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Evaluating the Influence of SDG Educational Practices on the CIT-U Industrial Engineering Graduates' Commitment to Sustainable Industrial Development

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Abstract

Despite curricular efforts, there remains a lack of empirical data measuring the extent to which SDG education influences graduates' actual implementation of sustainability practices in the workplace. This study aims to investigate that research gap through an online survey done among the CIT-U Industrial Engineering alumni. The study examines CIT-U's SDG-related educational practices, tracks graduates with SDG education, analyzes how and which educational factors influence their sustainable industrial development (SID) efforts, and explores the link between SDG awareness and actual SID engagement to offer recommendations for improvement. The study uses a quantitative, descriptive-correlational design, relying on self-reported data gathered from 31 Industrial Engineering graduates through an online questionnaire. The research evaluates SDG Awareness in terms of knowledge, attitude, and behavior (using a modified Alfroz & Ilhan KAP model), SID Implementation through enumerated Project Educational Objectives (PEOs) mapped against key SID components and the relationship between SDG awareness/education and SID implementation through Spearman Correlation analysis. The study found the graduates to have high cognitive and affective awareness of SDGs, a strong correlation between attitude and behavior (confirming that positive attitudes strongly predict sustainable actions) and weak non-significant correlation between SDG awareness and actual SID-related PEOs (indicating a possible gap between education and workplace application). So, while CIT-U's curriculum effectively fosters SDG awareness among its IE graduates, the translation of such awareness into workplace sustainability practices is still limited. This suggests the need for more immersive SDG engagement during academic training and follow-up programs post-graduation.

Keywords

Engineering Education, Curriculum Improvement, Higher Education, Sustainable Development Goals, SDG9, SDG4, Sustainable Industrial Development

1. Introduction

The Sustainable Development Goals, outlined by the UN and made to ensure a better and steady future for the present and succeeding generations, calls for people who understand and embody collective responsibility for both their community and the environment. In this world of rapid technological advancements paired with the increasing rate of globalization, companies are increasingly looking to hire individuals who could aid and support the businesses in consolidating the sustainable industrial development goals into the business processes [Alimehmeti et al. 2024]. SDG Awareness is spread through various forms, even through education. Just as in CIT-U, where the envisioned key result is to have Stewardship or a collective responsibility as an instilled way of life while also aiming for values-driven competent graduates.

According to the UNIDO Industrial Analytics Platform, the Philippine economy ranks 52nd in the SDG-9 Industry Index, with a negative 3 ranks change in the progress within 2000-2020. This spurs the need for more individuals who can drive the progress forward for the economy. To this end, the Philippine Development Plan for 2023-2028 emphasizes the importance of workers' skillsets to drive industrial growth with special attention to developing the skills, technical capacity and expertise, especially in science and engineering, to adopt emerging technologies. The Philippine government has also implemented policies aimed at promoting green jobs through initiatives which include financing strategies for climate change programs, support for sustainable practices, and the establishment of indicators for characterizing green jobs. Companies are increasingly adopting practices that align with these initiatives by adopting various energy efficiency and conservation practices, indicating a shift towards more sustainable operations [International Labour Organization 2024].

This trend underscores the rising demand for skills related to sustainability in the workforce, as businesses seek qualified individuals to meet these evolving needs. But the lack of definitive timely quantitative research data on how SDG educational practices translate to workplace sustainability implementation.

1.1. Objectives of the Study

The purpose of this research is to provide quantitative data of the influence of CIT-U's SDG educational practices on the graduate's sustainable industrial development practices. In that respect, this study is mixed-method research on how much educational practices are affecting the graduates' propensity to develop sustainable industrial development actions in their workplace.
In a summarized bullet form, the objectives of this study are as follows:

- Define the institution's SDG educational practice, track the CIT-U IE graduates and determine the measurement tool for SID practices
- Determine the graduate's SDG awareness, sustainability commitment status or awareness, enumerate their sustainability related achievements and determine the relationship of SDG education to workplace sustainability application
- Bridge the research findings to practical applications by giving recommendations

2. Theoretical Background

Education, by purpose, enlightens the mind and sharpens one's thinking [Al-Shuabi 2014]. Serving as an instrument that imparts knowledge, skills and techniques, helping individuals understand their responsibilities toward their family, society, and nation, it broadens perspectives and enhances the ability to view the world with greater clarity [Prasad and Gupta 2020]. As a result, it supports the broader aims of the Sustainable Development Goals (SDGs). Many universities worldwide have started integrating SDG content into their curricula in various ways [Cembranel et al. 2024], as guided education helps mold students' real-world awareness and behavior. Teaching SDGs aligns with the core purpose of education and can influence students' future decisions, from job choices to the kinds of ideas they champion in the workplace. Since students are future keyholders of society, the lessons they internalize often extend beyond school, continuing into their professional actions and decisions.

A study entitled "The Effects of Education as an Institution" states that "Education restructures whole populations, creating and expanding elites and redefining the rights and obligations of members" [Meyer 1977]. One way that SDG was incorporated into the lessons was through teaching Sustainable Industrial Development practices. Sustainable Industrial Development (SID) is defined as "the improvement in the environmental performance of industry" [Zodape et al. 2015]. With this integration, graduates may feel a personal obligation to embed sustainability in workplace policies, projects, or innovations. While this might seem optional, the likelihood is high due to both educational exposure and the growing demand from companies for sustainability-minded individuals - whether for profit, legal compliance, or genuine environmental concern [Blessinger 2024]. These values often manifest clearly in the objectives of workplace projects, which serve as their foundation and guiding principle [Atlassian 2025].

Since education through explosion to different viewpoints and ideas lead to self-reflection [GastonJ 2024], SDG Educational influence will, by concept, be portrayed by the graduates' SDG Awareness. SDG Awareness is further defined and broken down into cognitive awareness, affective awareness and behavioral awareness. Cognitive awareness is defined as awareness from being knowledgeable, informed and alert of the subject [Gafoor 2012], which in this case is the SDG. Affective awareness is when knowledge roots into beliefs which influence attitudes [Sweldens et al. 2014]. Behavioral awareness is to positive perception and increased likelihood and incorporation of related behavior [Ludwig et al. 2020]. Note that awareness is present and encompassing in the interaction between knowledge,

attitude, and behavior is dynamic and reciprocal [Schrader and Lawless 2004], where knowledge can inform attitudes, and attitudes can influence behavior.

SID, in relation to the SDGs, refers to the practice of developing industries in a way that promotes economic growth while minimizing environmental impact and ensuring social equity, aligning most directly with SDG 9, which focuses on "Industry, Innovation and Infrastructure" as implied in the United Nations' Industry section. The key components used here will be the Sustainable Product Design and Lifecycle Management, Resource & Energy Efficiency in Manufacturing, Pollution Reduction and Control, Waste Management and Circular Economy, Green Building and Facility Management, Sustainable Supply Chain Management, Industrial Symbiosis and Workplace Engagement to Green Behavior Culture (Figure 1).

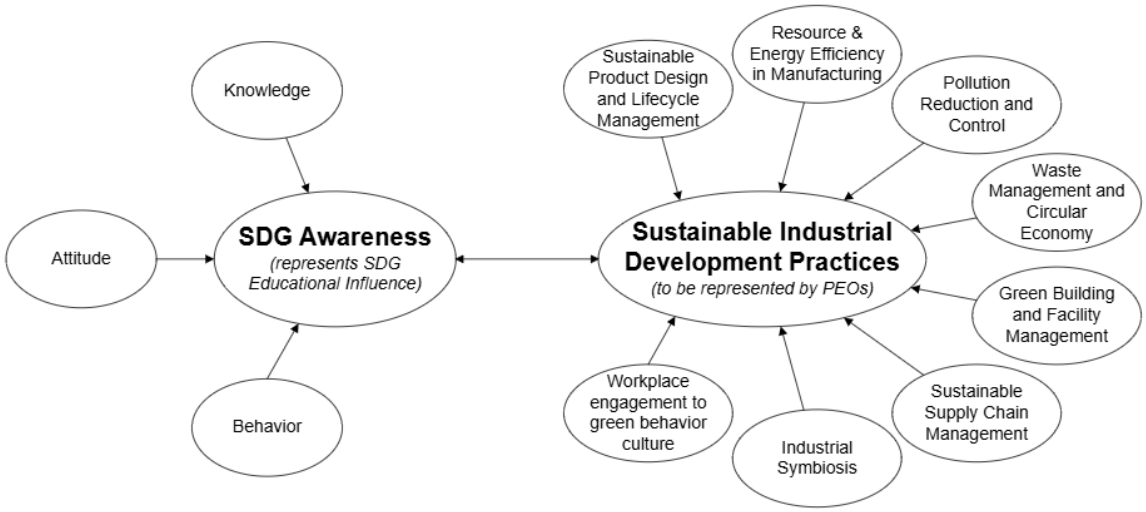

Figure 1. Conceptual Framework between SDG Education and SID Workplace Implementation

The similarities between Sustainable Development Goals and Sustainable Industrial Development are emphasized by the term 'Sustainable'. By integrating SDG awareness into corporate strategies, companies can address global challenges such as environmental degradation and social inequality, leading to more sustainable industrial practices. This alignment fosters innovation, enhances brand reputation, and ensures long-term profitability, thereby contributing to sustainable industrial development [Shayan et al. 2022].

3. Methodology

This research is done in a quantitative descriptive correlational design, beginning with the collection of the CIT-U IE syllabus listing SDG-related subjects and a graduate list of IE students from any year before 2025 (Figure 2). Due to limited accessibility to some alumni, a convenience sampling method was used. A Google Forms survey was then distributed to Industrial Engineering graduates, consisting of five sections: Respondent Demographics, SDG Knowledge, SDG Attitude, SDG Behavior, and SID-related PEOs. Demographic questions included job title, industry type, graduation year, and whether and where SDG lessons were taken. SDG awareness was assessed through three sections: Knowledge (yes/no answers), Attitude (1–7 Likert scale), and Behavior (1–7 Likert scale). Graduates listed their SID-related project educational objectives (PEOs) under the study's key SID categories. The SDG Education sections - covering cognitive, affective, and behavioral awareness - used a modified version of the Alfroz & Ilhan (2020) KAP model tailored to match the prospect respondent demographics.

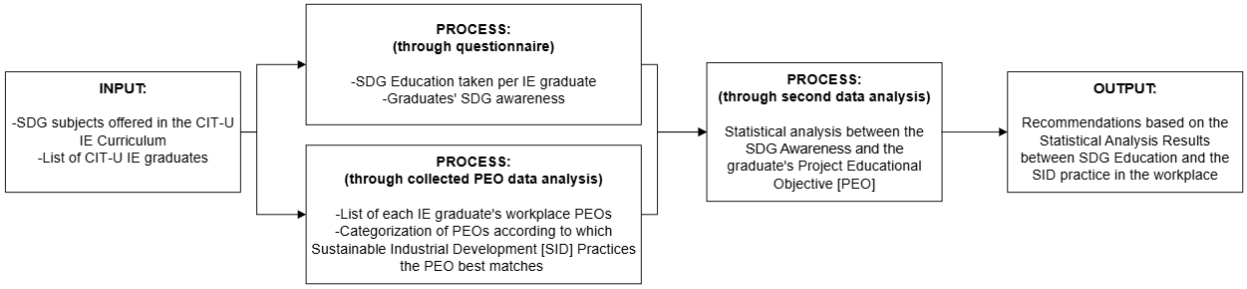

Figure 2. Flow of Research Process

After which, the collected data is then organized, categorized and summarily calculated. Demographic results will be presented in tables alongside pie charts or bar graphs, as needed. For the question sets, especially the ones that have the Likert Scale, percentages per question will first be collected. Then these will be compared most likely with their respective weighted averages and illustrated in bar graphs. For Sustainable Industrial Development (SID) implementation, two tables will be created: one showing the number of SID-related Project Educational Objectives (PEOs) implemented by each respondent, and another identifying the most and least applied SID components.

To analyze the relationship between SDG education and respondent's workplace SID practices, statistical tools will be used to measure the strength and significance of the correlation. For SDG Awareness, average scores will be calculated by category per participant. For SID implementation, the total number of SID areas influenced by each graduate's PEOs will be tallied. These results will undergo correlation analysis, and significant findings will be visualized with a scatterplot and regression line. Final recommendations will be based on the outcomes of this analysis.

3.1. Research Notes

The overarching question of the study is: What is the relationship between being educated in Sustainable Development Goals and being able to implement them into the real world. For a further breakdown, the study will delve into the relationships between having knowledge of SDG, forming attitude on SDG, developing a behavioral change for the SDGs and the increased involvement and formulation of PEOs for various SIDs.

Regarding the study's validity, the research cautions at least three internal validity threats regarding the accuracy of the causal relationship findings due to the limited instrumental resource. Namely, the Instrumentation Effect from possible misinterpretation, Statistical Conclusion Validity from its relatively small sample size and demand characteristics from the respondent's possible guesswork on the survey's purpose. And for those wishing to use this study as foundation or reference to their own studies or analysis, it is recommended to keep watch of at least 8 external validity threats this research namely, the Selection Bias from convenience sampling, Nonresponse Bias, Setting-Specific Differences from difference in the SDG learning exposure, Industry-Specific Difference, Time-Based Generalizability since the data was recently collected, Self-Selection Bias, Context Dependence from possible differences in the workplace cultures and Survey Method Dependence as it is generally self-reported.

4. Data Collection

A review of the educational institution was done to identify how sustainability concepts were integrated. It was then found that in CIT-U IE present curriculum, there is a subject course entitled "Sustainable Development and Global Citizenship" whose code is SSP032. The subject syllabus' objectives are stated as from being able to discuss SDG to global citizenship to generating solutions and applying them in an engineering way. Using the teaching classroom environment, including lecture, seatwork, quizzes, discussions, reports and exams, it fosters SDG Awareness and practice class work innovation that leans towards sustainable industrial development among students. A list of graduates was compiled with the assistance of educational authorities. To ensure comprehensive tracking considering those who started to work abroad and cannot be approached by land within the researcher's reach, group chats and active social media accounts were also utilized to identify and contact graduates who had been exposed to sustainability teachings during their studies. Of the many forms sent online, the study has gathered 33 responses. Eliminating one duplicate answer and one invalid response as that responder says they are still unemployed; the study is now left with 31 responses to analyze.

5. Results and Discussions

For the survey results, the respondent demographics of the respondents were first tabulated (Table 1).

Table 1. Industry and Title of the Survey Respondents

Industry			Graduate Year			Learning Source	
Service	6		2024	18		Subject Course Offering	25
Production	5		2023	4		School Seminars	5
Education	5		2022	1		Company-Sponsored seminars	5
Quality	3		2020	3		Self-taught or other forms	4
Safety	2		2019	2		No lessons taken	2
Supply Chain	2		2018	1			
Retail	1		Before 2018	2			
Human Resource	1						
Marketing	1						
Manufacturing	1						
Warehousing	1						
Accounting	1						
Sales Effectiveness / Capability	1						
Oil and Gas / Maintenance	1						

In this survey, although the **Service** sector has the highest representation (6 respondents), followed by **Production** and **Education** (5 each), the gap against other industries, having only 2-1 respondent representatives, is **not that wide**. With widely varied professions, the respondent group reflects **a diverse set of backgrounds industry-wise**. Although most of respondents are **recent graduates** (2023–2024) with 18 graduates from 2024, followed by 4 graduates from 2023. Lastly, most respondents reported learning about Sustainable Development Goals (SDGs) mostly came through the **subject course offering**, with **25 aligned responses**.

As for identifying the SDG Awareness of each respondent, tables were made to summarize and visualize the graduates' responses in the SDG Knowledge/Cognitive section, SDG Attitude/Affective Awareness section, SDG Behavioral Awareness section and Graduates Workplace PEOs section (Table 2).

Table 2. Summary of Survey Responses in the SDG Knowledge Section

#	Items	%Yes	%No
K1	I have heard about the term "Sustainable Development Goals (SDGs)" before.	96.77%	3.23%
K2	I recognize that the meaning of the word "Sustainability" is the ability to be maintained at a certain rate or level.	***100.00%***	0.00%
K3	I am aware of the fact that Sustainable Development Goals are targeted to [be] achieve[d] by the year 2030.	87.10%	***12.90%***
K4	The overuse of natural resources is affecting the well-being of future generations.	***100.00%***	0.00%
K5	To achieve sustainable development, all people in the world must have access to a good education.	90.32%	9.68%
K6	Environmental protection, economic growth, and social equity are the fundamental element[s] of a nation.	96.77%	3.23%
K7	Healthy oceans and seas are essential to our existence.	***100.00%***	0.00%
K8	Increased use of renewable resources can reduce greenhouse gas emissions.	93.55%	6.45%
K9	Income inequality is a global problem that requires global solutions.	96.77%	3.23%
K10	Maintaining good relationship[s] with various countries is crucial to preserve peace around the world.	***100.00%***	0.00%

The knowledge level of the CIT-U Industrial Engineering graduates is **high**, ranging from **87.10% to 100%.** Four questions, namely **K2**, **K4**, **K7** and **K10**, have a **perfect mark** meaning all the respondents cognitively aware and possess good knowledge in **"sustainability"**, **"dangers in overusing natural resources", "oceans and water quality" and "peace in good global partnerships"**. Although all the questions had a considerably high overall positive rating, **K3 ranked the lowest.**

This means despite many knowing a lot regarding the SDGs, **not all knew these goals were targeted to be achieved by 2030** and consequently may lack the pressing initiative that a set timeline could bring.

For the affective awareness, the Likert scale was signed as follows: 1-Strongly Disagree, 2-Disagree, 3- Somewhat Disagree, 4-Neutral, 5-Somewhat Agree, 6-Agree, 7-Strongly Agree. And it was found that the attitude of the CIT-U Industrial Engineering graduates towards Sustainable Development Goals is **relatively high,** mostly leaning to somewhat agree to strongly agree for SDG goals (Table 3).

Table 3. Summary of Survey Responses in the SDG Attitude Section – Simplified with Weighted Averages

#	Items	Weighted Average
A1	Reducing poverty and hunger in the world are more important than increasing the economic welfare of the industrialized countries.	5.6129
A2	To me, society should be provided with the best free basic health services.	6.5484
A3	To me, raising awareness on Sustainable Development Goals among the university students is necessary.	6.4839
A4	I feel basic environmental courses should be a part of our university curriculum.	6.3226
A5	I think in society, males and females should be treated equally in all aspects of life.	6.3548
A6	The rise of global temperature has increased water scarcity.	6.4194
A7	Environmental problems are a matter of my concern.	6.1935
A8	People from varying cultural backgrounds must be treated with the same respect.	6.6774
A9	I try to conserve the use of electric energy at my place.	6.0968
A10	Functioning and resilient infrastructure is the foundation of every successful community.	6.0323
A11	The government should take greater account of sustainability within their political decision.	6.6452
A12	Research and educational institutions should take greater account of sustainability in their activities and campaigns.	6.4194
A13	I believe that participation in a sustainable lifestyle will bring peace and justice globally.	5.9032

As can be seen, the statements with the highest affective resonance are **A8 - treating people from varying cultural backgrounds with the same respect (6.68)**, **A11- the belief that governments should consider sustainability in political decisions (6.65)** and **A2 - the necessity of providing basic health services to society (6.54)**. Support is somewhat lower **A13 participation in a sustainable lifestyle promoting peace and justice (5.90)**, and **A1 - prioritizing poverty reduction over economic welfare in industrialized countries (5.61)**.

Overall, the results indicate **strong advocacy** for **social equity, sustainability in governance and education, and environmental responsibility**, with **slightly less consensus** on the **broader economic implications of sustainability efforts.**

For SDG behavioral awareness, the Likert scale was signed as 1-Never, 2-Rarely, 3-Occasionally, 4-Sometimes, 5-Often, 6-Very Often, 7-Always. The self-reported behaviors of the respondents towards SDGs are **relatively moderate to high**. To simplify, weighted averages are computed per question and are laid out as follows in Table 4:

Table 4. Summary of Survey Results in the SDG Behavior Section – Simplified with Weighted Averages

#	Items	Weighted Average
B1	I avoid using plastic straws at restaurants/cafes.	4.5484
B2	I bring my own reusable bag for grocery shopping.	4.3548
B3	I discard recyclable material (ex: [as] plastic bottle, newspaper, glass) separately at home.	4.5161
B4	I conserve the use of water supply at my place.	5.9032
B5	I treat people from all caste, creed and religion equally.	6.4516
B6	I prefer public transport rather than a private one.	4.2258
B7	I switch off electrical appliances of my home that I don't need when I am not around.	6.2258
B8	I turn off the air-conditioner and lights of the room after when I go out and no one is around	6.4194
B9	I am willing to utilize renewable energy.	6.3548
B10	I avoid using the animal skinned [animal skin] product.	5.5806
B11	I am interested to pay more on environmentally friendly products.	5.5161
B12	I have taken courses related to environmental sustainability.	5.5484
B13	I participate in events (ex: [as] seminar, talk, workshop[s]) that relates [relate] to environmental sustainability.	4.8710
B14	I talk about environmental sustainability with my friends and family.	5.1935

The most incorporated behaviors are the action statements: **B5- treating people equally regardless of caste, creed, or religion (6.45)**, followed by **B8- turning off air conditioners and lights when not in use (6.42)**, **B9- utilizing renewable energy (6.35)** and **B7- switching off home electrical appliances when not in use (6.23)** whereas the least practiced behaviors are **B6- choosing public transport over private vehicles (4.23)**, **B2- bringing reusable grocery bags (4.35)**, **B1- avoiding plastic straws (4.52)** and **B3- separating recyclable materials at home (4.55) (Table 5)**.

The data implies that the respondent group as a whole 'very often' engage in energy-saving and ethical treatment practices, actions relating to inconvenient or out-of-the-way participation in environmental advocacy is done closer to sometimes.

Table 5. Summary of Incorporated SID PEO area per graduate

No SID PEO Area	1 SID PEO Area	2 SID PEO Areas	3 SID PEO Areas	4 SID PEO Areas	5 SID PEO Areas	6 SID PEO Areas	7 SID PEO Areas	8 SID PEO Areas
3	3	3	2	6	5	2	1	6

This table shows that most respondents have incorporated multiple key areas of SID into their workplace Project Educational Objectives (PEOs), with **4 PEOs** and **8 PEOs** being the most common (**6 respondents each**) Overall, the data indicates that the **vast majority has tackled a SID PEO Area and incorporated them into their project's objectives**, with **only three respondents saying they haven't incorporated an SID Area/Components in their PEOs yet (Table 6)**.

Table 6. Summary of Survey Results in the SID-related PEOs Section per question– Simplified

#	Items	Has	None
SID1	Sustainable Product Design and Lifecycle Management *[Eco-design and innovation; Product Life Cycle Assessment; Durability and Upgradability; etc.]*	48.39%	51.61%
SID2	Resource & Energy Efficiency in Manufacturing *[Energy efficiency; Water Management; Raw Material Optimization; etc.]*	64.52%	35.48%
SID3	Pollution Reduction and Control *[Minimizing Air and Water Emission; Carbon Neutrality and Emission Reduction Goals; Toxic Substance Management; etc.]*	48.39%	51.61%
SID4	Waste Management and Circular Economy *[Zero-Waste Management; Closed Loop Systems; Circular Economy Practices; etc.]*	74.19%	25.81%
SID5	Green Building and Facility Management *[Advanced Manufacturing; Clean Technologies; etc.]*	54.84%	45.16%
SID6	Sustainable Supply Chain Management *[Green Procurement; Sustainable Logistics; Supplier Collaboration for Sustainability; etc.]*	41.94%	58.06%
SID7	Industrial Symbiosis *[Collaborative Resource Sharing; etc.]*	22.58%	77.42%
SID8	Workplace Engagement to Green Behavior Culture *[Employee Engagement & Workplace Wellness; CSR Program; Transparency and Sustainability Reporting; etc.]*	67.74%	32.26%

This table shows that the most proposed policies include objectives related to **SID4 - Waste Management and Circular Economy (74.19%)** suggesting a strong focus on waste reduction. Conversely, the least touched SID focused project educational objectives, where **less than 50%** of the implemented objectives, are **SID1 - Sustainable Product Design and Lifecycle Management (48.39%)**, **SID3 - Pollution Reduction and Control (48.39%)**, **SID6 - Sustainable Supply Chain Management (41.94%)** and **SID7 - Industrial Symbiosis (22.58%)**.

Overall, the data suggests that while some sustainability practices, particularly those related to **waste management and circular economy**, are **widely considered**, others that may need the **adoption of collaborative resource-sharing strategies** remain **underutilized**.

Then, to determine the relationship strength and significance between SDG Awareness and SID Implementation, Spearman's Correlation (Table 7- Table 8). Analysis was used for analyzing ordinal or non-linear relationships by ranking data, making it effective for research with non-normally distributed variables [Statstutor 2025].

Table 7. Spearman Correlation Table [Dancey and Reidy (2004)]

Spearman's formula	Spearman's rho	Correlation
$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$	≥ 0.70	Very strong relationship
	0.40 - 0.69	Strong relationship
	0.30 - 0.39	Moderate relationship
	0.20 - 0.29	Weak relationship
	0.01 - 0.19	No or negligible relationship

Table 8. Spearman's Correlation Analysis Results

	R	Relationship	P	Decision
Knowledge to Attitude	0.3359	Moderate	0.0647	H_0: There is no significant relationship
Knowledge to Behavior	0.0631	Negligible	0.7360	H_0: There is no significant relationship
Knowledge to PEOs	0.0200	Negligible	0.9150	H_0: There is no significant relationship
Attitude to Behavior	0.4851	Strong	0.0057	**H_1: There is a significant relationship**
Attitude to PEOs	0.0447	Negligible	0.8115	H_0: There is no significant relationship
Behavior to PEOs	0.3469	Moderate	0.0559	H_0: There is no significant relationship

Spearman's correlation analysis found the relationship strengths of **Knowledge to Behavior**, **Knowledge to PEOs** and **Attitude to PEOs** to be **negligible**. Then, the relationships worth looking into are **Knowledge to Attitude [moderate correlation: R= 0.3359]**, **Attitude to Behavior [strong correlation: R= 0.4851]**, and **Behavior to PEOs [moderate correlation: R= 0.3459]**.

But among these, only **Attitude to Behavior** is found to be **statistically significant**, highlighting that attitude plays a critical role in driving sustainable behavior (Figure 3).

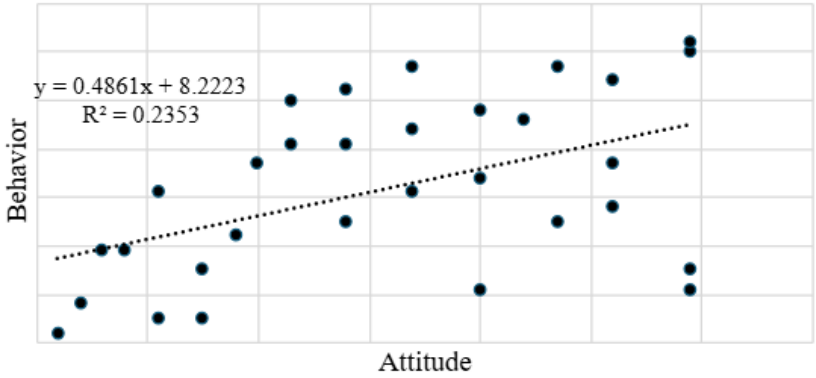

Figure 3. Spearman's Correlation Scatter Plot

The **positive correlation** between **SDG Attitude** and **SDG Behavior**, as indicated by the **upward trend** of the dotted line, also reveals that for every *1 unit increase in SDG Attitude*, SDG Behavior *increases* by approximately *0.49 units*, with a baseline behavior score of *8.22* when attitude is *zero*. The scattered data points suggest **moderate variability**, indicating that while higher SDG Attitude generally leads to stronger SDG Behavior, the relationship is not perfectly consistent. **R^2 value of 0.2353** means that **about 23.5% of the changes in SDG Behavior** can be explained by **SDG Attitude**, the remaining **76.5% is influenced by other factors** that are not shown in the graph, such as personal values, experiences, or external circumstances.

Overall, the graph suggests that **graduates with higher SDG Attitude scores are more likely to demonstrate SDG-aligned behaviors**, though other factors may also influence their actions.

To determine the appropriate sample size for this correlational study, the Fisher z-transformation of the expected correlation coefficient (r) was applied [Hulley et. al 2013]. This transformation converts the skewed distribution of correlation values into a normally distributed scale, allowing for more accurate statistical estimation. Based on a desired power of 80% and a significance level of 0.05, the required sample size was calculated using this approach and were tabulated as follows in Table 9- Table 10.

Table 9. Sample Size Needed for Correlation

$\tanh^{-1}(r) = \frac{1}{2}\ln\left(\frac{1+r}{1-r}\right)$	**Correlation (r)**	Small	Small - Moderate	Moderate	Moderate-Strong	Strong
		0.1	0.2	0.3	0.4	0.5
$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2}{[\tanh^{-1}(r)]^2}$	**Required Sample Size (n)**	783	194	84	47	26

Table 10. Sample Size Needed for Attitude and Behavior Relationship

Correlation (r)	0.48	0.49
Required Sample Size (n)	27	29

The results show that the study's collected number of responses or sample size used to determine the variable relationships is indeed lacking, apart from the relationship between SDG attitude and SDG behavior.

Should there be a need for closer evidence, the study also calculated with consideration of relationship's computed R, which is 0.4851. Since the study had a sample size of 31, it can be inferred that study has **enough sample size data to support the strong meaningful relationship between SDG attitude and SDG behavior** as the study's sample size is more than the 27 to 29 sample size required.

5.1 Implications

The study revealed the SDG awareness levels of CIT-U IE graduates and the extent of their Sustainable Industrial Development (SID) implementation at work, as well as the connection between the two. It found that despite high SDG awareness, the actual degree of SID practice was lower, suggesting that other factors may be limiting the influence of SDG education on real-world application. While many graduates did implement at least one SID area in their PEOs, this alone doesn't guarantee a strong or consistent commitment to SID practices in the workplace, highlighting the need for deeper investigation into other influencing variables.

Still, the research remains valuable. Among the three types of SDG awareness—cognitive, affective, and behavioral—behavioral awareness scored the lowest. Identifying both the most and least practiced sustainability behaviors, as well as the strong link between attitude and behavior (supported by the Theory of Planned Behavior [Ajzen 1991], helps inform more targeted strategies. These findings can guide improvements in policy, curriculum design, and school-wide events to strengthen sustainability efforts more effectively. For example, some eco-friendly behaviors, like using public transport or avoiding plastic, weren't commonly practiced, even though respondents understood sustainability well. This may be due to a lack of strong positive emotional understanding behind those choices. Developing deeper affective awareness could help graduates adopt sustainable habits — even if inconvenient — by strengthening their beliefs more effectively.

While the study has not found out a significant relationship of any SDG awareness towards SID-related project objectives implementations, perhaps due to the low sample size and/or standardized general nature using survey questionnaires to gather data, the study was at least able to gather that there is a moderate relationship between knowledge to attitude and behavior to PEOs. Perhaps with better and more in-depth research instrumentation, a clearer connection of order among variables could be found.

The study has also identified the underutilized sustainability areas. The gaps found in the inability to address the SID areas of Sustainable Product Design and Lifecycle Management, Pollution Reduction and Control and Industrial Symbiosis highlight missed opportunities for innovation, job creation, and economic growth, as well as negligence to the continued environmental harm. Although this is mostly geared SDG Governmental bodies as it is more about the collaborations between companies and industries and leans towards the lack of sustainability initiative, environmental protection policy supports and accountability for environmental harm.

5.2 Proposed Improvements / Recommendations

The study has yielded positive results. However, as seen in the implications, there are a few areas of improvement and gaps within this study due to a few system constraints and capabilities. The researcher therefore would like to recommend the following both for better results and for better understanding of similar future research study.

To Cebu Institute of Technology - University

For the administration, it is recommended to organize and make available more activities that could encourage positive or strong feelings for SDG and/or where the students are able to practice SDG behaviors. This in the idea that what helps form attitudes are experience [Fazio and Zanna 1981], knowledge [Kusumawati and Nugraheni 2022], media [Riggle et al. 2010], emotional affection [Dillard and Nabi 2006] and social connection [Jhangiani and Tarry 2022]. Although the institution already has a school bus transport system and SDG Booth Fest, it would be best for the institution to expand on these.

- For the SDG Booth Fest, it would be best to include it through social media. That is aside from making SDG awareness an educationally fun experience, it would be best that the participants get to take a picture of themselves and with their decisions towards SDG.
- About the school transport system, it is to advertise more to its students, making it a viable alternative to private transport. To promote further SDG affective awareness, the bus walls could display positive images, articles, or media related to sustainability, encouraging observational learning [Cherry 2024]. Similarly, institution walls could feature inspiring SDG content or impactful news on climate issues, fostering a stronger belief and personal commitment to SDG involvement.

It is also recommended to develop a system that could keep in touch with the graduates and also encourage these same graduates to keep in touch with the institution to make it easier for future data gathering. Be it with incentives and/or benefits. This could be introduced right after graduation during the process of acquiring Alumni ID and perhaps answering at least one ongoing alumni survey when renewing their Alumni ID.

To the IE teaching staff

For IE teaching staff, explore more teaching strategies that help raise positive affective SDG awareness in students and strengthen attitude formation strategies. Be it included in the curriculum or syllabus to not only raise knowledge but also affection and behavioral tendency towards SDG. To cite:

- During the SDG lessons, perhaps create an assignment where students have to pass a handwritten [Arezki.A 2025] reflection about SDG3, for example. This includes a personal experience that might be related to the subject, (may include a photo for extra points) an article they read specifically relating to the effects/concerns/praise towards the subject and their personal feelings and decision about the knowledge, how does it affect them.
- Create or facilitate activities where the students can state and practice their beliefs for SDG. Roleplaying sessions for collaborative sustainable industrial development simulations, letting them express and imagine the possible problems and concerns, discuss, weigh or rank the problems and brainstorm for possible solutions to the problem.

To SDG Monitoring Bodies

Spreading an official standardized format on how to calibrate SDG education effectiveness into the real world is highly encouraged. Be it a set of outlines, survey questions with a degree of leeway to allow the researchers to benchmark certain on and create while still tailoring to the uniqueness of the research environment - best if this was most easily accessible and can be taken online. It is also recommended to work with governing policy making bodies to develop more specific and focused across-companies-collaborative sustainability initiatives, environmental protection policy supports and both specific and collective accountability for environmental harm.

To Future Researchers

To reduce validity threats faced in this study, future researchers are advised to use personalized invitations, as personal messages often result in higher response rates than general ones. It also helps to send multiple follow-ups—for example, one after 3–5 days, another after a week—and, if possible, to incentivize participation (e.g., raffle entry, summary of findings, or networking opportunities). Conducting face-to-face interviews is also recommended to ensure respondents fully understand the survey questions and provide more accurate answers. For demographics, researchers

should consider expanding beyond the Industrial Engineering (IE) department and collect data from other programs, provided the graduates received SDG instruction in their curriculum. Finally, to test the accuracy, strength, and broader relevance of the findings, collaborating with other universities or companies is highly recommended.

6. Conclusion

The study underscores the pivotal role of education in shaping sustainable industrial development practices, highlighting how SDG awareness through knowledge, attitudes, and behaviors cultivated during academic experiences influence graduates' real-world sustainability efforts. The findings demonstrate that positive attitudes toward sustainability are the strongest drivers of sustainable behavior, reinforcing the importance of fostering values and advocacy alongside technical knowledge.

The results show that the graduates possess high levels of SDG awareness with a vast majority incorporated sustainable industrial development practice into their workplace project's objectives, highlighting the impact of SDG education towards real-world change. The results also identify gaps in SDG-related knowledge and practices, providing the institution with actionable feedback to enhance its curriculum. By revealing that graduates with stronger positive attitudes toward SDG principles are more likely to incorporate sustainable behavior, the educational institution could focus on analyzing strategies to raise affective awareness and attitude formation for SDG. Then, strengthening areas such as industrial symbiosis, supply chain sustainability, and broader economic sustainability strategies can better prepare students for workplace sustainability challenges.

While the results reflect the experiences of CIT-U Industrial Engineering graduates, the insights may have broader implications. Schools, companies, and policymakers can use SDG-based education to encourage long-term sustainable behavior. By embedding sustainability into lessons, promoting reflection, and refining programs, institutions can help shape future professionals who drive meaningful environmental and social change.

Overall, the study yielded a clearer understanding of the situation and its limitations. Despite these constraints, it was highly productive, enabling CIT-U to take a significant step toward strengthening its key values, bringing the institution closer to its vision while actively contributing to the Global Sustainable Development Goals. Ultimately, the study highlights the need for continuous investment in sustainability education, not only to enhance graduates' competencies but also to cultivate a workforce committed to building a more sustainable future.

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