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Assessment of Energy Literacy among University Occupation: The Case of Kuwait

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***Abstract* – Energy literacy is not only knowledge related to energy; it is also related tocognitive, affective, and behavioral components. An energy-literate person could generate effective energy decisions and desire to conduct responsible energy behaviors.In this respect, this study aims to assess and compare the energy literacy of university occupants (students, faculty, and staff) in Kuwait. A pragmaticapproach including qualitative and quantitative has been followed in this study. First, an energy literacy survey is applied to the occupants, and then interviews with students and faculty members are conducted. Findings suggest that students find items in the cognitive part the most difficult, followed by staff and faculty. It is concluded that attitude and intention significantly affect student and faculty groups' behavior. However, faculty's attitude has more significance on intention than student groups because most of the faculty in this study are engineers of high education levels. Hence, their current knowledge is playing a role in their increased intentions.**

Index Terms – Energy consumption, energy literacy, energy-saving behavior,university occupation.

INTRODUCTION

It is an undeniable fact that energy is a substantial resource for countries and societiesin order to maintain development. Therefore, it is continually generated and consumed. Energy consumption has been increasing incrementallyand rapidly over the recent decades, causing several environmental issues such as global warming, GHG emissions, Pollution, etc. This increase necessitated careful control of energy consumption, which can be accomplished by increasing energy literacy. With the help of energy literacy, people began to understand what energy is, its sources, production methods, and conservation measures; therefore, optimal decisions on the optimum energy use can be made.

Energy literacy has been defined in different ways in the literature. However, DeWaters and Powers's [1] energy literacy definition has been taken as a reference. According to them, it is a realm of fundamental energy-related knowledge combined with a grasp of the environmental implications of energy production and consumption, how energy is utilized in everyday life, and the embracing of energy-conservation habits.

This definition includes the three elements of cognitive, affective, and behavioral. The cognitive element refers to understanding fundamental scientific ideas, laws, theories, energy transformation, the effect of energy flows, and the function of energy in ecosystems.

The affective element evaluates understanding of each person's feelings or emotions they show towards energy issues such as energy production, consumption processes, and their environmental impacts, the effect of energy problems on human lives, and each person's convictions and ideologies, all of which are developed based on energy knowledge which willexamine the cognitive element. The behavioral element assesses one's understanding of the effects of their daily behaviors, energy consumption, responsibilities as a global citizen, and dedication to effective energy conservation efforts.

Overall, energy literacy provides a framework for analyzing a person's energy knowledge, attitudes toward energy-saving, and actual behaviors. Many studies throughout the literature investigated energy literacy for various reasons. As mentioned above, three classic cognitive, affective, and behavioral aspects are adopted to structure the literature's energy literacy [2]-[4]. Some studies stated that responsible behavior might be expected when the cognitive element serves as the foundation ofthe affective component; therefore, energy literacy is a serious problem [5]-[6]. In others, behavioral models, which createsthe links between knowledge, affective, and behavior, are also used [7]-[8].

An energy literacy scale is established in this study to better comprehend university occupants' energy literacy in Kuwaiti higher education institutions.The majority of the cognitive indicators are designed to catch the typical misconceptionsabout energy concerns. After that, a survey is undertaken to establish the students', faculty's, and the staff's energy literacy level. Moreover, the students and the facultyare interviewed to unveil the reasons behinds university occupations' low performances in energy literacy cognitive part.

The remainder of the paper is structured as follows: The firstsection examines the literature on energy literacy. Next, the technique, which includes the construction of energy literacy measures, a questionnaire, and interviews, is provided in the methodology section. The section is the results section, the data from the surveys will be evaluated. In the last section, the discussion section, the reasons behinds university occupations' low performances in energy literacy will be displayed and analyzed based on interviews. In the final section, the conclusion will be given.

LITERATURE REVIEW

Energy literacy has been studiedexploredin the literature from various perspectives. The present application of energy literacy and its empirical indicators are discussed in this part. These studies are summarized in Table I.

TABLE I
ENERGY LITERACY STUDIES IN THE LITERATURE

Studies	Application Area	Country
DeWaters and Powers [1]	Secondary level students	US
Suryana*et al*. [2]	High school students	Indonesia
Chandrasenan*et al*. [3]	Graduate students	Ethiopia
Chodkowska-Miszczuk*et al*.[4]	Local communities	Poland
Chen *et al*. [5]	Secondarylevel students	Taiwan
Maddock and Kriewaldt [6]	Secondarylevel students	Australia
Cotton *et al*. [7]	University students	UK
Brounen*et al*. [8]	Households	Netherlands
Van den Broek [9]	Households	-
Brent and Ward [10]	Customers	Australia
Boogen*et al*. [11]	Households	Italy/Netherlands/ Switzerland
Lee *et al*. [12]	Secondary level students	Taiwan
Yeh *et al*. [13]	High school students	Taiwan
DeWaters*et al*. [14]	Secondary level students	US
Akitsu and Ishihara [15]	Lower secondary students	Japan
Pradana*et al*. [16]	Vocational female students	Indonesia
Hamidi Razi *et al*. [17]	University staff and faculty	Iran
Martins *et al*. [18]	University community	Portugal

Some studies researched energy literacy among communities and households. Chodkowska-Miszczuk*et al*. [4] studied energy literacy of local communities in Poland. They found that there is a need for efficient energy management. Also, there is a potential for various investments to enhance residential building energy efficiency and allow renewable energy generation. Brounen*et al*. [8] examined household energy literacy with home energy costs in the Netherlands. They demonstrated low respondents' awareness and "energy literacy"levels. 56% of respondents were aware of their monthly energy consumption costs, and 40% do not know how to adequately analyze investment decisions for energy-efficient equipment. Van den Broek [9] presented a classification of households' energy literacy that includes four distinct categories: device, action, financial, and multidimensional. Brent and Ward [10] looked at the link between Australia's financial literacy and energy efficiency. They discovered that financial literacy causes decisions to be more compatible with specific consumer preferences. Low financial literacy causes people to be less eager to invest in energy efficiency. Boogen*et al*. [11] assessed the degree of efficiency in the electricity consumption of Italy, Netherlands, and Switzerland households. They found a relationship between energy efficiency and energy-related financial literacy. While knowledge does not appear to substantially influence energy efficiency behavior, it was found that higher financial knowledge related to energy is linked to higher levels of energy efficiency.

As a result, it's no surprise that energy literacy has recently become more important in academic environments at various levels. Effective energy education programs will boost energy literacy since educational experiences can help students achieve desired proficiency levels. As a result, a large portion of the studies about energy literacy focuses on students [1]-[3], [5]-[7], [12]-[16]. Students' performances on three dimensions of energy literacy (cognitive, affective, and behavioral) are explored in these studies.

DeWaters and Powers's [1] analyzed energy literacy in middle and high school students of New York in the US. Although the results show that students were worried about energy issues, their low cognitive and behavioral ratings imply they may lack the knowledge and skills necessary to contribute to solutions successfully. Suryana*et al*. [2] investigated the energy literacy of Indonesian high school students. They found that students' energy literacy is depressingly poor, and adequate importance was not given to energy literacy in teaching. Furthermore, ratings on the affective element were greater than those on the cognitive and behavioral aspects. Chandrasenan*et al*. [3] examine the energy literacy of Ethiopian university students from several angles and attempt to categorize students into distinct personas based on their attitudes and views about energy. Chen *et al*. [5] worked on the energy literacy of secondary school students in Taiwan. Their findings show a shallow level of energy literacy among students; energy cognition and behavior were more strongly associated than effect and behavior. Maddock and Kriewaldt [6] studied energy literacy in secondary school students in Australia from the perspective of the geography program. They revealed that despite Australia's new geography program, potentially educating young energy-literate people's energy literacy is not clearly stated or legislated. As a result, the teacher's energy literacy, desire, and capacity largely determine the extent of energy literacy in secondary level students. Cotton *et al*. [7] researched the strengths and limitations of university students' energy literacy in the UK. This study showed that cognitive and affective elements were critical factors for developing successful energy-saving behaviors among university students. Despite the widely held belief that information alone does not lead to more sustainable behavior, the cognitive element is undoubtedly influential in behavior change. Also, it was shown that a lack of understanding of the reasons and solutions might lead to poor energy-saving behaviors. In addition, informal and campus curriculum influenced students' attitudes and behaviors, including extra-curricular activities and social learning; thus, there is room for energy literacy to be developed further within areas of the formal curriculum. Lee *et al*. [12] examined energy literacy among secondary school students in Taiwan. It was found that energy literacy was solid and encouraging among senior high school students compared to junior high school students, while gender and socioeconomic status had modest impacts. The cognitive part of energy literacy was adequate; still, there was a significant gap between affective and behavioral factors. This gap indicates that what individuals say they would do and what they do may not be the same. Yeh *et al*. [13] analyzed energy literacy among junior high school students in Taiwan. They demonstrated that students have increased knowledge about energy-related topics covered in school, but they lack knowledge of complex scientific issues. In addition, students whose parents had a higher degree of education or worked in the education field had much more knowledge than other students. Also, students had a positive attitude and intention regarding energy. However, there was a decline among junior high school students in their desire to conduct energy conservation-related behaviors. DeWaters*et al*. [14] assessed US secondary school students' energy literacy found that the cognitive part of energy literacy was low among students. Still, affective and behavioral scores were slightly higher than the cognitive part. Akitsu and Ishihara [15] found that Japanese lower secondary students' energy literacy also fell short of the required threshold of 70%. Pradana*et al*. [16] examined the literacy level of female students in vocational schools of Indonesia and discovered that energy literacy-based learning activities increase students' energy literacy.

Only a few studies examine energy literacy regarding university staff and faculty members. Hamidi Razi *et al*. [17] assessed the energy literacy of staff and faculty members in Iran universities. They found that staff and faculty members should be educated on energy-related economic and financial literacy to save energy. Martins *et al*. [18] studied energy literacy in Portuguese academic communities, including students, staff, and faculty members. They discovered that, despite having lower levels of cognitive, women had a more positive attitude and better behavior. A greater degree of education appears to positively and substantially impact knowledge. Still, financial knowledge does not seem to have a statistically significant effect despite having a positive association with energy knowledge. Attitude and behavior appear to have a favorable impact on one another.

From the above literature, a research gap was found wherein the literature related to energy literacy in Kuwait. First, research on energy literacy in Kuwaiti schools is scarce regarding the amount of energy literacy among Kuwaiti students with the goal of improving the quality of students' energy literacy. Second, there is a limitation in the literature regarding studying the energy literacy of university occupants. Most of the studies focused on students. Some were only assessing staff and faculty members. This study was designed to overcome these limitations, considering the whole academic community, including students, staff, and faculty members. This study will contribute to the literature by comprehensively analyzing energy literacy among the academic communities with cognitive, affective, and behavioral perspectives.

METHODOLOGY

I. Quantitative Methods

A focus group approach is followed to develop a questionnaire adapted to the study setting. The questionnaire is based on the "Energy Literacy Scale" as provided by [7], [15], [19]-[21]. Initially, a draft of the questionnaire is proposed. This draft included questions related to the characteristics of the energy literacy scale, as shown in the model of Figure 1.

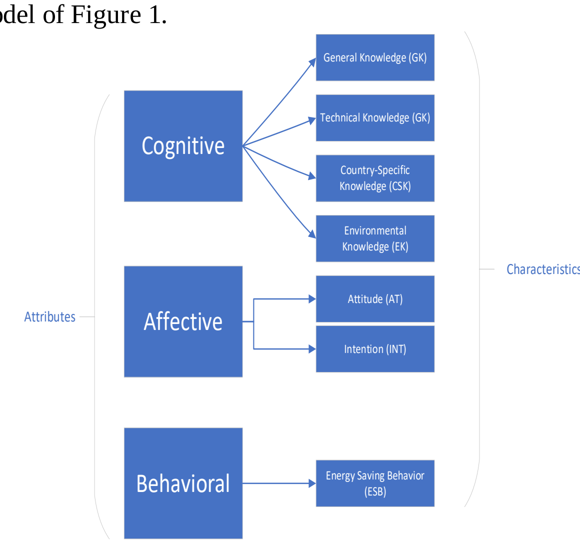


FIGURE 1
ENERGY LITERACY SCALE ATTRIBUTES AND CHARACTERISTICS

The draft questionnaire is then submitted to consultants and experts in energy education, and feedback is received from them. The validated comments are addressed, and an updated version of the questionnaire is developed.

The next step is to ensure the validity and reliability of the questionnaire from the respondent's side. Hence a pre-test is conducted. One hundred six students, 35 faculty members, and 30 administrative staff participated. This pre-test enabled us to get feedback from the respondents' side.

Any vague questions can be recognized that, if not modified, may give false indications. Hence, the questionnaire is again reviewed to be more understandable and more evident clear for the level of each group.

The final version of the questionnaire is divided into five parts. Each questionnaire had a label in the footer to indicate which category it would be used, whether student, faculty, or staff. The first part covered *demographics* and included two questions to collect personal information, which are gender and major. The second part covered the *cognitive* attribute of energy literacy and included 55 questions. The second part is divided into four sections, each related to a characteristic or descriptive of the *cognitive* attribute. All questions are of multiple-choice type where the respondent needed to choose the best answer out of five items relevant to the cognition of environmental issues. The four sections are 1) general knowledge (GK) which included 15 questions, 2) technological knowledge (TK), which included 21 questions, 3) country-specific knowledge (CSK), which included 14 questions; and 4) environmental knowledge (EK) which included five questions. The third part is related to the *affective* attribute of energy literacy and covered this attribute's two characteristics: attitude (AT) and intention (INT). Part 3 consisted of 8 questions, with four questions related to attitude and four related to intention. The fourth part is associated with the *behavioral* attribute of energy literacy and covered one characteristic of this attribute: energy-saving behavior (ESB). Part 4 consisted of 4 questions related to energy-saving behavior. Parts 3 and 4 consisted of questions of a 5-point Likert scale where 1 denotes "Strongly Disagree," 2 denotes "Disagree," 3 denotes "Neutral," 4 denotes "Agree," and 5 denotes "Strongly Agree."

The questionnaire aimed to concentrate more on collecting comprehensive information related to the cognitive attribute. Accordingly, the number of questions related to cognitive attribute indicators is more than other indicators related to other components of energy literacy.

The survey population is the occupants of the educational institution "Australian University" AU in Kuwait identified as students, faculty members, and administrative staff.

The sample size validity is checked for the three groups that conducted the survey. For student group,as per the enrollment numbers provided by the admissions and registration department at the Australian University, there are 2800 students enrolled and registered at AU. The minimum sample number to be drawn from a population with a 95% confidence level and ±5% error can be calculated as 338 students. Based on previous research conducted on the same population, a prediction for the return ratio is found around 80%. Accordingly, a minimum of 425 official questionnaires are needed to collect from AU students. Moreover, based on the numbers received from the admissions and registration department at AU, the school of business endorsed 33% of AU enrolled students (924 students). In comparison, the school of engineering endorsed the remaining 67% of the students (1876 students). The number of samples in each department is then determined by multiplying the total number of the recommended sample, which is 425, by the percentage of enrolled students in each school. Accordingly, 143 students from the school of business and 287 students from the engineering school are selected based on purposive sampling to allow more convenience and commitment to the research outcome. Moreover, students are selected based on their willingness to participate in the questionnaire, attend future workshops, and interact with any energy knowledge campaigns conducted.

The other populations are the faculty and the administrative staff. The human resources department at AU provided us with the number of faculty members (252) and administrative staff (237). A similar estimation is conducted, and the researchers decided to engage at least 153 faculty members and 147 administrative staff. A faculty member is identified as a person engaged in the teaching process. In contrast, the administrative staff is a person who is involved in the day-to-day operations within AU, such as IT, finance, registration.

Data collected is initially tested for reliability and validity to ensure that our results are acceptably valid. As for the *cognitive* part questions, the difficulty level and the discrimination power are assessed. As for the *practical* and *behavioral* parts, multi group analysis is implemented on the two groups (students and faculty members) by using partial least squares structural equations modeling (PLS-SEM). The statistical software Smart-PLS 3.2.9 is for this method. This analysis aims to test if there are significant differences between the selected groups in our study. The recommended sample size (n=62) in PLS-SEM for a statistical power of 80% [22] - [23] is validated based on the minimum R^2 (.59), significance level (1%), and a maximum number of arrows pointing at a construct (5).

II. Qualitative Methods

After questionnaires are collected and analyzed, a comprehensive analysis is implemented on the results that gave preliminary deductions and explanations. Hence, the qualitative part aimed to build on these conclusions. The two extreme categories are the students' group and the faculty members' group. Accordingly, the qualitative part included these two groups only. Interview questions are intended to tackle two points that are deducted from the outcomes of the quantitative part. The first point is to explore the reasons behind the low performance of students in the energy literacy knowledge part. The second point is to explore the factors that can influence the energy behavior of faculty.

Two "conceptual code maps" models are developed using NVivo 12 that included all factors and sources that can impact 1) students' energy literacy knowledge and 2) faculty's energy behavior. Potential educational strategies are then proposed, hence considering the model's practicality and applicability.

a. Faculty Interviews Instruments:

Five questions are designed to be asked to the faculty in a structured manner. A convenience sampling method is used, and 20 faculty (10 from the school of engineering and ten from the school of business) members are engaged in the interview process. Each participant is asked the questions, and answers are recorded or noted down based on the participant's preference. Another approach is used based on the respondent's preference, (sending the responses by e-mail). All interview records are represented in a script, and detailed content analysis is then conducted using NVivo 12 to identify the key factors that can impact the faculty's energy behavior. Table II shows the interview questions of faculty members.

TABLE II
INTERVIEW QUESTIONS

Attribute	Characteristic	Interview Question
Behavioral	Energy Saving Behavior	1. How would you define the notion of "energy literacy" in your own words? 2. Which source do you consider to be a "reliable source" for energy-related information? A. the School Internet websites B. Internet search engine C. social media (Instagram, snapchat, twitter. etc. D. Books, newspaper or magazine E. Television programs 3. What might an energy literacy program look like? And what is the best strategy to reduce energy consumption at your school buildings? 4. What are your preferences for learning options and the most motivating method to increase your willingness to participate in sustainable energy education or alternative activities?

The data collected are tested for reliability through many means. First, anonymity is assured for all participants, and all their preferences are accommodated. Second, all recorded interviews are scripted word by word without changing any word. Moreover, content analysis is based on raw words to eliminate over-inference, and the analyzer did not attempt to add his/her interpretation into the script. Third, when interviews are noted rather than recoded, two interviewers are present to assure no bias or discrepancy when documenting the responses.

b. Student Interviews Instruments:

The same interview questions that are used with faculty are asked to students in a structured manner. The convenience sampling method is also used, and 30 students (15 from the school of engineering and 15 from the school of business) are engaged in the interview process. The same approach that is used with faculty is used with students.
Same reliability procedures are applied to ensure reliability and maintain the authenticity of the data collected from students.

Same reliability procedures are applied to ensure reliability and maintain the authenticity of the data collected from students.

RESULTS AND DISCUSSION

I. Energy Literacy Survey

During the Fall 2020semester, responses are collected from the students' group (360), faculty group (160), and staff group (150). Data collection is through the final version of the questionnaire implemented on Google Forms. Validated responses are only chosen based on the survey's completion with no missing data. Validated student responses are 338, faculty is 158, and staff responses are 147. All data are extracted in an excel sheet imported to the statistical software SPSS 27 and processed then analyzed accordingly.

Almost predicted, the response rate is about 85% for the students' group and 100% for faculty and staff groups.

Gender-wise, the sufficient student sample consisted of 203 males and 135 females with 60% and 40%. The effective sample consisted of 227 engineering students and 111 business students, with 67% and 33%. As for the faculty sample, there are 58% males, 42% females and 60% engineering, and 40% business majors. While for the staff group there are 51% males, 49% females and 7% engineering, 42% business, and 51% with another major. These indicated that the samples are relatively homogeneous in gender and major as they matched the entire population. Table III shows the demographic details of 643 participants sampled for this study.

TABLE III
DEMOGRAPHIC DATA OF RESPONDENTS

		Students		Faculty		Staff		TOTAL
		%	N	%	N	%	N	
Gender	Male	60	203	58	92	51	75	643
	Female	40	135	42	66	49	72	
Major	Engineering	67	227	60	95	7	10	
	Business	33	111	40	63	42	62	
	Other	0	0	0	0	1	75	
TOTAL			338		158		147	

a. Item Analysis of Cognitive Part:

Different tests are implemented based on the nature of the questions. As for the *cognitive* part questions, the level of difficulty and the discrimination power is assessed. Data collected from each sample (students, faculty, and staff) is analyzed with two indices: level of difficulty (p) and discrimination power (D).

The difficulty of a question (p) is defined as the ratio of the number of respondents who answered a question correctly to the total number of respondents who answered correctly or incorrectly. When the value of (p) is more than 0.5, this means that more respondents answered correctly. This indicated that the question level is less difficult. The equation used to calculate (p) is represented in (1) [24].

$$p_i = \frac{A_i}{N_i} \tag{1}$$

While the questionnaire is designed to have easy items covering 5% of the questionnaire; medium to low difficulty items covering 20% of the questionnaire; medium difficulty items are covering 50% of the questionnaire; medium-hard items are covering 20% of the questionnaire, and difficult items covering 5% of the questionnaire. According to Lord [25], an ideal difficulty level of a five-response multiple-choice assessment should be 0.7. The item difficulty is arbitrarily classified as "easy" if the difficulty index is 0.85 or above; "moderate" if it is between 0.5 and 0.84 inclusive; and "hard" if it is 0.49 or below.

Alternatively, the discrimination power (*D*) reflects if the questionnaire accurately reflects the respondent's ability or competence. It is anticipated that if a participant scores high, he or she can probably answer the questions. Similarly, those who achieve low scores in the questionnaire will be having fewer chances to respond correctly to the terms. Hence, od quality items should distinguish respondents with high scores and low scores [26]

The discrimination index can be calculated as shown in (2):

$$D_i = \frac{A_{corrrect\ answers} - GB_{correct\ aswers}}{N_{largest\ group}} \quad (2)$$

When the value of the discrimination index increases, the item can differentiate the ability of respondents with high scores and low scores. The maximum value for a discrimination index can be one and happens when all the respondents of GA answer an item correctly and all the respondents of GB answer incorrectly. According to Ebel and Frisbie [27], to interpret the quality of the questions, the discrimination index can be matched to a quality level and a recommendation.

Another indicator of the discriminative power (*D*) is the discrimination coefficient (R^2) of an item that is characterized by (1) point of biserial correlation (r_{pbis}) and (2) the coefficient of biserial correlation (r_{bis}). The discrimination coefficient (R^2) has a more detailed value. All respondents are included in its calculation in contrary tothe case in the discrimination index (D), which only considers 54% of the total respondents (the 27% highest and the 27% lowest).

The point of biserial correlation (r_{pbis}) is calculated to validate the genuine relation between competent respondents and respondents who got the most questions correctly. In addition, this point can tell us how much predictive power an item has and how it can be affecting the prediction power. According to Henrysson [28], the (r_{pbis}) is more revealing and predicting than the (r_{bis}) as it can tell us more on how much ground is the prediction of the test since that leans towards favoring the items of medium difficulty. Henrysson also suggests that the (r_{pbis}) is an indicator that links the relationship between the measure of the item and its level of difficulty.

Hence, in this study, the (r_{pbis}) is obtained as it simply explains the relationship between the answers to an item (0 for incorrect relative and or 1 for correct answers) and the test scores of all the respondents. Glas and Stanly [29] one rammed an equation to calculate and obtain (r_{pbis}) as shown n (3).

$$r_{pbis} = \frac{X_1 - X_0}{S_x} * \sqrt{\frac{n_1 * n_0}{n(n-1)}} \quad (3)$$

where:

$\underline{x_1}$= median of the total scores of those who answered an item correctly.

$\underline{x_0}$= median of the total scores of those who answered an item incorrectly.

S_x= standard deviation of the total scores.

n_1= number of those who answered correctly.

n_0= number of those who answered incorrectly.

n= total number of respondents ($n_1 + n_0$).

b. Results and Analysis of Cognitive Part:

When data is imported to SPSS 27, all cognitive part questions are recorded by changing responses to a binary format with 1 representing a correct answer and 0 representing an incorrect answer. Accordingly, the level of difficulty (*p*), discrimination power (*D*), and the point of biserial correlation (r_{pbis}) for all cognitive part items are calculated. The three indicators are obtained by formulating equations (1), (2), and (3), respectively.

The descriptive statistics of the values *p*, *D*, and r_{pbis} are represented with the averages of their medians and standard deviations of each item of the four-energy literacy cognitive attribute characteristics for each sample (students, faculty, and staff). Results are shown in Table IV for each item within the group and Table V for each group.

TABLE IV
MEDIANS AND STANDARD DEVIATIONS OF THE DIFFICULTY INDEX (P), DISCRIMINATION INDEX (D), AND POINT OF BISERIAL CORRELATION (r_{pbis}) FOR EACH GROUP

Group	Characteristic	N	p		D		r_{pbis}	
			Median	SD	Median	SD	Median	SD
Students	GK	338	0.39	0.17	0.25	0.17	0.11	0.16
	TK		0.43	0.14	0.30	0.22	0.15	0.21
	CSK		0.46	0.21	0.27	0.22	0.21	0.21
	EK		0.44	0.13	0.33	0.13	0.17	0.17
Faculty	GK	158	0.71	0.22	0.23	0.14	0.27	0.18
	TK		0.73	0.16	0.39	0.19	0.29	0.13
	CSK		0.77	0.14	0.44	0.14	0.35	0.16
	EK		0.74	0.17	0.41	0.14	0.31	0.12
Staff	GK	147	0.65	0.14	0.33	0.12	0.27	0.11
	TK		0.67	0.15	0.37	0.16	0.28	0.12
	CSK		0.73	0.11	0.42	0.18	0.33	0.14
	EK		0.68	0.18	0.39	0.15	0.30	0.19

TABLE V
OVERALL MEDIANS AND STANDARD DEVIATIONS OF THE DIFFICULTY INDEX (P), DISCRIMINATION INDEX (D), AND POINT OF BISERIAL CORRELATION (r_{pbis})

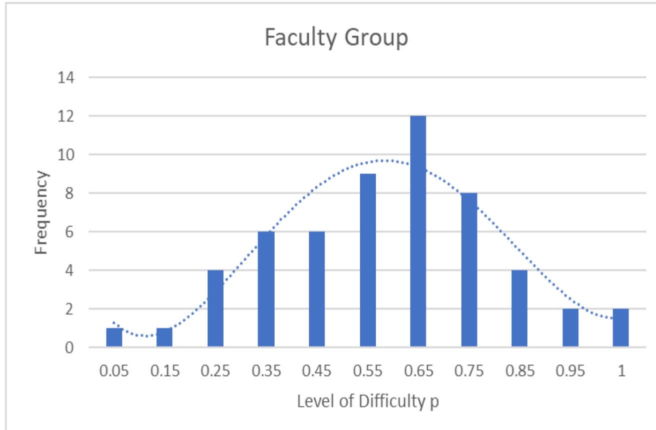
Group	*p*		*D*		r_{pbis}	
	Median	SD	Median	SD	Median	SD
Students	0.43	0.21	0.38	0.24	0.35	0.23
Faculty	0.74	0.11	0.43	0.16	0.40	0.14
Staff	0.68	0.13	0.40	0.14	0.38	0.12
Overall	0.62	0.15	0.41	0.13	0.38	0.11

It is noticed that the students scored the most negligible value (*p*) with (M=0.43 and SD=0.21) following the staff (M=0.68, SD=0.13) and faculty who they achieved the best (M=0.74, SD=0.11). This indicates that the students didn't score well in the "*cognitive*" part questions. The question's difficulty level is interpreted as hard since the number of students who responded incorrectly exceeded those who answered correctly. The low scores achieved by the students steered our research towards revealing the reasons behind this gap. Alternatively, faculty and staff scored acceptable results with the faculty exceeding the scores of staff, which can be related to the educational level.

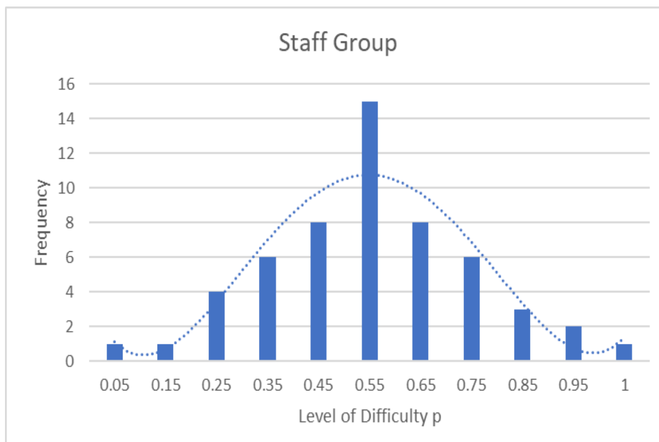
It is shown above and proved that the faculty group scored the best, followed by the staff group, and the least is the student group. These observations verified by values coincide with the academic levels they represent. Students undoubtedly found the cognitive part questions difficult to respond to even during the initial stages. After the pre-test, the variation level is taken into consideration. The questionnaire items are distributed to have easy items covering 5% of the questions in a subsection; medium to low difficulty items covering 20%; medium difficulty items covering 50%; medium-hard items covering 20%; and difficult items covering the rest 5%. The variation in the performance vs. the expected results can only be related to the fact that students are incapable of answering or understanding the majority of the questions due to the absence of *energy knowledge*. This drifts our focus to propose strategies and solutions that can promote the level of energy knowledge within the students. This energy knowledge can be implemented through workshops, training, seminars, energy tips posts on social media platforms, or energy marketing campaigns.

By analyzing the difficulty levels among the three groups according to each characteristic; GK (M= 0.48, SD= 0.11), TK (M= 0.52, SD= 0.13), CSK (M= 0.65, SD= 0.15), and EK (M= 0.58, SD=0.17).The level of difficulty rangesis from 0.48 to 0.65, and that the easiest are those related to country-specific knowledge followed by environmental knowledge and that the most difficult are those related to technical knowledge followed by general knowledge. Moreover, as it is focusing on the group which scored least, the study also analyzed the difficulty levels of each character,(explicitly sticking to the students' group). It is found out that the result observations in terms of ranking the difficulty level of the question with the characteristics matched the general analysis.

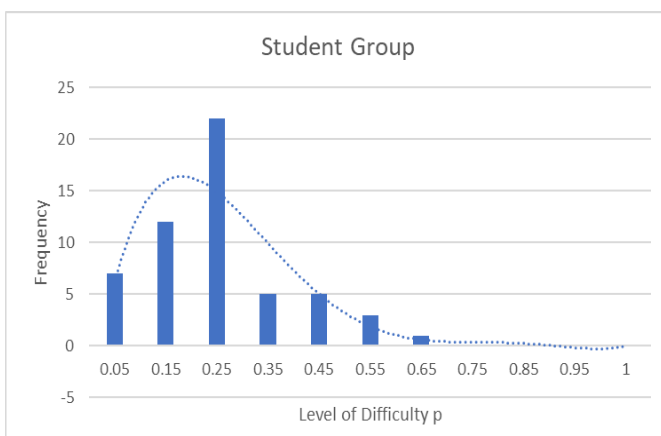
Accordingly, the performance of the 55 items with regards to its difficulty are displayed in Figures 2A, 2B, and 2C show the distribution of the frequencies of the values *p* over the 55 items for the three groups. As expected, the faculty and staff groups are almost normally distributed following the designed questions. However, there is irregularity and abnormality with the student group. There is skewness to the left, which matches the observation that the students found most of the questions difficult due to the lack of energy knowledge.



A)



B)



C)

FIGURE 2
ITEMS DIFFICULTY DISTRIBUTION OF THE COGNITIVE ATTRIBUTE FOR: A)FACULTY GROUP, B) STAFF GROUP, C)STUDENT GROUP

From Figure 2A, it can be observed that a greater number of cluttered items with medium values of *p*, meaning that most of the questions (67.3%) are above the *p*-value of 0.5. Moreover, the distribution curve has a positive bias. Again, there is a greater number of easy items than difficult ones, as reflected by the faculty's answers, with the highest number of items cluttered at p=0.65. Analyzing the items according to their difficulty level, the following can be identified: 21.8% of very difficult ($p <$ 0.35); 10.9%, difficult (from 0.35 to 0.5); 16.4% of medium difficulty (from 0.5 to 0.65); 36.4% moderately easy (from 0.65 to 0.8); and 14.5% very easy ($p \geq$ 0.8).

From Figure 2B, it can be observed that a greater number of cluttered items with medium values of *p*, meaning that most of the questions (67.3%) are above the *p*-value of 0.5. Moreover, the distribution curve has a perfectly normally distributed curve with the highest number of items cluttered at p=0.55. Analyzing the items according to their difficulty level, the following can be identified: 21.8% of very difficult ($p <$ 0.35); 14.5%, difficult (from 0.35 to 0.5); 27.3% of medium difficulty (from 0.5 to 0.65); 25.5% moderately easy (from 0.65 to 0.8); and 10.9% very easy (p $\geq$ 0.8).

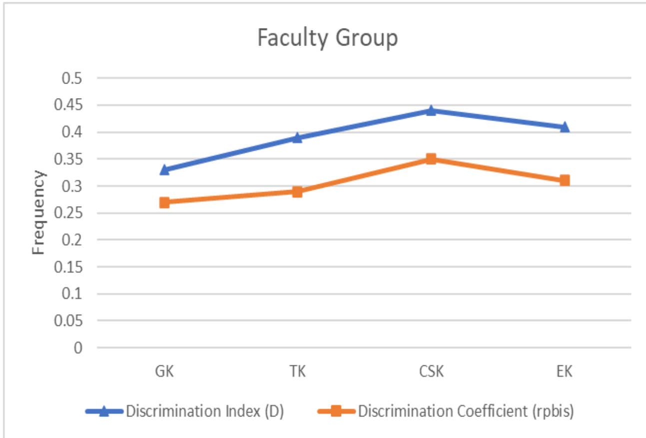
From Figure 2C, it can be observed that a greater number of cluttered items with low values of *p*, meaning that the majority of the questions (74.5%) are below the *p*-value of 0.35. Moreover, the distribution curve has a negative bias, meaning again that there are more difficult items than easy ones with the highest number of items cluttered at p=0.25. Analyzing the items according to their difficulty level, the following can be identified: 74.5% of very difficult ($p <$ 0.35); 18.2%, difficult (from 0.35 to 0.5); 5.5% of medium difficulty (from 0.5 to 0.65); 0.2% moderately easy (from 0.65 to 0.8); and 0% very easy ($p \geq$ 0.8).

Similarly, by analyzing the discrimination indices (*D*) and values of the point of biserial correlation (r_{pbis}) for each group, the faculty group D=0.43, r_{pbis}=0.4, and the staff group D=0.4, r_{pbis}=0.38, and the student group D=0.38, r_{pbis}=0.35.

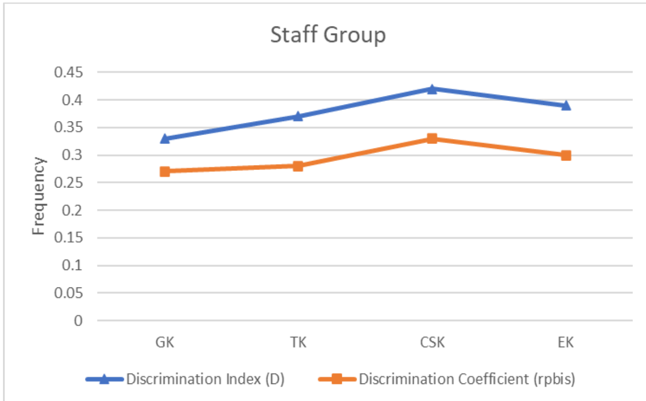
As clearly seen from the results presented in Figures 3A, 3B, and 3C, country-specific knowledge items discriminated the most with the highest value of (*D*). This can be related to the fact that most students are Kuwaiti nationals (78% of the picked sample). Hence, since Kuwait is well known for its high social connections, such knowledge related to Kuwait is widely spread between them through word of mouth in Diwaniya's, for example. This better knowledge about the country is mapped in the better performance in the CSK item. The following best discriminating items are related to environmental knowledge, followed by technical knowledge, and the last is general knowledge. This is a common observation for the three groups.

Referring to Table V, the overall average discrimination index for the whole cognitive attribute is 0.41, while the average point of biserial correlation is 0.38.

The four characteristics of energy literacy cognitive attribute discrimination indices for the three sampled groups range from 0.23 to 0.44. In contrast, the discrimination coefficients range from 0.11 to 0.35. Figures 3A, 3B, and 3C can provide us with a clear trend of the discriminative behavior through the trend lines of those two indicators. Both trend lines are moving almost parallel. The discrimination index (*D*) values are slightly higher than the values of the discrimination coefficients represented by the point of biserial correlation (r_{pbis}).



A)



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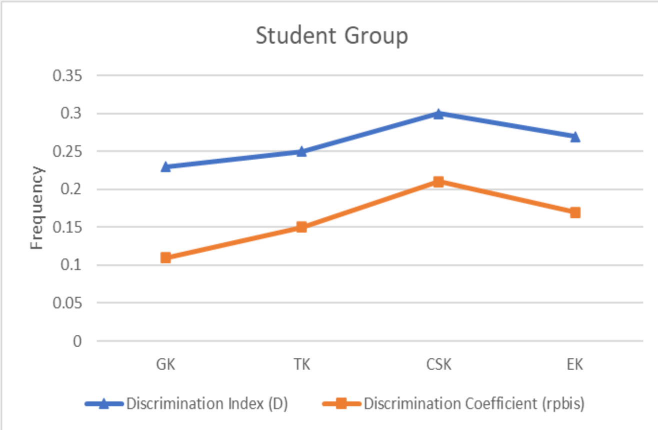

C)

FIGURE 3

DISCRIMINATION INDICES AND COEFFICIENTS OF THE FOUR CHARACTERISTICS OF ENERGY LITERACY COGNITION ATTRIBUTE FOR: A) FACULTY GROUP, B) STAFF GROUP C) STUDENT GROUP

By looking at the *D* values, it can be grouped the four characteristics of the energy literacy cognitive attribute as per its discriminative power. Characteristics with *D* values above 0.4 will be considered to be with excellent discriminative power. Characteristics with *D* values below 0.2 will be deemed to be with deficient discriminative power. Any values between 0.4 and 0.2 will be considered with good discriminative power. Similarly, ther_{pbis}will be usedto group the four characteristics.

Using this grouping, it is found out that general knowledge items have the least discriminative power, and items with the best discriminative power are country-specific knowledge. Hence, the country-specific knowledge question is the best way to distinguish respondents' abilities with high and low scores. On the other hand, the general knowledge-related questions are the least able to differentiate the respondents' capabilities as most of the two respondents answered these questions incorrectly.

c. Results and Analysis of Affective and Behavioral Parts:

Based on the previous results obtained from the cognitive attribute analysis, the students and the faculty groups are the two groups that represented the extreme results, with the staff group results in the middle. Hence, it is decided to limit that analysis of the effective and behavioral parts to the two extreme groups: students and faculty.

The statistical software Smart-PLS 3.1, which implements the partial least square structural equation modeling (PLS-SEM) method, is used to conduct the item analysis of both the affective and the behavioral parts. PLS-SEM is a variance-based method used to estimate structural equation models. The key point behind using PLS-SEM is that it does not require any specific assumptions on the distribution of the sample [30]. In addition, the sample size matches the requirement that it has to be greater than the most significant number of indicators of any item. While the most significant number of indicators is four, our sample sizes are way more important than 40. Moreover, the larger sample sizes will provide more consistency to the estimations within the model.

The composite reliability, convergent validity, and discriminant validity are determined to evaluate the measurement of the model [31]. The composite reliability approximates the reliability based on the intercorrelations of the indicator variables of a specific construct. Composite reliability values for all constructs in the faculty model ranged between 0.892 and 0.901, and in the student, model ranged between 0.845 and 0.914. Table VI shows values of composite reliability.

TABLE VI
COMPOSITE RELIABILITY

	Faculty Model	Student Model
Attitude (AT)	0.896	0.845
Intention (INT)	0.892	0.914
Energy Saving Behavior (ESB)	0.901	0.904

According to Nunally and Bernstein [32], composite reliability values must exceed 0.95, or the indicators will be assessing the same information. None of our values exceeded the recommended value.

On the other hand, convergent validity assesses and measures the positive correlation between an indicator and the other indicators of a construct. The average value extracted measure (AVE) is calculated to measure the construct validity above the value 0.5. Table VII shows the AVE values for both models. All values exceeded the value 0.5 and ranged between 0.863 and 0.898 for the faculty model and between 0.743 and 0.823 for the student model.

TABLE VII
AVERAGE VALUE EXTRACTED

	Faculty Model	Student Model
Attitude (AT)	0.898	0.823
Intention (INT)	0.863	0.804
Energy Saving Behavior (ESB)	0.877	0.743

To measure the extent to which a latent variable is different from another variable, the discriminant validity is obtained through the Fornell-Larcker criterion [33]. Fornell-Larcker's criterion requires that the square root of each construct's (AVE) must be larger than all its correlation with the other constructs. Tables VIII and IX reveal that all diagonal values ($\sqrt{AVE}$) are greater than the values within their respective columns and rows.

TABLE VIII
LATENT VARIABLE CORRELATION FOR THE FACULTY GROUP

	AT	INT	ESB
AT	**0.948**		
INT	0.71	**0.929**	
ESB	0.58	0.764	**0.936**

TABLE IX
LATENT VARIABLE CORRELATION FOR THE STUDENT GROUP

	AT	INT	ESB

AT	**0.907**		
INT	0.682	**0.897**	
ESB	0.412	0.561	**0.862**

Hypothesis testing isimplemented to validate the significance of the relationships between attitude on the intention from one side and intention on energy-saving behavior from the other side as follows:

H1: Attitude has a significant effect on intention towards energy literacy.

H2: Intention has a significant effect on energy saving behavior towards energy literacy.

The results of hypothesis testing are shown in Table X with the path coefficients and the *p*-values. Both hypotheses are found to be significant at the 0.000 level in both faculty and student models. The results came in harmony with previous literature [15], [18].

TABLE X
HYPOTHESIS TESTING RESULTS

	Faculty's Model		**Student's Model**	
	Coefficient	*p* values	Coefficient	*p* values
H1: AT → INT	0.648	0.000	0.621	0.000
H2: INT → ESB	0.723	0.000	0.541	0.000

The bootstrapping method is implemented to test whether the faculty and student models' path relationships are significant or not based on the *t*-test.

Figure 4A shows the values of the outer loadings for the faculty model and Figure 4B for the student model, respectively. Values varied between 0.815 and 0.953 in both models. All the outer loading values are above the defined threshold value, which is 0.7. Moreover, the models show the squared multiple correlations (R^2) for all endogenous variables. The SEM model explained substantial variance in intention (R^2=0.674 for the faculty model and R^2=0.412 for the student model) and energy-saving behavior (R^2=0.458 for the faculty model and R^2=0.286 for the student model).

In addition, to study if there is a significant difference between the faculty and student's energy literacy, the PLS path coefficients are formulated. A non-parametric multigroup analysis (PLS-MGA) is implemented to examine the hypotheses that the path coefficients are not significantly different for the two supported hypotheses. Table XI shows the absolute difference of the path coefficients along with the *p*-values. A difference between the two groups is considered significant at the error level of 0.05 if the *p*-value is less than 0.05 or larger than 0.95 [34].

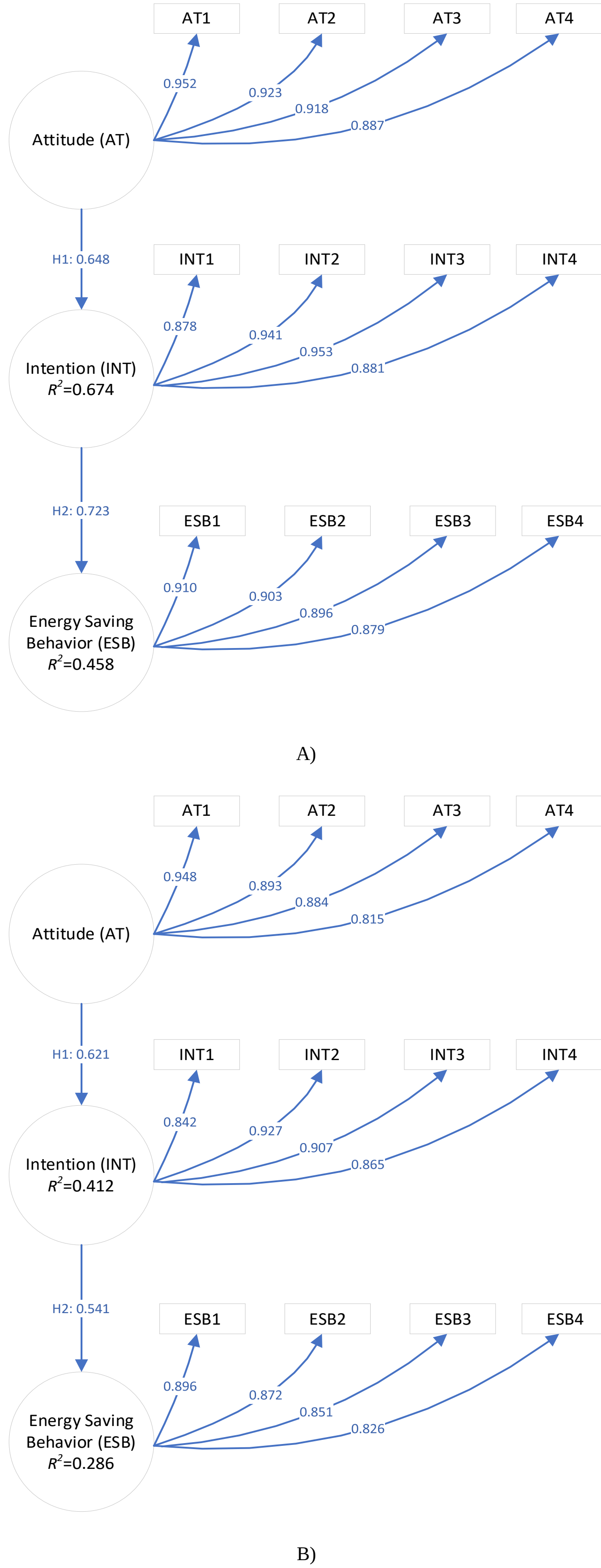

FIGURE 4
THE PLS OUTPUT FOR: A) FACULTY MODELB) STUDENT MODEL

TABLE XI
MULTI-GROUP COMPARISON BETWEEN FACULTY AND STUDENT GROUPS

Path Relation	***Path coefficient difference (|faculty-student|)***	***p-values (faculty vs student)***
AT → INT	0.189	0.021
INT → ESB	0.295	0.038

Results from Table XI show a significant difference between the two groups: faculty and students for both relations, the *p*-value is less than 0.5. This can be interpreted that faculty's attitude is more affecting their intentions towards energy literacy. It can be related to the fact that most of the faculty are engineers of high education levels. Hence, their current knowledge is playing a role in their increased intentions. On the contrary, students' intentions are lower than the faculty as they are less confident with their energy literacy. Moreover, this has contributed to the effect on energy-saving behavior. Similarly, students' energy-saving behavior is at lower levels as compared to the faculty. While the intention is at a lower level, this yielded not achieving good behavior in the scope of energy literacy. Hence, students' ability to address and respond to items related to energy-saving behavior is limited. Students found it challenging to adopt a standardized energy-saving behavior because they lacked the intention to be powered by good attitude levels. As for the faculty, their confidence is at better levels within this scope. It is presumed that faculty have achieved a good level of energy-saving behavior; however, these levels can be optimized with some strategies.

II. Energy Literacy Interviews

a. Results and Analysis of Faculty Interviews:

Some faculty interviewees started the interview by visualizing their conceptualization of energy literacy by referring to more formal literacy definitions, including environmental, financial, health, etc. After generally talking about the concept of energy literacy, all interviewees moved into the details by referring to specific definitions of energy literacy. These particular definitions are listed in the order of their frequency in interviews, as shown in Table XII.

TABLE XII
FACULTY INTERVIEW RESULTS THROUGH FREQUENCY CODING

Strategies	***Measure***	***Count***	***Weighted Percentage (%)***
Awareness	Peer group knowledge sharing sessions, posters, emails, displays	21	35
Policies	Rules and regulations to monitor energy consumption	16	26
Control	Participating in energy decisions	8	13
	Energy use management (air condition, lights, electrical equipment)	4	6

Many faculty interviewees pointed out that attending awareness sessions to enhance their energy literacy by answering the questions would be beneficial. Specifically, when they are asked about the best strategies to be adopted that may, in turn, reduce the energy consumption, which reflects an enhancement in the behavior, one faculty responded, "[…] and I would love to attend like seminars or some awareness sessions that teach us how to reduce our energy consumption. One day, I paid a visit to ASCC, where they had a section dedicated to energy saving. I was amazed that they brought some tips to reduce energy consumption, such as not boiling a full kettle. I am excited, and I am willing to participate in such events if they are organized in AU". Another faculty gave ideas about making a month dedicated to energy awareness campaigns every year. She suggested doing something similar to cancer awareness sessions in November. She said, "[…] we can select a month to conduct activities, seminars, competitions, etc.… that will, in turn, have a great impact on all."

Another emerging point that is common among interviewees' answers is the policies. Many interviewees are trying to conceive that no policies are set to control energy behavior. One faculty said, "[…] while I was responding to your questions through e-mail, I searched for any policy in AU that is related to energy behavior. I just found nothing. People will not participate in anything with good intentions unless a policy monitors it. Having a policy that clearly defines a good and model energy behavior will be a plus to AU".

The last reference mentioned intensively in the scripts of interviewees is "control". Faculty members are AU referring in many questions to the term control to explain that they feel they have no control over energy choices. For instance, one interviewee mentioned in their response that "[…] even if I wanted to change my lifestyle and try to practice good energy habits, I do not have any control over this. For example, I cannot change the temperature from the AC controller. It is locked, and we are not allowed to touch it. Also, the decision is at the management level if I want to embed solar panels anywhere in AU".

b. Results and Analysis of Student Interviews:

Some student interviewees started the interview by expressing their vagueness about energy literacy. Other students didn't know what the question meant; hence most of the interviewed students requested further explanation to answer. Through the discussions with the interviewees, we came to a common observation that most of the students could not respond to the questions about energy literacy because they lacked the energy education aspect. These specific definitions are listed in the order of their frequency in interviews, as shown in Table XIII.

TABLE XIII
STUDENT INTERVIEW RESULTS THROUGH FREQUENCY CODING

Strategies	***Measure***	***Count***	***Weighted Percentage (%)***
Energy Education/ Complexity	Lack of knowledge	18	26
	Difficulty	25	

Awareness	Social post, Posters, Displays	22	21
Motivation	Motivation Need	12 5	10

One of the students explained: "[…] I know what energy means, but I haven't heard about energy literacy. I never read about it, and I didn't study anything about this topic. When filling the survey, I felt that some questions looked easy, and I answered them. However, I found many misconceptions when I wanted to check the correct answer. I think we don't learn or read enough about aspects of energy".

In addition, it is observed from the student's interviews that many students expressed that some questions are complicated to answer or advanced to their level. Many students stated the word *complex* or *hard* through their response when addressing energy knowledge. One student said that: "It is difficult to calculate some quantities, and we don't even know the equations." This emphasizes observing the students 'general lack of knowledge about energy literacy components. The lack of knowledge is the main trigger for students; therefore, they find even the straight forward questions too complicated related to energy. Moreover, the most of observations extracted from the interviews are related to the faculty members awareness level. There is a common conclusion extracted from many scripts, which indicated the need for awareness sessions. One interviewee answered the question pertaining to the most motivating methods by "[…] I don't have enough energy information. Maybe engineering students know better than me as business students. However, the topic is now global, and awareness must be spread nation wise. I see that social media posts can be extremely helpful, especially that most of our generation relies too much on social media as a source of information".

Additionally, students expressed that there are no incentives to learn such concepts related to energy literacy. They headed to the fact that although there is an essential need to learn this knowledge, students won't participate and engage themselves in this learning unless there is some sort of motivation or incentive. No one provided them with any training or engaged them in any form of energy workshops. But if there are any sort of motivation, they would like to participate and get the required knowledge. One student said: "[…]I am an environmental advocate. It is time to take care of care of this planet and keep it safe. How do you expect someone to practice good energy habits while he doesn't know what are they? No one cares to educate me about energy because they think the resources are available. But one day, these resources will come to an end".

The NVivo output for the faculty and student model is shown in Figure 5 with the new and most prominent factors being mapped as mapped in Tables XII and XIII.

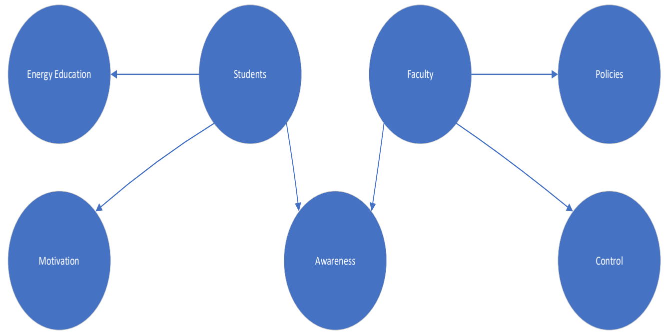

FIGURE 5
THE NVIVO OUTPUT FOR THE FACULTY AND STUDENT MODEL

CONCLUSION

As energy is a fundamental resource that is necessary for developing economies and societies, Energy consumption has been steadily growing in recent decades, resulting in various difficulties such as environmental concerns, global warming, etc. This growth needed careful energy consumption management, which may be achieved by improving energy literacy.

The purposes of this study are to assess and compare university occupants' energy literacy levels about their performance in the areas of cognition, emotion, and behavior. also, to investigate the relationships between the above-mentioned areas. The findings of this study revealed that students in Kuwait get low scores in energy literacy. This outcome is insightful to consider when formulating a strategy with clear goals for all students embedded within well-established standards for energy education. On the other hand, the faculty group that has the highest scores can be assumed to reflect education level among all groups. Therefore, education is found to be the main factor in the cognitive part of energy literacy.

Accordingly, such findings emulate the need to adopt strategies and create policies that can first bridge the gap between faculty and students' behavior. Second, optimize the behavior levels within both groups prepare students for rigor and independent learning to improve and increase their energy literacy. It would be beneficial that create educational policies which give more importance to sustainable behaviors such as energy conservation—creating policies for strengthening energy literacy in universities to accelerate the adoption of sustainable energy behaviors of individuals.

The staff and faculty members' energy literacy may be assessed in terms of their efficacy in teaching energy-related subjects using the energy literacy scale. Furthermore, this scale may be used to identify aspects linked to university occupants' energy literacy levels. It may also be used to determine which approaches are most efficient for instilling cognitive, emotional, and behavioral qualities in students, staff, and faculty members. Finally, universities may use the scale to identify their occupants' cognitive, affective, and behavioral competencies regarding energy-related environmental concerns and then plan instructional activities to help them develop these skills.

These may be a starting point for developing successful instructional strategies to help university occupants increase their energy literacy. This study suggested some possible instructional solutions, but further research is needed to link the identification and treatment of energy literacy.

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REFERENCES

[1] DeWaters J, E, Powers S, E, "Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect, and behavior," *Energy Policy*; Vol 39, No 3., 2011, pp. 1699–710.

[2] Suryana, T, G, S, Setyadin, A, H, Samsudin, A, Kaniawati, I, "Assessing multidimensional energy literacy of high school students: An analysis of rasch model", *Journal of Physics: Conference Series*, Vol 1467, No 1., 2020, p. 012034.

[3] Chandrasenan, D, Mammen, J, Yesodharan, V, "Energy Literacy of University Graduate Students: A Multidimensional Assessment in Terms of Content Knowledge, Attitude and Behavior," In *Proceedings of the 7th International Conference on Advances in Energy Research*, pp. 879-889, Springer, Singapore, 2021.

[4] Chodkowska-Miszczuk, J, Kola-Bezka, M, Lewandowska, A, Martinát, S, "Local Communities' Energy Literacy as a Way to Rural Resilience - An Insight from Inner Peripheries", *Energies*, Vol 14, No 9., 2021, p. 2575.

[5] Chen, K, L, Liu, S, Y, Chen, P, H, "Assessing Multidimensional Energy Literacy of Secondary Students Using Contextualized Assessment", *International Journal of Environmental & Science Education*, Vol 10, 2015, pp. 201–218.

[6] Maddock, B, Kriewaldt, J, "Post-Primary Education and Energy Literacy: An Analysis of the Potential for Geography Curricula to Contribute to Australian Students' Energy Literacy," *Geographical Education*, Vol 27, 2014, pp. 39–50.

[7] Cotton, D, R, E, Miller, W, Winter, J, Bailey, I, Sterling, S, "Developing Students' Energy Literacy in Higher Education", *International Journal of Sustainability in Higher Education*, Vol 16, 2015, pp. 456–473.

[8] Brounen, D, Kok, N, Quigley, J, M, "Energy Literacy, Awareness, and Conservation Behavior of Residential Households", *Energy Economics*, Vol 38, 2013, pp. 42–50.

[9] Van den Broek, K, L, "Household energy literacy: A critical review and a conceptual typology", *Energy Research & Social Science*, Vol 57, 2019, 101256.

[10] Brent, D, A, Ward, M, B, "Energy efficiency and financial literacy", *Journal of Environmental Economics and Management*, Vol 90, 2018, pp. 181-216.

[11] Boogen, N, Cattaneo, C, Filippini, M, Obrist, A, "Energy efficiency and the role of energy-related financial literacy: evidence from the European residential sector" *Energy Efficiency*, Vol 14, No 4., 2021, pp. 1-17.

[12] Lee, L, S, Lee, Y, F, Altschuld, J, W, Pan, Y, J, "Energy literacy: Evaluating knowledge, affect, and behavior of students in Taiwan", Energy Policy, Vol 76, 2015, pp. 98-106.

[13] Yeh, S, C, Huang, J, Y, Yu, H, C, "Analysis of energy literacy and misconceptions of junior high students in Taiwan", Sustainability, Vol 9, No 3., 2017, p. 423.

[14] DeWaters, J, Qaqish, B, Graham, M, Powers, S, "Designing an energy literacy questionnaire for middle and high school youth", The Journal of Environmental Education, Vol 44, No 1., 2013, pp. 56–78.

[15] Akitsu, Y, Ishihara, K, N, "An Integrated Model Approach: Exploring The Energy Literacy and Values of Lower Secondary Students in Japan", *International Journal of Educational Methodology,* Vol 4, No 3., 2018, pp. 161–186.

[16] Pradana, N, L, Kesmawan, A, P, Maharani, S, "Energy literacy-based learning activities on female students", *International Journal of Scientific & Technology Research*, Vol 8, 2019, pp. 1711-1715.

[17] Hamidi Razi, D, RanjPour, R, Motafakker Azad, M, A, "Energy Literacy and Energy-related Financial Literacy in Iran: Case of Northwestern Academic Community", *Environmental Energy and Economic Research*, Vol 5, No 3., 2021, pp. 1-14.

[18] Martins, A, Madaleno, M, Dias, M, F, "Energy literacy assessment among Portuguese university members: Knowledge, attitude, and behavior", Energy Reports, Vol 6, 2020, pp. 243-249.

[19] Bodzin, A, "Investigating urban eighth-grade students' knowledge of energy resources", International Journal of Science Education, Vol 34, No 8., 2012, pp. 1255-1275.

[20] Brewer, R, S, "Fostering sustained energy behavior change and increasing energy literacy in a student housing energy challenge" (Doctoral dissertation, University of Hawai'i at Manoa), 2013.

[21] Güven, G, Yakar, A, Sülün, Y, "Adaptation of the energy literacy scale into turkish: a validity and reliability study", Çukurova University Faculty of Education Journal, Vol 48, No 1., 2019, pp. 821-857.

[22] Cohen, J, "Statistical Power Analysis", Current Directions in Psychological Science, Vol 1, No 3., 1992, pp. 98-101

[23] Hair, J, F, Sarstedt, M, Hopkins, L, Kuppelwieser, V, G, "Partial least squares structural equation modeling (PLS-SEM): an emerging tool in business research", European Business Review, Vol 26, No 2., 2014, pp. 106–121.

[24] Crocker, L, Algina, J, "Introduction to classical and modern test theory", New York: Holt, Rinehart and Winston, 1986.

[25] Lord, F, M, "The relation of the reliability of multiple-choice tests to the distribution of item difficulties", Psychometrika, Vol 17, 1952, pp. 181-194.

[26] Backhoff, E, Larrazolo, N, Rosas, M, "The level of difficulty and discrimination power of the Basic Knowledge and Skills Examination (EXHCOBA)", RevistaElectrónica de InvestigaciónEducativa, Vol 2, No 1. 2000, pp. 1-16.

[27] Ebel, R, L, Frisbie, D, A, "Essentials of education measurement. Englewood Cliffs", NJ: Prentice Hall, 1986.

[28] Henrysson, S, "Gathering, analysing, and using data on test items", In R. L. Thorndike (Ed.), Educational measurement. Washington, DC: American Council on Education, 1971.

[29] Glass, G, Stanley, J, "Métodosestadísticosaplicados a las cienciassociales", (E. Galvis& E. Guzmán, Trans.). México: Prentice-Hall Hispanoamericana, 1986.

[30] Cassel, C, Hackl, P, Westlund, A, H, (). Robustness of partial least-squares method for estimating latent variable quality structures. Journal of Applied Statistics, Vol 26, No 4., 1999, pp. 435-446.

[31] Barclay, M, J, Smith, C, W, Watts, R, L, “The determinants of corporate leverage and dividend policies”, Journal of Applied Corporate Finance, Vol 7, No 4., 1995, pp. 4-19.

[32] Nunnally, J, Bernstein, I, “Psychometric theory”, McGraw Hill, New York, 1994.

[33] Fornell, C, Larcker, D, F, “Structural equation models with unobservable variables and measurement error: Algebra and statistics”, Journal of Marketing Research, Vol 18, No 3., 1981, pp. 382-388.

[34] Henseler, J, Ringle, C, M, Sinkovics, R, R, “The use of partial least squares path modelling in international marketing”, Advances in International Marketing (AIM), Vol 20, 2009, pp. 277-320.

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