional programs focused heavily on finance or operations without sustainability integration may show lower student engagement (Azapagic et al., 2005). Therefore, program content

alignment with sustainability values significantly influences how students prioritize and relate to global concerns.

Building upon the reviewed literature, it becomes evident that sustainability awareness, knowledge, and attitudes are interrelated yet distinct constructs that influence students' engagement with sustainability concerns in higher education. Furthermore, demographic variables such as gender, year of study, and academic program have been shown to play a moderating role in shaping these relationships. However, limited empirical research exists that tests these dynamics collectively within the context of business education in Egypt. To address this gap, the current study examines the direct effects of awareness, knowledge, and attitude on sustainability concerns, as well as the moderating influence of key demographic factors.

Based on the literature review and the conceptual framework, the following hypotheses were developed to guide this study:

H1.   There is a significant relationship between awareness, knowledge, attitude, and sustainability concerns

H2.   Gender moderate the relationship between awareness, knowledge, attitude, and sustainability concerns

H3.   Year moderate the relationship between awareness, knowledge, attitude, and sustainable concerns

H4.   Program moderate the relationship between awareness, knowledge, attitude, and sustainable concerns.

3. Research Methodology

The main purpose of the current research is investigating students' awareness , knowledge and attitudes perceptions about sustainability issues in addition to students' involvement in sustainability. To achieve the main objective of the research, the researchers adopted a quantitative and descriptive research design to analyze the gathered data . Furthermore, reasonable methods and quantitative analysis guarantee that the study's conclusions are supported by factual facts rather than arbitrary interpretations.

In the current study, the primary data was collected by using a structured, self-administered questionnaire to acquire the required data from the population of the study. Accordingly, The research population targeted are undergraduate students enrolled in the College of Management and Technology (CMT) at the Arab Academy for Science, Technology and Maritime Transport (AASTMT) in Alexandria, Egypt. The population consisted of students from various business-related disciplines and levels of study.

 Prior to launching the main data collection phase, a pilot study was conducted to evaluate the clarity, reliability, and content validity of the questionnaire. The pilot study is done at March 2025 .The pilot sample included 30 undergraduate students from CMT who were not part of the final study sample. Feedback

from the pilot respondents was used to refine wording, improve the structure of specific items, and ensure alignment with the research aim. Internal consistency of the pilot data was assessed using Cronbach's alpha, which yielded acceptable reliability values ($\alpha > 0.7$) for the key dimensions of awareness, knowledge, and attitude. Based on the pilot results, minor adjustments were made to improve item clarity, particularly in sections measuring students' agreement with sustainability issues and their exposure to sustainable practices on campus.

The questionnaire was designed to gather comprehensive data to explore business students' perceptions on sustainability concerns. The questionnaire starts with an introduction that shows the aim of the questionnaire, The final version of the questionnaire consisted of four main parts. The first measured students' awareness of sustainability concepts using a 5-point Likert scale ranging from "least aware" (1) to "very highly aware" (5). The second part assessed knowledge of global sustainability issues, including climate change, poverty, and responsible consumption. The third part focused on students' attitudes and engagement behaviors, such as participation in environmentally friendly practices and exposure to sustainability messages. The final section measured the level of concern for specific sustainability issues and the perceived presence of sustainability-related practices and resources on campus. A total of 281 valid responses were collected during May – April of 2025. The questionnaire

was distributed electronically via university mailing lists and online platforms. No restrictions were applied to student major or year of study, as the aim was to gather diverse perspectives from across the business college.

4. Results and Findings

This section investigates the effect of Awareness, Knowledge and Attitude on the development of Sustainability concerns in education. It displays the main results of the empirical study by introducing the descriptive analysis of the respondents' profile and the research variables. In addition, the confirmatory factor analysis of the measurement model is illustrated, followed by the structural equation modeling of the model under study.

Descriptive Analysis of Respondents' Profile

Table 1 represents the respondents' profile that have participated in this study. In this section, the explanation about Gender, Program, and Year is introduced. It is observed that male respondents contribute the highest percentage with 51.2%, meanwhile female consumers are about 48.4%. On the other part, most of respondents in this research are in the business administration department with 69.4%. Lastly, for Semester, the respondents who are in the seventh semester are the highest with 34.2%.

Table 1: Descriptive Statistics for Respondents Profile

Item	Category	Frequency (N=281)	Percent %
Gender	Male	144	51.2
	Female	137	48.8
Department	Accounting and Finance	61	21.7
	Business Administration	195	69.4
	Tourism	25	8.9
Semester	First Semester	2	.7
	Third Semester	38	13.5
	Fourth Semester	7	2.5
	Fifth Semester	89	31.7
	Sixth Semester	26	9.3
	Seventh Semester	96	34.2
	Eighth Semester	22	7.8

Descriptive Analysis of Research Variables

It provides summary statistics about the research variables, including the mean, and standard deviations. Table 2 shows the descriptive analysis for the research variables with a 5-point Likert scale. It was observed that the mean values of Awareness, and Knowledge are 3.8114, and 3.9606 respectively. This means that these variables evaluation is above average, yet, the responses are in the agree zone and did not catch the zone of strongly agree, which indicate the need for some improvements in these research variables.

Table 2: Descriptive Analysis for Research variables

Research Variables	N	Mean	Std. Deviation	Frequency				
				1	2	3	4	5
Awareness	281	3.8114	.79956	0	13	82	131	55
Knowledge	281	3.9609	.77591	0	9	63	139	70

Table 3 shows the descriptive analysis for the research variables with a 4-point scale. It was observed that the mean values of

Attitude, and Sustainability Concerns are 2.4270, and 2.7722 respectively. The same observation is obtained here, where it could be claimed that these variables evaluation is above average, yet, the responses are in the agree zone and did not catch the zone of strongly agree, which indicate the need for some improvements in these research variables.

Table 3: Descriptive Analysis for Research variables

Research Variables	N	Mean	Std. Deviation	Frequency			
				1	2	3	4
Attitude	281	2.4270	.82970	37	112	107	25
Sustainability Concerns	281	2.7722	.76397	0	121	103	57

Confirmatory Factor Analysis

The confirmatory factor analysis technique is used to show the model fit indices for the measurement model, which confirms the measurement scale of the constructs under study, which are; Awareness, Knowledge, Attitude, and Sustainability Concerns. Table 4 shows the model fit indicators values in CFA and their acceptable cutoff values. The model fit of the confirmatory factor analysis were computed, where it was found that the minimum discrepancy or chi-square divided by the degrees of freedom (CMIN/DF) was 1.411; the probability of getting as larger discrepancy as occurred with the present sample (p-value) was 0.000; goodness of fit (GFI) was 0.898; adjusted goodness of fit index (AGFI) was 0.875 - that evaluate the fit of the model versus the number of estimate coefficients or the degrees of freedom needed to achieve that level of fit; the Bentler-Bonett

normed fit index (NFI) was 0.874 and the Tucker-Lewis index or Bentler-Bonett non-normed fit index (TLI) was 0.953 – which assess the incremental fit of the model compared to a null model; the comparative fit index (CFI) was 0.959. Also, the root mean square residual (RMR) was 0.048 – which shows the amount by which the sample variances and covariances differ from their estimates obtained under the assumption that the model is correct; the root mean square of approximation (RMSEA) was 0.038 – which is an informative criterion in covariance structure modeling and measures the amount of error present when attempting to estimate the population.

Table 4: Measurement Model Computed Fit Indices and their Cutoff Points

Measure	Results	Cutoff Points
Chi-square/df	1.411	< 3
GFI	0.900	> 0.90
AGFI	0.875	> 0.85
NFI	0.874	> 0.80
TLI	0.953	> 0.85
CFI	0.959	> 0.80
RMR	0.048	< 0.09
RMSEA	0.038	< 0.10

Figure 1 shows the confirmatory factor analysis using the covariance method, where the factor loadings are shown on arrows implying good bfactor loadings for the confirmatory factor analysis (Factor Loadings > 0.4).
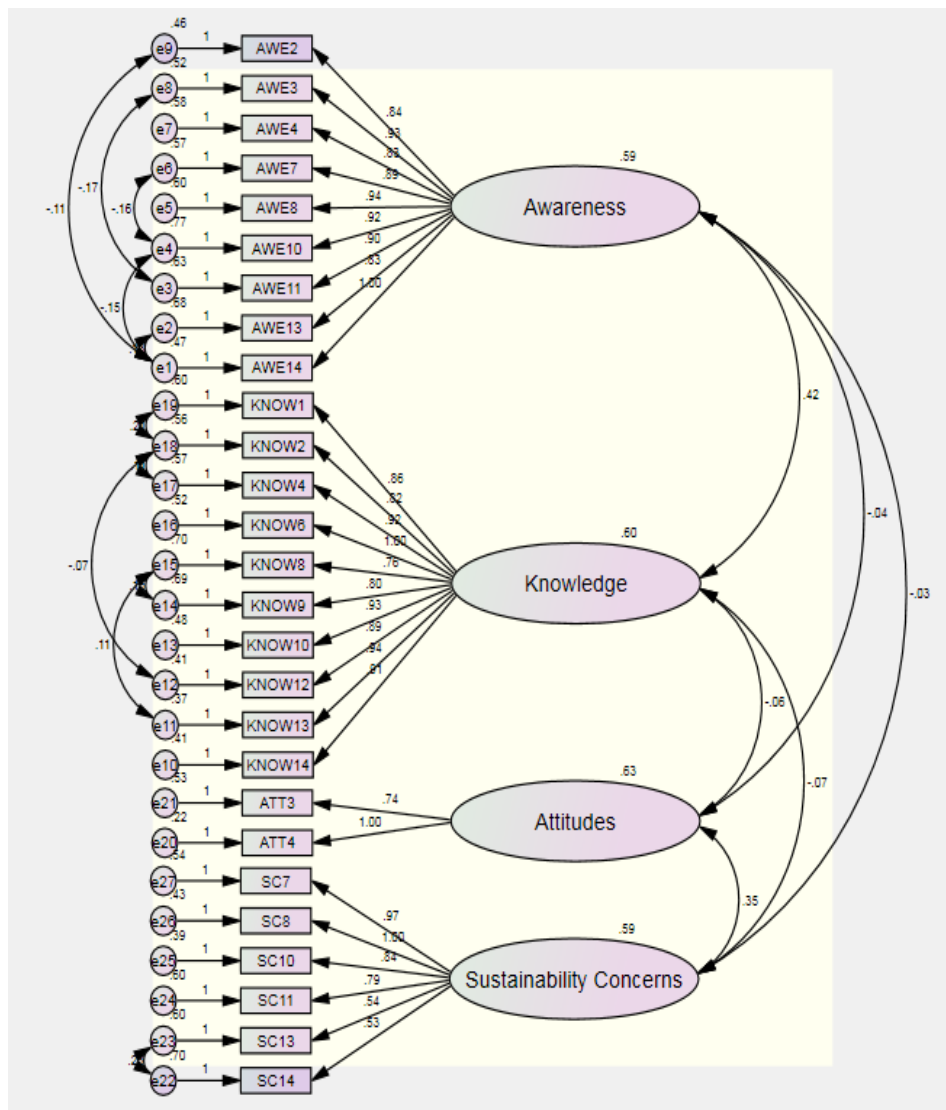
Figure 1: CFA using Covariance Method for the Measurement Model

Table 5 shows that all factor loadings (FL); which is defined as the size of the loadings of items on their corresponding constructs, are all greater than 0.40 referring to an adequate convergent validity.

Table 5: Item Loading after Confirmatory Factor Analysis

Item		Construct	Estimate	S.E.	C.R.	P
AWE14	<---	Awareness	1.000			
AWE13	<---	Awareness	.831	.074	11.197	***
AWE11	<---	Awareness	.897	.085	10.553	***
AWE10	<---	Awareness	.923	.101	9.155	***
AWE8	<---	Awareness	.943	.085	11.142	***
AWE7	<---	Awareness	.887	.082	10.834	***
AWE4	<---	Awareness	.835	.080	10.502	***
AWE3	<---	Awareness	.927	.082	11.359	***
AWE2	<---	Awareness	.844	.083	10.179	***
KNOW14	<---	Knowledge	.906	.076	11.978	***
KNOW13	<---	Knowledge	.939	.075	12.477	***
KNOW12	<---	Knowledge	.894	.075	11.912	***
KNOW10	<---	Knowledge	.927	.079	11.692	***
KNOW9	<---	Knowledge	.798	.083	9.605	***
KNOW8	<---	Knowledge	.760	.083	9.190	***
KNOW6	<---	Knowledge	1.000			
KNOW4	<---	Knowledge	.923	.083	11.085	***
KNOW2	<---	Knowledge	.819	.079	10.343	***
KNOW1	<---	Knowledge	.865	.082	10.549	***
ATT4	<---	Attitudes	1.000			
ATT3	<---	Attitudes	.739	.115	6.404	***
SC14	<---	Sustainability Concerns	.531	.080	6.669	***
SC13	<---	Sustainability Concerns	.543	.075	7.224	***
SC11	<---	Sustainability Concerns	.790	.084	9.425	***
SC10	<---	Sustainability Concerns	.837	.077	10.878	***
SC8	<---	Sustainability Concerns	1.000			
SC7	<---	Sustainability Concerns	.971	.090	10.805	***

Table 6 shows the discriminant validity of the research variables, where it could be observed that all square roots of AVE values are greater than the correlations between the corresponding

construct and other constructs. This means that the research variables have adequate discriminant validity.

Table 6: Discriminant Validity of the Research Variables

Constructs	Mean	St. Dev.	1.	2.	3.	4.
1. Awareness			(.709)			
2. Knowledge			.557**	(.729)		
3. Attitude			-.091	-.091	(.868)	
4. Sustainability Concerns			-.006	-.078	.346**	(.713)

Testing the First Hypothesis of the Effect of Awareness, Knowledge and Attitude on Sustainability Concerns

Table 7 shows the SEM analysis of the impact of the Awareness, Knowledge and Attitude on Sustainability Concerns. It could be observed that there is an insignificant effect of Awareness on Sustainability Concerns, as the corresponding P-value is greater than 0.05 (P-value = 0.554). Therefore, the first sub hypothesis of the first hypothesis, testing the effect of Awareness on Sustainability Concerns "H$_{1a}$: There is a significant effect of Awareness on Sustainability Concerns." is not supported.

Also, it was noticed that there is an insignificant effect of Knowledge on Sustainability Concerns, as the corresponding P-value is greater than 0.05 (P-value = 0.294). Therefore, the second sub hypothesis of the first hypothesis, testing the effect of Knowledge on Sustainability Concerns "H$_{1b}$: There is a significant effect of Knowledge on Sustainability Concerns." is not supported.

However, it was found that there is a positive significant effect of Attitude on Sustainability Concerns, as the corresponding P-value is less than 0.05 (P-value = 0.000) and the corresponding estimate is greater than zero (Estimate = 0.556). Therefore, the third sub hypothesis of the first hypothesis, testing the effect of Attitude on Sustainability Concerns "H_{1c}: There is a significant effect of Attitude on Sustainability Concerns." is supported.

Furthermore, the R square is 0.341, which means 34.1% of the variation of the Sustainability Concerns can be explained by this model. Therefore, the first hypothesis "H_1: There is a significant effect of Awareness, Knowledge, Attitude on Sustainability Concerns" is partially supported.

Table 7: SEM for Awareness, Knowledge and Attitude Effects on Sustainability Concerns

			Estimate	P	R^2
Sustainability Concerns	<---	Awareness	.056	.554	
Sustainability Concerns	<---	Knowledge	-.101	.294	.341
Sustainability Concerns	<---	Attitude	.556	***	

It should be noted that the model fit indices; CMIN/DF = 1.411, GFI = 0.898, CFI = 0.959, AGFI= 0.875, and RMSEA = 0.038 are all within their acceptable levels. The SEM model conducted for the effect of the Awareness, Knowledge and Attitude on Sustainability Concerns is illustrated in Figure 2.
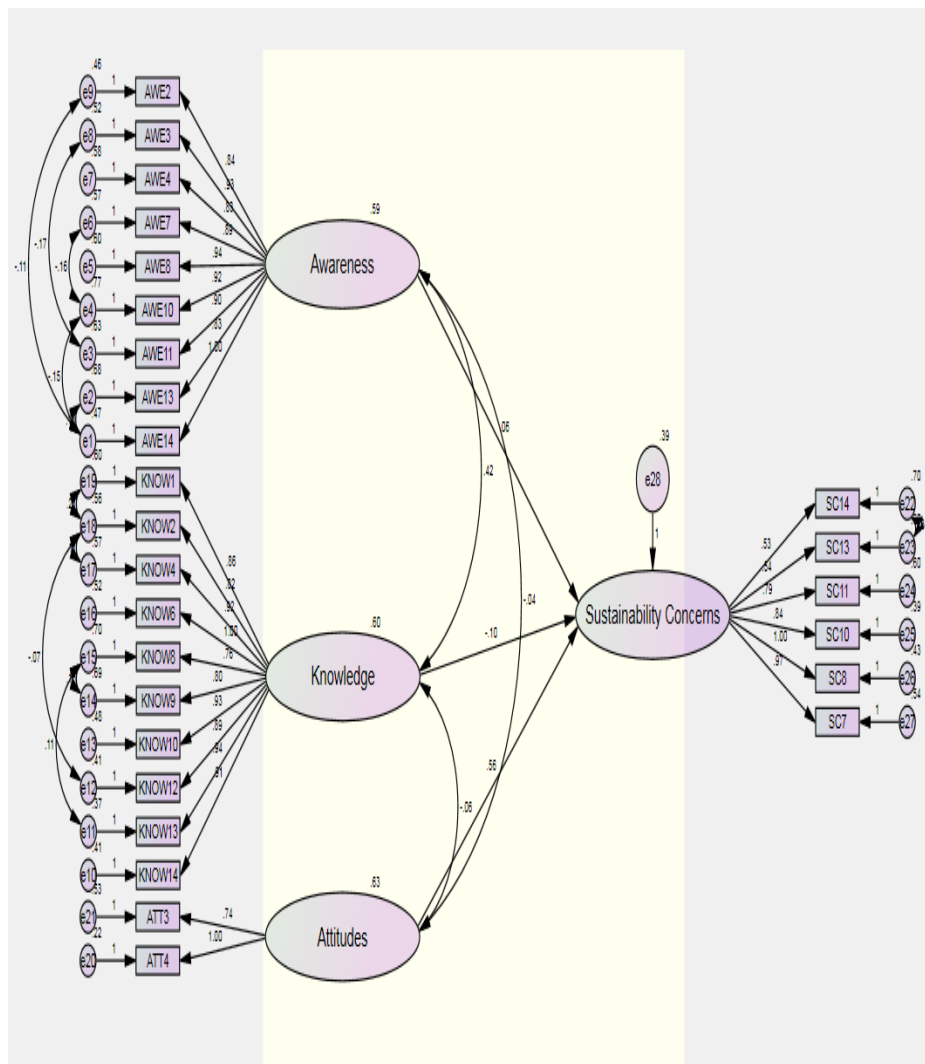
Figure 2: SEM for Awareness, Knowledge and Attitude on Sustainability Concerns

Testing the Moderation Role of Gender

This section tests the moderation role of Gender between Awareness, Knowledge, Attitude and Sustainability Concerns by computing the interaction variable of the independent variables; Awareness, Knowledge, and Attitude and Gender. From Table 8, it could be observed that Gender could moderate the relationship between Attitude and Sustainability Concerns, as the corresponding P-value is less than 0.05 (P-value = 0.011). However, it could be claimed that Gender could not significantly moderate the relationship between Awareness and Sustainability Concerns, as the corresponding P-value is greater than 0.05 (P-value = 0.919). Similarly, Gender could not significantly moderate the relationship between Knowledge and Sustainability Concerns, as the corresponding P-value is greater than 0.05 (P-value = 0.142). Therefore, the second hypothesis testing the moderation role of Gender "H_2: Gender significantly moderates the relationship between Awareness, Knowledge, Attitude and Sustainability Concerns" is partially supported.

Table 8: Testing the Moderation Role of Gender

			Estimate	P
Sustainability Concerns	<---	Awareness	-.046	.958
Sustainability Concerns	<---	Knowledge	.996	.254
Sustainability Concerns	<---	Attitudes	-1.628	.040
Sustainability Concerns	<---	AWE*Gender	-.043	.919
Sustainability Concerns	<---	KNOW*Gender	-.638	.142
Sustainability Concerns	<---	ATT*Gender	1.160	.011

The model fit indices; CMIN/DF = 1.332, GFI = 0.895, CFI = 0.971, AGFI= 0.870, and RMSEA = 0.034 are all within their acceptable levels. The SEM model conducted for the Moderation Role of Gender between Awareness, Knowledge, Attitude and Sustainability Concerns is illustrated in Figure 3.
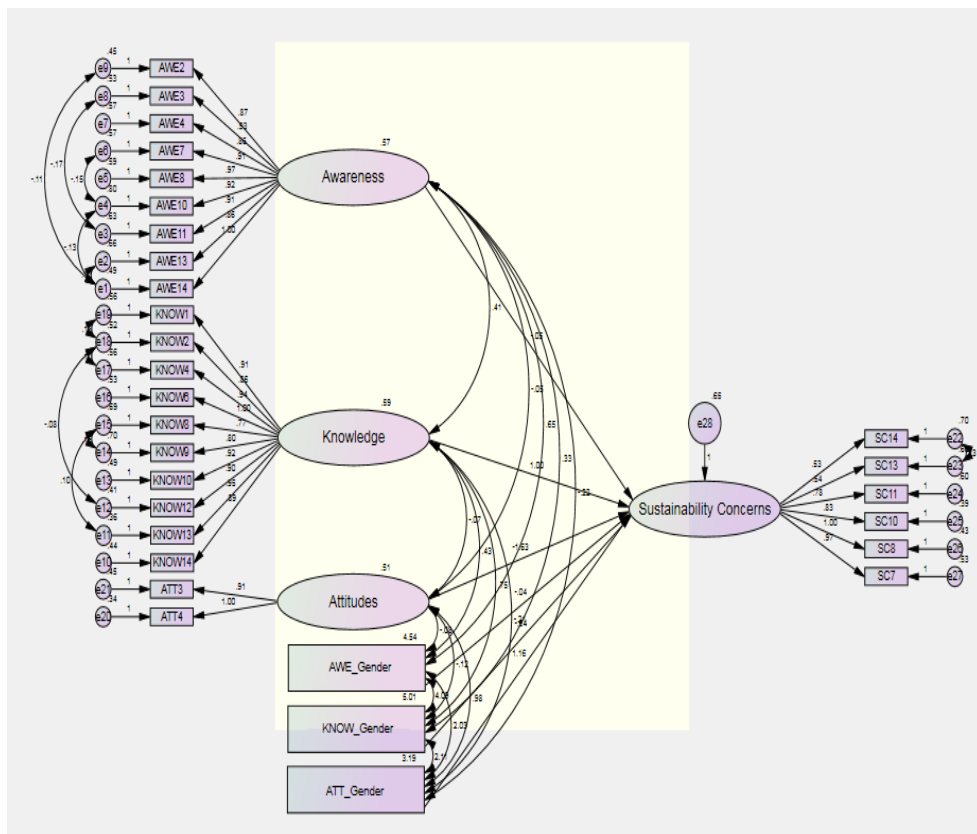

Figure 3: SEM for the Moderation Role of Gender `

Testing the Moderation Role of Year

This section tests the moderation role of Year between Awareness, Knowledge, Attitude and Sustainability Concerns by computing the interaction variable of the independent variables; Awareness, Knowledge, and Attitude and Year. From Table 9, it could be observed that Year could moderate the relationship between Attitude and Sustainability Concerns, as the corresponding P-value is less than 0.05 (P-value = 0.004). However, it could be claimed that Year could not significantly moderate the relationship between Awareness and Sustainability Concerns, as the corresponding P-value is greater than 0.05 (P-value = 0.471). Similarly, Year could not significantly moderate the relationship between Knowledge and Sustainability Concerns, as the corresponding P-value is greater than 0.05 (P-value = 0.184). Therefore, the third hypothesis testing the moderation role of Year "H₃: Year significantly moderates the relationship between Awareness, Knowledge, Attitude and Sustainability Concerns" is partially supported.

Table 9: Testing the Moderation Role of Year

			Estimate	P
Sustainability Concerns	<---	Awareness	-1.321	.467
Sustainability Concerns	<---	Knowledge	1.833	.260
Sustainability Concerns	<---	Attitudes	-.625	.108
Sustainability Concerns	<---	AWE*Year	.176	.471
Sustainability Concerns	<---	KNOW*Year	-.286	.184
Sustainability Concerns	<---	ATT*Year	.170	.004

The model fit indices; CMIN/DF = 1.380, GFI = 0.892, CFI = 0.968, AGFI= 0.866, and RMSEA = 0.037 are all within their acceptable levels. The SEM model conducted for the Moderation Role of Year between Awareness, Knowledge, Attitude and Sustainability Concerns is illustrated in Figure 4.
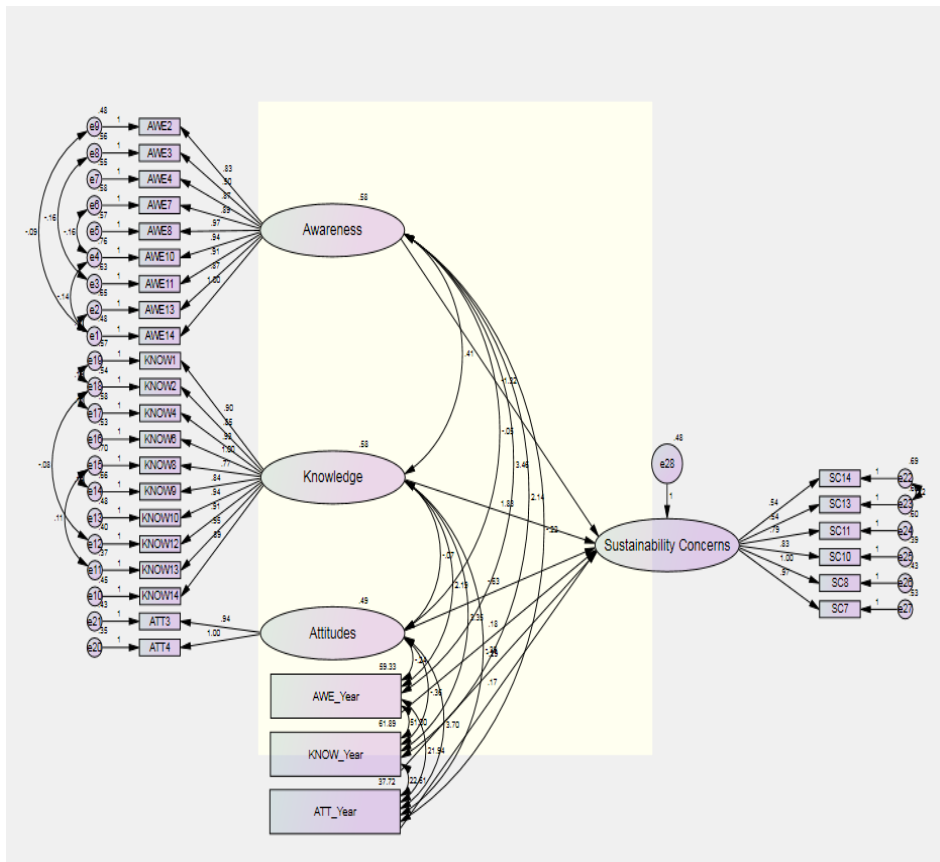

Figure 4: SEM for the Moderation Role of Year `

Testing the Moderation Role of Program

This section tests the moderation role of Program between Awareness, Knowledge, Attitude and Sustainability Concerns by computing the interaction variable of the independent variables; Awareness, Knowledge, and Attitude and Year. From Table 10, it could be observed that Program could moderate the relationship between Attitude and Sustainability Concerns, as the corresponding P-value is less than 0.05 (P-value = 0.000). However, it could be claimed that Program could not significantly moderate the relationship between Awareness and Sustainability Concerns, as the corresponding P-value is greater than 0.05 (P-value = 0.847). Similarly, Program could not significantly moderate the relationship between Knowledge and Sustainability Concerns, as the corresponding P-value is greater than 0.05 (P-value = 0.474). Therefore, the fourth hypothesis testing the moderation role of Program "H_4: Program significantly moderates the relationship between Awareness, Knowledge, Attitude and Sustainability Concerns" is partially supported.

Table 10: Testing the Moderation Role of Program

			Estimate	P
Sustainability Concerns	<---	Awareness	.137	.868
Sustainability Concerns	<---	Knowledge	.403	.618
Sustainability Concerns	<---	Attitudes	-.841	.005
Sustainability Concerns	<---	AWE*Program	-.064	.847
Sustainability Concerns	<---	KNOW*Program	-.230	.474
Sustainability Concerns	<---	ATT*Program	.616	***

The model fit indices; CMIN/DF = 1.431, GFI = 0.889, CFI = 0.963, AGFI= 0.863, and RMSEA = 0.039 are all within their acceptable levels. The SEM model conducted for the moderation role of Program between Awareness, Knowledge, Attitude and Sustainability Concerns is illustrated in Figure 5.
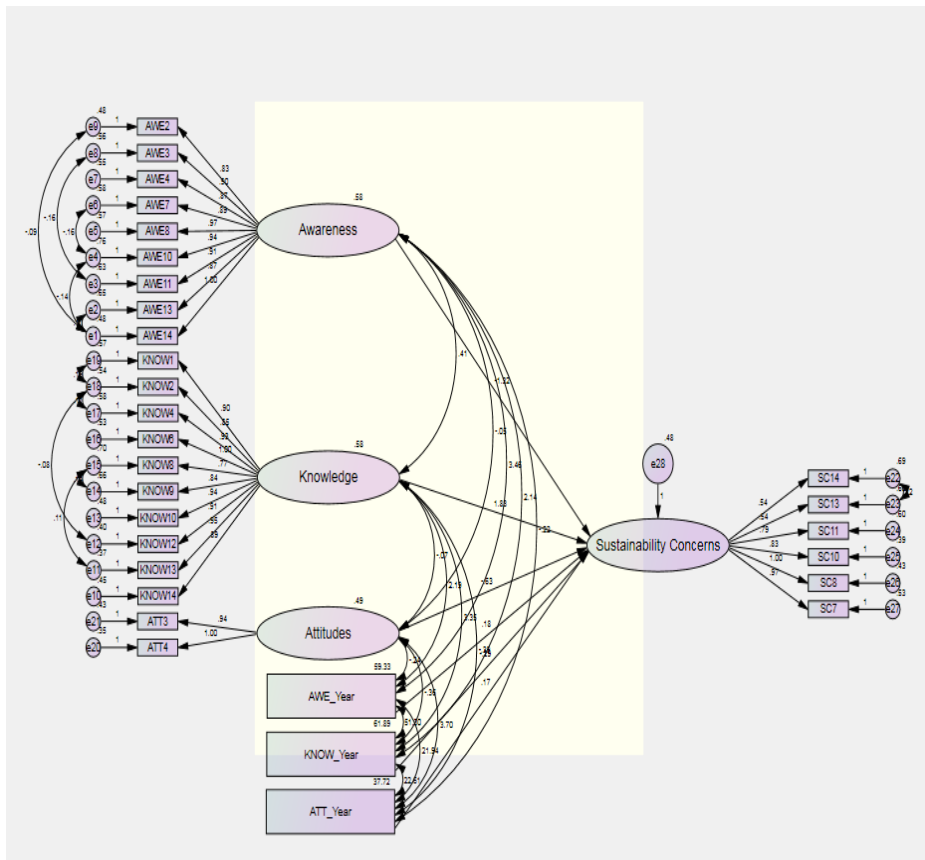

Figure 5: SEM for the Moderation Role of Program

5. Discussion and Conclusion

This section represents the discussion of the research findings. The study investigates the interrelationships between sustainability awareness, knowledge, attitudes, and concern among business students at the College of Management and Technology (CMT), AASTMT, Alexandria, Egypt. The use of SEM and CFA allowed for a robust analysis of both the measurement properties and the structural paths among key constructs, revealing critical insights for advancing Education for Sustainable Development (ESD).

The CFA results confirmed the validity and reliability of the measurement model, with all factor loadings exceeding 0.4 and fit indices falling within acceptable thresholds (e.g., RMSEA = 0.038; CFI = 0.959). This reinforces confidence in the structure of the measured constructs and allows for a credible interpretation of structural paths , setting the context for testing the hypothesized relationships among awareness, knowledge, attitude (A-K-A), and sustainability concerns.

The descriptive results showed that students report moderately high awareness (mean = 3.81) and knowledge (mean = 3.96) of sustainability, yet attitudes (mean = 2.43) and sustainability concerns (mean = 2.77), measured on a 4-point scale, were noticeably lower. This disparity reinforces what multiple studies have termed a disconnect between what students know and what

they prioritize emotionally or behaviorally and this goes with studies done by Teather & Etterson,(2023); Maoela et al., (2024). Most students agree that they understand sustainability issues but their affective engagement and expressed concerns are only moderate. Although, awareness and knowledge are necessary conditions, they are not by themselves sufficient to inspire commitment or concern, suggesting room to deepen students' emotional connection to sustainability.

The structural equation model (SEM) revealed that Awareness and Knowledge did not have significant direct effects on Sustainability Concerns. In contrast, Attitude had a strong positive effect on sustainability Concerns (β = 0.556, p < 0.001). These findings echo prior empirical work (Boeve-de Pauw & Van Petegem, 2017; Cotton et al., 2020) suggesting that emotional and attitudinal engagement—not just intellectual understanding—is key to activating concern and behavior. This pattern aligns with the Theory of Planned Behavior (Ajzen, 1991), which assumes that attitudes (reflecting emotional engagement) are key predictors of intentions and actions. In other words, knowing about sustainability is not enough; students must internalize positive attitudes for concern to rise and this paradox mirrors Kollmuss and Agyeman's (2002) and Maoela et al., (2024). The R² of 0.341 indicates that 34.1% of the variance in sustainability concern was explained by the model, a moderate value that suggests other unexplored factors such as institutional

culture, peer influence (Konuk & Altuntaş, 2021) , may also imply that the combined A–K–A constructs only partially predicted students' concerns.

Accordingly, the value–action gap persists even among students with high awareness and knowledge, reinforcing that curricular reform must go beyond content delivery. Students need to be emotionally invested, which can be fostered through experiential learning simulations, real-world projects, and value-based reflection (Lee & Kim, 2020). Based on the above, the first hypothesis " There is a significant relationship between awareness, knowledge, attitude, and sustainability concerns" is partially supported.

For the moderation hypotheses, the SEM modes were consistent across all studied demographic factors. Gender significantly moderates only the Attitude–Concerns relationship interaction, while interactions of Awareness×Gender and Knowledge×Gender were non-significant. This implies that female and male students differ in how their attitudes toward sustainability translate into concern, with females potentially exhibiting stronger emotional responses and concern when they hold favorable attitudes. These results are consistent with findings from Teather & Etterson (2023) and Yücel (2025), who report stronger sustainability engagement among female students. Aligning with global studies where gender differences manifest in affective domains more than cognitive ones (Lee & Kim,

2020). In this study context, gender does not change whether students are aware of issues, but it influences how their attitudes translated into concern. This suggests female students may be more inclined to let their positive attitudes amplify their concern. According to the above, the second hypothesis, " Gender moderates, the relationship between awareness, knowledge, attitude, and sustainability concerns", is partially supported.

Similarly, academic Year moderates only Attitude–Concerns, Awareness×Year and Knowledge×Year are not significant. This indicates that the impact of attitudes on sustainability concern strengthens with academic progression and they can better integrate values into professional priorities, likely due to increased exposure to sustainability-related content and greater maturity in values among senior students. These findings reinforce prior evidence that sustainability perspectives evolve throughout academic experiences (e.g., Cebrián et al., 2015; Lambrechts et al.'s (2018). This may reflect that upper-year students have had more exposure to sustainability content or maturity in their values. Yücel (2025) also found that students' sustainability attitudes and behaviors increased with years in university. No moderation by year was found for awareness or knowledge, suggesting that across all year levels, those constructs alone did not change how concern was formed. According to the above results, the third hypothesis "year

moderates the relationship between awareness, knowledge, attitude, and sustainable concerns" is partially supported.

Likewise, academic program significantly moderates the attitude–concern link as well but Awareness×Program and Knowledge×Program are not significant. This is consistent with Yücel's (2025) and Lozano et al., (2019) findings of program may influence students' sustainability attitudes, suggesting that programs curricula may emphasize sustainability. According to the above, the fourth hypothesis "program moderates the relationship between awareness, knowledge, attitude, and sustainable concerns" is partially supported.

In conclusion, this research shows that Attitude (affective emotional engagement) was the sole significant predictor of concerns and the central bridge between cognitive understanding and sustainability concern. This reinforces the idea that cognitive awareness/knowledge alone often fails to translate into motivation or concern. This is similar to the well-documented "value–action gap": students may care and know about sustainability, but this does not always stimulate active engagement or deeper concern. These results highlight that enhancing sustainability education requires more than information delivery – it must foster genuine attitudinal shifts.

In addition, the significant moderating effects suggest that while awareness and knowledge provision may be similar across

groups, it is the attitudinal engagement – and its amplification through factors like gender, academic maturity, and study program – that truly shapes student concern. In short, this case study of CMT, AASTMT Alexandria, Egypt reinforces the call for educational model that go beyond raising awareness to actively nurture students' commitment and translate their positive attitudes into sustainable behavior.

6. Research Recommendations

From the results concluded from the analysis, some recommendations are provided to CMT decision makers.

Integrate Experiential and Affective Learning Approaches;
Since students' attitudes significantly influence their sustainability concern, CMT should incorporate more experiential and emotionally engaging pedagogies. This includes service-learning, real-world projects, simulations, and ethical dilemma role-playing within existing business courses (e.g., CSR, marketing, finance). These approaches can foster personal relevance and emotional connection, helping to bridge the observed value–action gap.

Customize Sustainability Education Based on Student Demographics;

The study revealed that gender, year of study, and program specialization influence how students translate their attitudes into

concern for sustainability. CMT should tailor interventions (e.g., themed workshops, talks, or surveys) to resonate with the needs and perspectives of specific student subgroups. For instance, workshops on sustainable finance for final year business students .Strengthen Co-Curricular Sustainability Programs;

CMT should reinforce its support for student-led sustainability efforts—such as the Sustainability Club and other initiatives through the Business Development Center (BDC)—by offering more resources, mentorship, and recognition for impactful projects that align with the SDGs.

Establish a CMT Sustainability Ambassador Program;

CMT can launch a peer-mentorship or ambassador initiative that engages students with high sustainability concern scores to advice and influence their peers. These ambassadors can help implement campaigns and drive student participation in campus-wide green initiatives.

Track Students' Progress Through Longitudinal Assessment;

CMT should develop a longitudinal evaluation framework that tracks how sustainability awareness, knowledge, and attitudes evolve during students' academic journey. This would provide more robust insights for improving curriculum effectiveness.

Promote Cross-Faculty and Interdisciplinary Collaboration;

CMT is encouraged to collaborate with other faculties (e.g., Engineering, Logistics, Maritime Transport) to offer interdisciplinary workshops and elective courses. This will enrich students' perspectives on sustainability in diverse business and industrial contexts.

7. Research Limitations and future research

This study has limitations. First, it is a single-case design focused on one college within AASTMT, limiting generalizability to other institutions or cultural contexts. Second, the data are cross-sectional and self-reported, which may introduce biases and cannot establish causal links. Third, the reliance on quantitative survey measures means we cannot fully capture how or why students feel and behave as they do; additional qualitative insights would be valuable. Finally, the model explained a moderate portion of variance ($R^2 \approx 34\%$), indicating that other unmeasured factors and potential influences (such as social norms or perceived behavioral control,socioeconomic background) were not analyzed that may also influence sustainability concern.

For further research , the findings shows that there are possible areas for further investigation, for instance conducting a Longitudinal designs by following the same students over time (e.g. from freshman to senior year) would clarify how awareness, knowledge, and attitudes evolve through the curriculum, and

whether interventions have lasting effects, including students from other faculties and institutions across Egypt and the MENA region, measuring sustainability-related behaviors rather than relying solely on perceptions, and using In-depth interviews or focus groups could uncover the reasons behind students' attitudes and perceived barriers. By extending this work, scholars and practitioners can better understand and cultivate the mindsets needed for sustainable business leadership.

References

AASTMT (2024), Arab Academy for Science Technology and Maritime Transport. . Sustainable AASTMT- environmental social and governance (ESG) initiatives retrieved July 22, 2025, from https://aast.edu/en/sdg/

Abdelrahman, M., & Hassan, A. (2021). Sustainability awareness and practices among university students in Egypt: An exploratory study. International Journal of Sustainability in Higher Education, 22(4), 765–784.

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Alattar, L., Baroudi, S., & Baroud, H. (2021). Sustainability literacy and education in Arab universities: A case study from Lebanon. International Journal of Sustainability in Higher Education, 22(5), 1009–1028.

Alonso-Almeida, M. D. M., Llach, J., & Marimon, F. (2022). Embedding sustainability in business education: A systematic literature review and research agenda. Journal of Business Ethics, 178(3), 741–759. https://doi.org/10.1007/s10551-021-04858-w

Alsaati, B., El-Nakla, S., & El-Nakla, H. (2020). Level of sustainability awareness among university students in the Eastern Province of Saudi Arabia. Sustainability, 12(8), 3159. https://doi.org/10.3390/su12083159

Ali, S., & El-Shamy, N. (2022). Perceptions of sustainability among Egyptian university students: A career-focused investigation. Sustainability, 14(12), 7410.

Azapagic, A., Perdan, S., & Shallcross, D. (2005). How much do engineering students know about sustainable development? The findings of an international survey and possible implications for the engineering curriculum. European Journal of Engineering Education, 30(1), 1–19.

Barth, M., & Rieckmann, M. (2012). Academic staff development as a catalyst for curriculum change towards education for sustainable development: An output perspective. Journal of Cleaner Production, 26, 28–36.

Barth, M., & Rieckmann, M. (2016). State of the art in research on higher education for sustainable development. In W. Leal Filho & M. M. Pace (Eds.), Teaching education for sustainable development at university level (pp. 100–110). Springer.

Beamond, M. T., Schmitz, M., Cordova, M., Ilieva, M. V., Zhao, S., & Panina, D. (2024). Sustainability in business education: A systematic review and future research agenda. Critical Perspectives on International Business. DOI:10.1108/cpoib-06-2022-0071.

Boeve-de Pauw, J., & Van Petegem, P. (2017). Eco-school evaluation beyond labels: The impact of environmental policy, didactics and nature at school on student outcomes. Environmental Education Research, 23(2), 125–141.

Cebrián, G., & Junyent, M. (2015). Competencies in education for sustainable development: Exploring the student teachers' views. Sustainability, 7(3), 2768–2786. https://doi.org/10.3390/su7032768

Cebrián, G., Grace, M., & Humphris, D. (2015). Academic staff engagement in education for sustainable development. Journal of Cleaner Production, 106, 79–86.

Chang, Y. C., Chen, M. H., Chien, H. M., & Yu, T. H. (2019). University students' attitudes and behavioral intentions toward sustainability: A case study in Taiwan. Sustainability, 11(14), 3851.

Chou, J., & Vun, L. W. (2025). Knowledge and awareness on sustainable development among university students. European Journal of Development Studies,5(1), 21–27.

Cotton, D., & Winter, J. (2010). It's not just bits of paper and light bulbs: A review of sustainability pedagogies and their potential for use in higher education. In Sustainability Education (pp. 39-54).

Cotton, D. R. E., Shiel, C., & Cano, I. G. (2020). Incorporating sustainability into teaching and learning: Recent developments in the UK. *International Journal of Sustainability in Higher Education,21(7), 1329–1348.

Dourish, P., & Bellotti, V. (1992). Awareness and coordination in shared workspaces. In CSCW 92 Proceedings (pp. 107–114).

Ghosh, S. (2025). Inclusion of sustainability into business education: Understanding the student's awareness, knowledge, attitude, and beliefs—A study based on India. In S. O. Idowu & S. Vertigans (Eds.), Sustainability in Global Companies: CSR, sustainability, ethics & governance (pp. 299–327). Springer.

Godemann, J., Bebbington, J., Herzig, C., & Moon, J. (2014). Higher education and sustainable development: A model for curriculum integration. Journal of Cleaner Production, 62, 1–9. https://doi.org/10.1016/j.jclepro.2013.11.048

Kagawa, F. (2021). Sustainable development education in the post-COVID era: An opportunity for transformative pedagogies. Journal of Environmental Education Research, 27(3), 359–374.

Khalil, R., & Mostafa, A. (2013). Perception towards sustainable development concept: Egyptian students' perspective. Sustainability Accounting, Management and Policy Journal, 4(3), 307–327. https://doi.org/10.1108/SAMPJ-01-2013-0008

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? Environmental Education Research, 8(3), 239–260. https://doi.org/10.1080/13504620220145401

Kopnina, H. (2014). Future scenarios and environmental education. The Journal of Environmental Education, 45(4), 217–231.

Konuk, F. A., & Altuntaş, G. (2021). Sustainability awareness, attitude, and behavioral intention of university students: An application in a developing country. International Journal of Sustainability in Higher Education, 22(4), 810–826. https://doi.org/10.1108/IJSHE-11-2020-0450

Lambrechts, W., Van Liedekerke, L., & Van Petegem, P. (2018). Higher education for sustainable development in Flanders: Balancing between normative and transformative approaches. Environmental Education Research, 24(9), 1284–1300. https://doi.org/10.1080/13504622.2017.1378622

Lee, K., & Kim, J. (2020). Effects of experiential sustainability education on emotional engagement and behavior intention. *Journal of Cleaner Production, 253, 119913.

Leal Filho, W., Salvia, A. L., Brandli, L., Raymond Freires, F. G., & Platje, J. (2019). The role of digital technologies in education for sustainability. Journal of Cleaner Production, 232, 585–592.

Leal Filho, W., Salvia, A. L., Lellis, B., & Pretorius, R. (2022). Implementing sustainable development in higher education in the MENA region: Challenges and opportunities. Sustainability, 14(4), 2342. https://doi.org/10.3390/su14042342

Leal Filho, W., Sierra, J., Price, E., Eustachio, J. H. P., Novikau, A., Kirrane, M., Dinis, M. A. P., & Salvia, A. L. (2024). The role of universities in accelerating the sustainable development goals in Europe. Scientific Reports, 14, Article 15464.

Lozano, R., Barreiro-Gen, M., Lozano, F. J., & Sammalisto, K. (2019). Teaching sustainability in European higher education institutions: An overview of courses. Sustainability, 11(6), 1602.

Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2020). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. Sustainability, 12(16), 6365.

Maoela, M. A., Chapungu, L., & Nhamo, G. (2024). Students' awareness, knowledge and attitudes towards the sustainable development goals at the University of South Africa. International Journal of Sustainability in Higher Education, 25(9), 455–473. https://doi.org/10.1108/IJSHE-11-2023-0518

Melles, G., Anderson, N., Barrett, T., & Thompson-Whiteside, H. (2021). Designing sustainability into business education: The transformative role of experiential learning. International Journal of Management Education, 19(3), 100569. https://doi.org/10.1016/j.ijme.2021.100569

Michelsen, G., & Fischer, D. (2020). Sustainability and university life: Learning, acting, and engaging. In Sustainability and the University (pp. 45–62). Springer.

Mohiuddin, M., Al Mamun, A., Syed, F. A., Masud, M. M., & Su, Z. (2018). Environmental knowledge, awareness, and business school students' intentions to purchase green vehicles in emerging countries. *Sustainability*, *10*(5), 1534.

PRME. (2022). Principles for Responsible Management Education: Report and Impact. UN Global Compact. Retrieved from https://www.unprme.org

Ramos, T. B., Caeiro, S., Van Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2020). Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities. Journal of Cleaner Production, 250, 119511.

Sidiropoulos, E. (2018). Education for sustainability in business education programs: A question of value. Journal of Cleaner Production, 172, 2865–2874.

Starik, M., Kanashiro, P., & Collins, E. (2020). Educating for responsible management: Emerging development and new directions. Journal of Business Ethics, 162(4), 751–759. https://doi.org/10.1007/s10551-018-3965-4

Stubbs, W., & Schapper, J. (2011). Two approaches to curriculum development for educating for sustainability and CSR. International Journal of Sustainability in Higher Education, 12(3), 259–268.

Teather, A. M., & Etterson, J. R. (2023). Value-action gaps between sustainability behaviors, knowledge, attitudes and engagement in campus and curricular activities within a cohort of Gen Z university students. Journal of Sustainability Education, 28.

UNESCO. (2020). Education for Sustainable Development: A roadmap. United Nations Educational, Scientific and Cultural Organization. Retrieved from https://unesdoc.unesco.org

Vicente-Molina, M. A., Fernández-Sáinz, A., & Izagirre-Olaizola, J. (2013). Environmental knowledge and other variables affecting pro-environmental behaviour: Comparison of university students from emerging and advanced countries. Journal of Cleaner Production, 61, 130–138.

Yücel, E. (2025). Sustainability attitudes and behaviours of university students: The case of Bursa Uludag University. Business and Economics Research Journal, 16(1), 43–67. https://doi.org/10.20409/berj.2025.456

Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. Journal of Cleaner Production, 48, 126–138.