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Student engagement and perceptions of the educational environment in industrial engineering programs in Jordan

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In recent years, increasing attention has been directed toward assessing the educational environment within engineering higher education. Such assessments offer insights that support curriculum adjustments, teaching practices, and improvements to the learning setting. Among the several tools designed to evaluate learning environments, the Dundee Ready Educational Environment Measure (DREEM) and the University Student Engagement Inventory (USEI) are among the most widely applied. In this study, both DREEM and USEI were distributed among industrial engineering students across six public universities in Jordan, with 400 students completing the questionnaires. Data was analyzed using the Statistical Package for Social Sciences (SPSS). The overall mean DREEM score across all universities was 122, with institutional averages ranging from 112.61 to 129.68, reflecting a generally positive perception of the educational environment. USEI results indicated moderate levels of student engagement, with overall scores ranging from 49 to 57 across the participating universities. Findings demonstrate that students' views of the educational environment strongly shape their perspectives on teaching and learning within industrial engineering programs. A recurring weakness observed across institutions was students' social self-perception, highlighting challenges in this domain. Many students expressed dissatisfaction with peer interactions, collaboration, and their sense of belonging in the academic community. These findings point to areas requiring immediate attention for enhancement.

KEYWORDS

Dundee Ready Educational Environment Measure model, learning environment, student engagement, students' perception, University Student Engagement Inventory

Introduction

The learning environment is a crucial factor influencing students' educational experiences and overall performance. It affects their mental wellbeing, motivation, academic success, and satisfaction with their studies (Plucker, 1998; Lizzio et al., 2002; Audin et al., 2003; Mayya and Roff, 2004; Al Ayed and Sheik, 2008; Demirören et al., 2008; Arzuman et al., 2010; Veerapen and McAleer, 2010; Schweder and Raufelder, 2024). Additionally, as the learning environment directly relates to the curriculum, it serves as a key performance indicator (KPI) for assessing curriculum quality and alignment with student needs. To maintain a high-quality curriculum that meets expectations, institutions frequently evaluate the learning environment (Sahu et al., 2020).

For more than 40 years, extensive research has been conducted on students' perceptions of their educational environment. Students are well-positioned to evaluate these environments due to their exposure to diverse learning settings and significant time spent in them (Fraser, 2012). Numerous studies have examined student satisfaction and how they evaluate teaching quality at universities (Barth, 2008; Merritt, 2008; Douglas et al., 2015). Factors such as the quality of instruction, course difficulty, teacher characteristics, and grading practices have been identified as critical determinants of students' evaluations (Erdle et al., 1985; Zabaleta, 2007). Additionally, satisfaction is strongly influenced by the alignment of course structure with students' expectations and the quality of the student-teacher relationship (Westerman et al., 2002; Ginns et al., 2007).

Various tools and methods have been developed to assess students' perceptions of learning environments. These include both qualitative approaches and standardized questionnaires, the latter offering significant advantages in comparing environments across institutions (Al-Hazimi et al., 2004; Holt and Challis, 2007). Among these tools, the Dundee Ready Educational Environment Measure (DREEM) has gained widespread acceptance. Developed by Sue Roff in 1997 at the University of Dundee, the DREEM questionnaire evaluates various aspects of the educational environment and identifies deficiencies that may require attention (Roff, 2005; Varma et al., 2005). Its reliability and validity have been established globally, making it a preferred method for assessing undergraduate learning environments in multiple disciplines, particularly in medicine, dentistry, and nursing (Pimpanyon et al., 2000; Soemantri et al., 2010; Miles et al., 2012; Chan et al., 2018; Rusticus et al., 2020).

Studies utilizing the DREEM tool have highlighted notable patterns, such as differences in perception between students at various stages of their education. For example, junior students often report higher DREEM scores compared to seniors, a trend observed across disciplines like medicine, dentistry, and nursing (Abraham et al., 2008; Demirören et al., 2008; Mohd Said et al., 2009; Thomas et al., 2009; Kossioni et al., 2012; Dehghani et al., 2013; Hamid et al., 2013; Doshi et al., 2014; Ousey et al., 2014; Pai et al., 2014; Pales et al., 2015; Patil and Chaudhari, 2016). Some research has also compared perceptions between students and staff, revealing that while teachers often rate teaching quality more positively, overall scores show no significant differences (Miles and Leinster, 2007; Pinnock et al., 2011; Rotthoff et al., 2011; Shehnaz et al., 2012; Awawdeh et al., 2024).

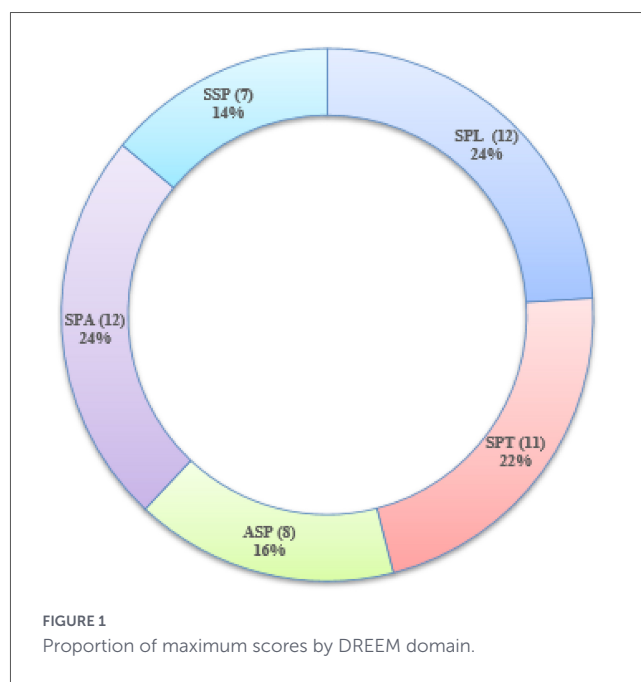
Few studies have utilized the DREEM inventory to compare students' perceptions of their educational environments across

different disciplines. According to Ousey et al. (2014) and Bakhshialiabad et al. (2015), the mean total DREEM scores across various disciplines were generally more positive than negative, ranging from 101 to 150 points. However, findings by Ousey et al. (2014) and Singh et al. (2023) indicate significant differences in DREEM scores between students from different fields of study. For example, Ousey et al. (2014) reported that students in occupational therapy, physiotherapy, and nursing expressed higher satisfaction with their educational environments compared to those in midwifery, podiatry, and operating department practice, with the lowest scores observed among operating department practice students.

The success of students in their academic endeavors and the completion of their degrees depend not only on the learning environment but also heavily on student engagement. However, the operationalization and dimensions of student engagement remain a topic of debate (Marôco et al., 2016). From a theoretical perspective, how students perceive their educational environment determines how engaged they are in classroom activities. Students should feel safe, comfortable, have access to resources, and an environment that is open and inclusive so that they can fully participate in activities. Thus, a motivating and supportive environment has to support behavioral (participation and perseverance), emotional (belonging), and cognitive (deep learning investment and problem-solving) behaviors.

A multidimensional concept called student engagement refers to behavioral, emotional, and cognitive factors. Students' perceptions of key environmental dimensions, including learning, teaching, academic self-perception, atmosphere, and social context, are captured by the DREEM instrument, while behavioral, emotional, and cognitive engagement are measured by the USEI. Reviewing these instruments together provides insight into how perceived educational environments are related to student engagement in higher education.

Student Engagement (SE) is broadly defined as the time, effort, and energy students dedicate to activities that promote



academic success, such as attending lectures, completing assignments, and adhering to instructors' guidelines (Sinval et al., 2021). Additionally, it reflects institutional policies and practices designed to foster student participation in these activities (Hodson and Thomas, 2003; Wierstra et al., 2003; Kuh, 2005). While the importance of SE is widely recognized (Trowler, 2010), its exact nature is still contested. Different perspectives and approaches to understanding SE have led to numerous definitions, even among scholars referencing the same theoretical frameworks.

TABLE 1 Interpretation of the DREEM McAleer and Roff (2013) (McAleer and Roff, 2013).

DREEM items	Interpretations
Total DREEM score (out of 200)	
0–50	Very poor
51–100	Plenty of problems
101–150	More positive than negative
151–200	Excellent
DREEM subdomains	
Students' perception of learning	0–12, Very poor
	13–24, Teaching is viewed negatively
	25–36, A more positive approach
	37–48, Teaching highly thought of
Students' perception of teachers	
	0–11, Abysmal
	12–22, In need of some retraining
	23–33, Moving in the right direction
	34–44, Model teachers
Students' academic self-perceptions	
	0–8, Feeling of total failure
	9–16, Many negative aspects
	17–24, Feeling more on the positive side
	25–32, Confident
Students' perception of atmosphere	
	0–12, A terrible environment
	13–24, There are many issues that need changing
	25–36, A more positive atmosphere
	37–48, A good feeling overall
Students' social self-perceptions	
	0–7, Miserable
	8–14, Not a nice place
	15–21, Not too bad
	22–28, Very good socially
DREEM items	
Mean score of 3.5 or greater	Positive
Mean score between 2 and 3	Could be enhanced or improved
Mean score of 2 or less	Problematic area

One prominent framework, known as the North American model, was developed by Fredricks et al. (2004) to study engagement in educational settings, particularly in schools. According to this model, which forms the basis of the current study, engagement is multidimensional, encompassing emotional, behavioral, and cognitive aspects. SE has been linked to students' motivation (Senior et al., 2018), with studies identifying motivational antecedents, such as task value (Wang and Eccles, 2013) and mastery goal orientation (Wang and Holcombe, 2010), that can enhance engagement.

In the context of universities, Kahu (2013) outlined four main approaches to studying SE: (a) the behavioral approach, which focuses on students' actions and behaviors; (b) the psychological approach, which examines individual and psychological aspects of engagement; (c) the socio-cultural approach, which explores the influence of social contexts on university experiences; and (d) the holistic approach, which seeks to integrate the preceding perspectives.

Given the critical role of the educational environment in fostering motivation and enhancing learning capabilities, coupled with the scarcity of studies assessing students' perceptions of their learning environments in Jordan, this study aims to fill that gap by

TABLE 2 Demographic data.

Demographic details	Frequency	Percentage
Age		
17–19	80	
20–22	235	
23–25	84	
26–28	1	
Gender		
Male	170	42.5%
Female	230	57.5%
Educational level		
Year 1	57	14.2%
Year 2	55	13.8%
Year 3	69	17.3%
Year 4	80	20.0%
Year 5	124	31.0%
More than 5 years	15	3.8%
Nationality		
Jordanian	383	95.8%
Non-Jordanian	17	4.3%
University		
Mutah University	38	9.5%
University of Jordan	131	32.8%
Jordan University of Science and Technology	62	15.5%
Hashemite University	50	12.5%
Yarmouk University	42	10.5%
German Jordanian University	73	18.3%
Applied Science Private University	4	1%
Educational score (GPA)		
< 2.49	15	3.75%
2.5–2.99	140	35%
3.0–3.49	179	44.75%
3.5–4.0	66	16.5%

evaluating the educational environment at Jordanian universities specializing in industrial engineering.

Despite extensive research on educational environments and student engagement, there is a limited number of research studies that examine the relationship between perceived educational environments and multidimensional student engagement within engineering education. Furthermore, most applications of the DREEM instrument have focused on medical and health-related disciplines, with relatively few studies investigating its use in engineering programs. In this study, we integrate DREEM and USEI to examine how industrial engineering students' perceptions of their educational environment relate to their engagement across behavioral, emotional, and cognitive dimensions.

This study addresses three primary objectives. First, it explores whether the application of the DREEM tool can provide valuable insights into undergraduate students' perceptions of the learning environment at Jordanian universities, which host a diverse student body. Second, while DREEM has predominantly been validated in medical and paramedical settings, this study investigates its applicability in non-medical institutions. Lastly, the study utilizes the University Student Engagement Inventory (USEI) to assess levels of student engagement across public universities in Jordan.

Research design and methods

Data collection

The study was conducted among undergraduate students enrolled in industrial engineering programs at six public Jordanian universities. Participants were invited to complete a questionnaire following the conclusion of a curriculum block exam. The

questionnaire was administered electronically via Google Forms, and links to the survey were shared through email, Facebook groups, and Microsoft Teams. Before participating, students were informed about the study's objectives and assured that their responses would remain anonymous. Participation was entirely voluntary, and students were explicitly told that opting out would not require justification. This study was conducted in accordance with the Scientific Research Ethics Policy at the University of Jordan. According to the policy, research that evaluates academic or educational services and does not involve identifying personal information is exempt from formal ethical review.

Structure of the questionnaire

The Questionnaire consisted of four demographic questions [age, gender, year of study, university, and students' cumulative educational score (GPA)], and incorporated two validated instruments: the Dundee Ready Educational Environment Measure (DREEM) and the University Student Engagement Inventory (USEI).

DREEM originally was developed for health-professions education, but it is a generic, curriculum-independent measure of broad educational-environment dimensions across higher education. Its use has extended beyond medicine to other disciplines (e.g., dentistry, veterinary education, and science programs). To ensure contextual relevance, items were reviewed and any clinically oriented wording (e.g., "ward," "clinical") was replaced with discipline-neutral terms (e.g., "classroom," "course," "learning activities") without changing the constructs measured.

The DREEM questionnaire, widely recognized for its validity and reliability, includes 50 closed-ended statements categorized into five primary domains: Students' Perceptions of Learning

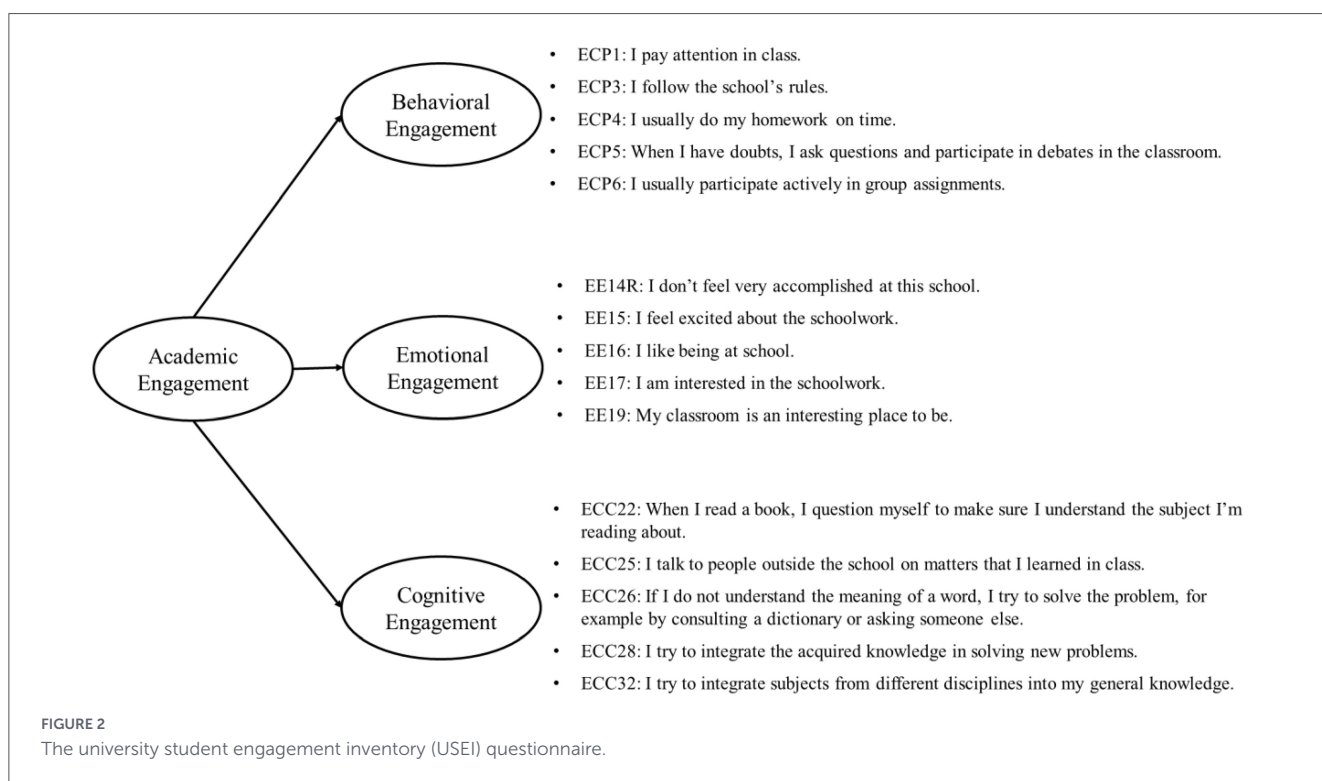


TABLE 3 Descriptive statistics of DREEM items and its correlation with item-total DREEM score.

DREEM item	Mean	SD	SEM	95% CI		Item-total correlation
				Lower	Upper	
Item 1	2.69	1.07	0.05	2.58	2.79	0.319**
Item 2	3.08	0.89	0.04	2.99	3.17	0.305**
Item 3	1.46	1.31	0.06	1.13	1.58	0.355**
Item 4	1.55	1.35	0.06	1.42	1.68	0.366**
Item 5	2.27	1.37	0.06	2.13	2.40	0.301**
Item 6	2.72	1.10	0.05	2.61	2.82	0.337**
Item 7	2.77	1.17	0.05	2.66	2.89	0.334**
Item 8	2.73	1.27	0.06	2.60	2.85	0.234**
Item 9	1.78	1.31	0.06	1.68	1.95	0.301**
Item 10	3.03	1.06	0.05	2.93	3.14	0.334**
Item 11	2.22	1.27	0.06	2.09	2.34	0.231**
Item 12	2.63	1.22	0.06	2.51	2.75	0.350**
Item 13	2.35	1.23	0.06	2.22	2.47	0.247**
Item 14	1.97	1.29	0.06	1.84	2.10	0.368**
Item 15	3.17	1.02	0.05	3.07	3.22	0.295**
Item 16	2.51	1.18	0.05	2.40	2.63	0.276**
Item 17	1.63	1.30	0.06	1.47	1.95	0.431**
Item 18	2.62	1.12	0.05	2.51	2.73	0.090*
Item 19	2.81	1.10	0.05	2.70	2.92	0.449**
Item 20	2.90	0.95	0.04	2.80	2.99	0.332**
Item 21	2.33	1.22	0.06	2.21	2.45	0.177**
Item 22	2.61	1.16	0.05	2.50	2.73	0.460**
Item 23	2.49	1.15	0.05	2.38	2.61	0.492**
Item 24	2.84	1.02	0.05	2.73	2.94	0.541**
Item 25	1.15	0.93	0.04	1.06	1.24	0.379**
Item 26	2.50	1.13	0.05	2.38	2.61	-0.365**
Item 27	2.13	1.28	0.06	2.00	2.26	0.393**
Item 28	2.57	1.29	0.06	2.44	2.69	0.345**
Item 29	2.72	1.09	0.05	2.62	2.83	0.289**
Item 30	2.65	1.11	0.05	2.54	2.76	0.449**
Item 31	2.60	1.18	0.05	2.48	2.72	0.446**
Item 32	2.43	1.17	0.05	2.32	2.55	0.346**
Item 33	2.72	1.11	0.05	2.61	2.83	0.391**
Item 34	2.56	1.10	0.05	2.45	2.66	0.448**
Item 35	2.63	1.35	0.06	2.49	3.164	0.538**
Item 36	2.65	1.15	0.05	2.54	2.77	0.289**
Item 37	2.84	1.00	0.05	2.74	2.94	0.351**
Item 38	2.69	1.07	0.05	2.58	2.79	0.432**
Item 39	1.98	1.28	0.05	1.85	2.10	0.448**
Item 40	2.90	0.96	0.04	2.81	3.00	0.402**
Item 41	2.80	1.05	0.05	2.69	2.90	0.410**
Item 42	2.06	1.33	0.06	1.93	2.19	0.443**
Item 43	2.47	1.19	0.05	2.35	2.58	0.489**

(Continued)

TABLE 3 (Continued)

DREEM item	Mean	SD	SEM	95% CI		Item-total correlation
				Lower	Upper	
Item 44	2.50	1.17	0.05	2.38	2.61	0.523**
Item 45	2.64	1.09	0.05	2.54	2.75	0.364**
Item 46	2.11	0.81	0.04	2.03	2.19	0.132**
Item 47	2.41	1.20	0.06	2.29	2.52	0.424**
Item 48	1.65	1.19	0.05	1.53	1.76	0.025
Item 49	2.61	1.25	0.06	2.48	2.73	0.410**
Item 50	2.24	1.21	0.06	2.12	2.36	0.067

* $p < 0.05$; ** $p < 0.01$.

TABLE 4 DREEM total score for the five aspects for the Universities in Jordan.

The university	DREEM score	Perception of learning	Perception of teachers	Social self-perception	Academic self-perception	Perception of atmosphere
The University of Jordan	115.6	26.88	27.35	14.91	18.92	27.51
Mutah University	129.68	30.57	28.78	16.68	23.23	30.39
Jordan University of Science and Technology	127	29.59	28.83	16.34	22.04	30.18
Hashemite University	124.94	29.03	29	16.03	21.11	29.74
Yarmouk University	112.61	27.76	26.23	14.09	19.16	25.35
German Jordanian University	129.58	30.72	30.36	16.26	21.26	30.97

TABLE 5 DREEM subscale statistics of all the Universities in Jordan.

Subscale	M	SD	Interpretation
DREEM score	122.53	26.30	“More positive than negative”
Perception of learning	28.81	6.39	“A more positive approach”
Perception of teachers	28.45	7.51	“Moving in the right direction”
Social self-perception	15.67	4.53	“Not too bad”
Academic self-perception	20.61	5.46	“Feeling more on the positive side”
Perception of atmosphere	28.89	7.55	“A more positive atmosphere”

(SPL, 48 points), Students’ Perceptions of Teachers (SPT, 44 points), Students’ Academic Self-Perceptions (ASP, 32 points), Students’ Perceptions of Atmosphere (SPA, 48 points), and Students’ Social Self-Perceptions (SSP, 28 points). To provide a clearer representation of the instrument’s structure, Figure 1 presents a donut chart illustrating the proportion of each domain’s maximum score relative to the overall maximum of 200. As shown, SPL and SPA contribute the largest share (24% each), followed by SPT (22%), ASP (16%), and SSP (14%). This visualization highlights the relative weight of each domain within the DREEM framework, ensuring transparency in how total scores are derived.

Each domain provides insights into specific aspects of the learning environment. Responses were recorded on a five-point Likert scale ranging from 0 (“Completely disagree”) to 4 (“Completely agree”). Nine negatively worded items (4, 8, 9, 17, 25, 35, 39, 48, and 50) were reverse scored to ensure proper interpretation. Higher scores reflect a more favorable evaluation, with a maximum total DREEM score of 200, representing an ideal

educational environment. Table 1 illustrates the interpretation of the DREEM scale and its subscales in accordance with McAleer and Roff (2013).

The USEI scale, comprising 15 items, evaluates student engagement across three dimensions:

1. *Behavioral engagement*: Focused on class participation, adherence to rules, and group assignments.
2. *Emotional engagement*: Examining feelings of accomplishment, interest, and excitement about schoolwork.
3. *Cognitive engagement*: Addressing efforts to integrate and apply acquired knowledge.

Responses were rated on a five-point scale, ranging from 1 (“Never”) to 5 (“Always”), with a maximum score of 75, indicating ideal academic engagement. Previous studies have demonstrated the USEI’s strong reliability and validity in measuring engagement across educational contexts. Table 2 illustrates the University Student Engagement Inventory (USEI) Questionnaire. Figure 2

TABLE 6 Comparison of DREEM total scores for different Universities in Jordan with other international universities around the world (sorted according to score mean) (Essa, 2023).

Country	University	Total DREEM score
KSA	KSU	89.9
Canada	Canadian Memorial Chiropractic College	97
Yemen	Sana'a University	100
KSA	KSU	100
KSA	King Abdulaziz University	102
KSA	Jazan University	104.9
Kuwait	Kuwait University	105
India	Kasturba Medical College	107
KSA	Umm Al-Qura University	107
Sri Lanka	University of Sri Jayawardenepura	108
KSA	Taiba University	109
KSA	Qassim University	112
KSA	King Khalid University	112.95
Nigeria	Nigeria Undergraduate Medical School	118
UAE	Gulf Medical University	120
KSA	KSAU-HS	131
UK	Birmingham University	139
Dundee	Dundee Medical School	139
Malaysia	Malaysian Medical School	125.3
Malaysia	Malaysian Medical School	134
Jordan	The University of Jordan	115.6
Jordan	Mutah University	129.68
Jordan	Jordan University of Science and Technology	127
Jordan	Hashemite University	124.94
Jordan	Yarmouk University	112.61
Jordan	German Jordanian University	129.58

illustrates the University Student Engagement Inventory (USEI) Questionnaire, highlighting its division into three domains of student engagement.

Statistical analysis

Following completion of the questionnaires, the data were entered into the Statistical Package for the Social Sciences (SPSS) version 28. Analyses of the data were conducted using descriptive statistics as well as inferential statistics. Comparisons between groups were assessed using simple tabulations and frequency tests.

Results and discussion

The DREEM tool was employed to examine how 400 undergraduate industrial engineering students in Jordan perceive

TABLE 7 Correlation between DREEM subscale statistics of all universities of Jordan, gender and educational score.

Subscale	Gender	Educational score
Perception of learning	$Z = -0.883, p = 0.377$	$r = 0.043, p = 0.290$
Perception of teachers	$Z = -2.036, p = 0.042$	$r = 0.070, p = 0.073$
Social self-perception	$Z = -0.386, p = 0.700$	$r = -0.033, p = 0.400$
Academic self-perception	$Z = -0.154, p = 0.878$	$r = 0.099^*, p = 0.011$
Perception of atmosphere	$Z = -2.047, p = 0.041$	$r = 0.075, p = 0.055$

*Correlation is significant 0.05 level.

their educational environment. The sample size of 400 respondents was determined using Cochran's formula with a 95% confidence level and a 5% margin of error. Assuming a conservative population proportion of 0.5, the minimum required sample size was 384; therefore, the final sample of 400 respondents was considered sufficient for the analyses conducted in this study. The research involved calculating average scores and standard deviations for items across five DREEM domains: perceptions of learning, perceptions of teachers, academic self-perceptions, perceptions of the environment, and social self-perceptions. The demographic data, descriptive data, comparison of DREEM total scores between the universities Jordan with international universities and correlation test results are deeply explained. Additionally, the USEI is a psycho-educational measure that has three dimensions Emotional, Behavioral and Cognitive. It is also covered in this section.

Demographic data

According to the demographic data have different criteria which are Age, Gender, Educational level, Nationality, and University (Table 2), in addition to students' cumulative educational score (GPA), which was collected as a self-reported variable. GPA data were used to examine differences in students' perceptions of the educational environment based on academic performance.

Most participants are of age 20–22 years old, and the least are of age 26–28 years old. Additionally, the females contributed more to the questionnaire than males (57% versus 43%). Understanding the gender composition of the sample is crucial for assessing potential gender-related differences in perceptions of the educational environment. Meanwhile, 4% of participants have been in school for more than 5 years, 31% are in their fifth year, 20% are in their fourth year, 17% are in their third year, 14% are in their second year, and 14% are in their first year. The majority of the study population was Jordanian (95.8%). The majority of participants are from the University of Jordan (33%), the second largest percentage of participants is for the German Jordanian University, and the third percentage for Jordan University of Science and Technology (15.5%), followed by Yarmouk University and Mutah University (11 and 9%, respectively). However, it is important to mention that the proportion of students from specific universities, such as Applied Science Private University (1%, 4 participants), was relatively limited in relation to the sample. Because of the narrow representation, data from these institutions

TABLE 8 P-value test for DREEM domain of all universities of Jordan, gender and educational score.

DREEM domain	Gender difference	Educational score (GPA) difference	Conclusion
Perception of learning	$p = 0.377 > 0.05$; Fail to reject H_0	$p = 0.290 > 0.05$; Fail to reject H_0	There is no strong evidence to suggest that the perception of learning differs significantly based on either gender or educational score
Perception of teaching	$p = 0.042 < 0.05$; Reject H_0 (significant)	$p = 0.073 < 0.05$; Reject H_0 (significant)	There is statistically significant evidence to suggest that the perception of teaching varies based on either gender or educational score
Social self-perception	$p = 0.700 > 0.05$; Fail to reject H_0	$p = 0.400 > 0.05$; Fail to reject H_0	There is no strong evidence to suggest that social perception differs significantly based on either gender or educational score
Academic self-perception	$p = 0.878 > 0.05$; Fail to reject H_0	$p = 0.011 < 0.05$; Reject H_0 (significant)	There is strong evidence to suggest that academic self-perception varies significantly based on educational score, but not based on gender
Perception of atmosphere	$p = 0.041 < 0.05$; Reject H_0 (significant)	$p = 0.055 > 0.05$; Fail to reject H_0	There is strong evidence to suggest that perception of atmosphere varies significantly based on gender, but not based on educational score

were not taken into consideration in institution-level comparisons or conclusions. Overall, these results offer valuable insights into the characteristics of the sample participating in the survey. Analyzing these demographics will facilitate a deeper understanding of the survey findings and help contextualize the perceptions of industrial engineering students regarding their educational environment.

Descriptive statistics

Descriptive statistics for each of the DREEM items are presented in Table 3. The tabulated results show mean, standard deviation, mean standard error, lower and upper and Item-total correlation. The mean DREEM total score was 122.53 with the SD equal to 26.30. Total DREEM scores ranged from 101 to 150, which shows that is more positive than negative.

Differences between the universities in Jordan in domains of DREEM

Table 4 represents the DREEM total score for the five aspects for the universities in Jordan. Table 5 indicates an overall positive perception among students across universities in Jordan, as reflected by the DREEM score of 122.53, indicating a “More positive than negative” sentiment. Specifically, students view the approach to learning (mean = 28.81) and the direction of teachers (mean = 28.45) as positive, suggesting an encouraging learning environment. However, there are areas for potential improvement, notably in social self-perception (mean = 15.67), which suggests that students perceive their social experience within the academic setting as “Not too bad,” indicating room for enhancing social support systems or creating a more engaging social atmosphere. On a positive note, academic self-perception (mean = 20.61) and the perception of the overall atmosphere (mean = 28.89) are rated quite positively, indicating a generally favorable view of academic competence and the overall learning environment. Comparing these results across universities could provide valuable insights into areas of strength and areas needing attention, helping institutions tailor interventions to enhance the overall student experience.

To improve the social self-perception aspect identified in the DREEM survey results, universities in Jordan could consider implementing several strategies. Firstly, develop and promote

TABLE 9 R-value test for DREEM domain of all universities of Jordan, gender and educational score.

DREEM domain	R-value (between gender and educational score)	Conclusion
Perception of learning	0.043	Weak positive correlation
Perception of teachers	0.07	Weak positive correlation
Social self-perception	-0.033	Weak negative correlation
Academic self-perception	0.099	Weak positive correlation
Perception of atmosphere	0.075	Weak positive correlation

TABLE 10 USEI for all participated Universities.

University	University student engagement inventory (USEI)	
	Mean	SD
Mutah University	56.2	7.61
University of Jordan	52.35	7.89
The Jordan University of Science and Technology	53.22	8.01
Hashemite University	53.06	8.33
Yarmouk University	49.28	8.64
German Jordan University	51.99	7.52

programs that foster a sense of community and belonging among students. This could include mentorship programs, peer support groups, and activities that encourage social interaction and collaboration. Create initiatives that celebrate diversity and promote inclusivity within the university community. This can include cultural events, diversity training for students and staff, and policies that ensure equal opportunities for all students. Secondly, organizing a variety of social activities and events that cater to different interests and preferences. This can range from sports tournaments and arts exhibitions to community service projects and networking events. Enhance communication channels between students, faculty, and administration to address social

TABLE 11 USEI dimension score for all participated Universities.

University	USEI scale		
	Behavioral engagement (out of 25)	Emotional engagement (out of 25)	Cognitive engagement (out of 25)
Mutah University	20.32	16.63	19.26
University of Jordan	19.27	15.57	17.53
The Jordan University of Science and Technology	19.03	16.1	18.31
Hashemite University	19.26	15.78	18.26
Yarmouk University	18.76	14.17	16.36
German Jordan University	19.37	15.59	17.03

concerns effectively. This can involve regular feedback sessions, open forums for discussion, and platforms for sharing ideas and suggestions. Finally, support for Mental Health and Wellbeing, implement initiatives that promote mental health awareness, provide counseling services, and offer resources for managing stress and improving overall wellbeing. This can contribute to a positive social environment by addressing individual needs and challenges. By focusing on these areas, universities can work toward creating a more supportive and inclusive social environment that enhances students' overall experience and wellbeing.

Comparison of DREEM total scores for different universities in Jordan with other international universities

Table 6 explains the comparison of DREEM total scores for different universities in Jordan with other international universities. Some Jordanian universities like Mutah University and Jordan University of science and technology have decent scores around 127–130, others like Yarmouk University and The University of Jordan have scores below 125, placing them lower in comparison. Countries like the UK, UAE, Dundee, Malaysia and Nigeria have universities with higher scores, indicating potentially better overall quality according to the DREEM score metric. Based solely on the DREEM score metric, which may not fully capture all aspects of university performance, the universities in Jordan appear to have room for improvement compared to some universities in other countries. While some Jordanian universities have achieved high scores, others fall below the scores of universities in countries like the UK, UAE, and Nigeria. However, it's essential to consider that the DREEM score is just one measure and may not reflect the full picture of a university's quality or potential. Continued investment in education, research, and infrastructure can help Jordanian universities advance and compete more effectively on a global scale.

We present summary differences between results of this study and some selected international studies using the DREEM instrument in Table 6. These comparisons are intended for contextual benchmarking purposes only. Because the studies are heterogeneous with respect to study design, population characteristics sampled, institutional settings, and time duration of data collection, such reported differences should not be interpreted as statistically significant signals of poor or better educational quality.

Correlation test results and statistical analysis

Evaluating possible differences in how students view the educational environment is difficult, especially among top performers. Thus, this study utilized students' perceptions to examine basic elements covering learning, teaching, atmosphere, self, and social perception. For that reason, some hypotheses were formed to measure these aspects, a few hypotheses were formulated:

H_{a0} : There is no difference in DREEM scores between students of different genders.

H_{a1} : There is a statistically significant difference in DREEM scores between students of different genders.

H_{b0} : There is no difference in DREEM scores between students with different educational scores (GPA).

H_{b1} : There is a statistically significant difference in DREEM scores between students with different educational scores (GPA).

Table 7 represents the Correlation between DREEM Subscale Statistics of all universities of Jordan considering the gender and educational score. Tables 8, 9 illustrate the p -value and r -value for DREEM aspects of all universities of Jordan, gender and educational score.

Where:

1. If r is positive, it indicates a positive correlation, meaning as one variable increases, the other also tends to increase.
2. If r is negative, it indicates an inverse or negative relationship between variables.
3. The closer r is to 1 or -1 , the stronger the correlation.
4. If r is close to 0, it indicates a weak or no correlation.

"Weak" indicates that the relationship between gender and educational score is not very strong based on the value of r -value. This means that while there is some association between

TABLE 12 Statistical data regarding the DREEM items, including corrected item-total correlations, the value of Cronbach's alpha if an item is removed, and standardized factor loadings.

Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted	Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
SPLQ1	119.843	670.278	0.372	0.919	SAPQ26	120.033	661.821	0.496	0.918
SPTQ2	119.448	673.957	0.375	0.919	SAPQ27	120.398	664.025	0.4	0.919
SSPQ3	121.073	659.626	0.457	0.918	SSPQ28	119.96	668.364	0.332	0.919
SSPQ4	120.98	662.35	0.403	0.919	SPTQ29	119.805	657.716	0.594	0.917
SAPQ5	120.263	667.177	0.325	0.919	SPAQ30	119.878	659.466	0.548	0.917
SPTQ6	119.813	667.07	0.417	0.918	SAPQ31	119.928	663.917	0.442	0.918
SPLQ7	119.758	659.868	0.514	0.917	SPTQ32	120.098	657.747	0.549	0.917
SPTQ8	119.803	670.826	0.3	0.92	SPAQ33	119.808	661.294	0.517	0.917
SPTQ9	120.745	662.366	0.413	0.918	SPAQ34	119.973	653.651	0.659	0.916
SAPQ10	119.498	674.251	0.303	0.919	SPAQ35	119.9	665.709	0.353	0.919
SPAQ11	120.313	657.834	0.5	0.918	SPAQ36	119.875	666.867	0.403	0.918
SPAQ12	119.895	672.315	0.288	0.92	SPTQ37	119.685	665.119	0.503	0.918
SPLQ13	120.183	658.636	0.506	0.917	SPLQ38	119.84	661.333	0.539	0.917
SSPQ14	120.558	664.759	0.387	0.919	SPTQ39	120.55	672.925	0.264	0.92
SSPQ15	119.355	672.32	0.354	0.919	SPTQ40	119.625	668.546	0.454	0.918
SPLQ16	120.015	657.879	0.543	0.917	SAPQ41	119.733	665.189	0.478	0.918
SPAQ17	120.91	686.979	0.051	0.922	SPAQ42	120.468	651.267	0.574	0.917
SPTQ18	119.91	656.804	0.59	0.917	SPAQ43	120.063	650.575	0.659	0.916
SSPQ19	119.715	665.939	0.44	0.918	SPLQ44	120.033	650.157	0.676	0.916
SPLQ20	119.633	675.962	0.308	0.919	SAPQ45	119.885	665.992	0.441	0.918
SPLQ21	120.203	653.981	0.586	0.917	SSPQ46	120.418	684.915	0.155	0.92
SAPQ22	119.915	654.454	0.61	0.917	SPLQ47	120.123	658.429	0.524	0.917
SPAQ23	120.035	652.475	0.648	0.916	SPLQ48	120.883	693.808	-0.049	0.923
SPLQ24	119.693	666.594	0.462	0.918	SPTQ49	119.92	655.778	0.542	0.917
SPLQ25	121.378	716.907	-0.509	0.925	SPAQ50	120.29	686.597	0.065	0.922

TABLE 13 Statistical data regarding the USEI items, including corrected item-total correlations, the value of Cronbach's alpha if an item is removed, and standardized factor loadings.

Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
ECP1	48.887	58.586	0.442	0.780
ECP3	48.295	59.401	0.377	0.784
ECP4	48.613	58.599	0.382	0.784
ECP5	49.247	55.901	0.519	0.773
ECP6	49.027	57.170	0.389	0.783
EE14R	49.780	70.764	-0.382	0.839
EE15	49.500	54.025	0.526	0.771
EE16	49.335	55.431	0.474	0.776
EE17	49.465	53.758	0.537	0.770
EE18	49.652	55.636	0.498	0.774
ECC22	49.290	56.923	0.409	0.782
ECC25	49.580	56.144	0.426	0.780
ECC26	48.772	57.114	0.459	0.778
ECC28	48.952	55.479	0.611	0.768
ECC32	49.087	56.060	0.489	0.775

gender and educational score in the domain, it is not a particularly strong relationship. Meanwhile, "Positive" indicates the direction of the relation. This indicates that as gender increases (from male to female), the average educational scores also increase. This doesn't imply causation but suggests that there might be some influence of gender on educational scores within the domain.

The university student engagement inventory results

Table 10 shows a comparison between Jordan universities in USEI score. It observed that the USEI score for all Universities is between 49 and 57. The university that has highest USEI score is Mutah University (56.2) followed by The Jordan University of Science and Technology (53.22). Yarmouk University has the lowest USEI score of 49.28.

The score for each dimension of the USEI scale is illustrated in Table 11. Students in Mutah University have the highest score on all dimensions. However, students at Yarmouk University have the lowest score on all dimensions. A student's behavioral engagement is defined as their participation in classroom tasks, their conduct in the classroom, and their participation in extracurricular activities associated with the school. A student's emotional engagement consists of attention to the teachers' instructions, a feeling of belonging to the school, and a belief that schooling is valuable. High emotional dimension score of the USEI refers to positive feelings and emotions related to the learning process, class activities, peers, and teachers. A student's cognitive dimensions are defined as their thoughts, perceptions, and strategies related to the acquisition of knowledge or the development of skills related to academic activities.

Reliability of DREEM questionnaire at the universities in Jordan

The inventory's reliability of the DREEM questionnaire was evaluated using Cronbach's alpha coefficient, as established by Cronbach (1970). The values of the Cronbach's alpha coefficients were interpreted as follows: ≥ 0.90 , excellent; 0.80–0.89, good; 0.70–0.79, acceptable; 0.60–0.69, questionable; 0.50–0.59, poor; and < 0.50 , unacceptable.

For this study Cronbach's alpha value for the DREEM 50-item was 0.92. This indicates excellent reliability. The values of Cronbach's alpha have been calculated after specific items from the DREEM 50-item list have been removed. Results show that Cronbach's alpha can be improved furthermore by eliminating SPLQ25 and SPLQ48, then reliability score (Cronbach's alpha) can be increased from 0.920 to 0.925 and 0.923, respectively. These statistics data given in Table 12 are crucial for assessing the reliability and validity of the DREEM questionnaire, which aims to improve educational settings.

Cronbach's alpha value for the USEI 15 items is 0.794 which means an acceptable level of reliability. The results suggest that if EE14R item is removed from the questionnaire, the reliability score will be improved from 0.794 to 0.839. It becomes an acceptable level to good. The statistical data presented in Table 13 are essential for evaluating the reliability and validity of the USEI questionnaire.

Conclusion and future work

In this study, the perspective of the educational environment on students' perception of teaching and learning Industrial Engineering in Jordanian universities has been tested by DREEM and USEI. The study has provided valuable insights into the

factors influencing students' opinions and identified areas for improvement. The students have a more positive view of the educational environment than a negative one. Additionally, gender and educational scores have played a significant role in some subscales, such as perception of teaching.

The results obtained of this study led to several findings. Firstly, the educational environment significantly impacts students' perceptions of teaching and learning in Industrial Engineering. Secondly, the study highlights the importance of continuous evaluation and improvement of educational programs in Industrial Engineering. It emphasizes the need for curriculum alignment with industry needs, the utilization of innovative teaching methods, and the provision of adequate learning resources. Thirdly, faculty development programs could also play a crucial role in enhancing teaching practices and creating an engaging learning environment. Finally, the social self-perception emerged as a common weak point across most universities, suggesting the need for improvement in social interactions, peer collaboration, and the sense of belonging within the academic community by implementing several strategies, such as encouraging group projects, and promoting student clubs and organizations. By implementing these strategies, universities can enhance the social aspects of the educational environment, thereby influencing students' overall perception of teaching and learning. Therefore, addressing the identified weaknesses and implementing the proposed strategies can enhance the educational experiences of Industrial Engineering students at the universities, improve student engagement and satisfaction, and prepare talented students for future careers.

Since social self-perception emerged as a common weak point in the universities, future works could build on this issue by measuring the importance of encouraging group projects. Additionally, conducting longitudinal studies, comparative analyses, and qualitative research could gain a deeper understanding of students' perceptions and experiences. Intervention studies can also be undertaken to test the effectiveness of proposed solutions, and industry alignment can be further explored to bridge the gap between academia and industry.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

This study was conducted in accordance with the Scientific Research Ethics Policy at the University of Jordan. According to the policy, research that evaluates academic or educational services and does not involve identifying personal information is exempt from formal ethical review. The study complied with local legislation and institutional requirements. Participation was voluntary, and informed consent was obtained from all participants prior to completing the survey.

Author contributions

NTA: Validation, Project administration, Writing – review & editing, Formal analysis, Software, Conceptualization, Writing – original draft, Methodology, Supervision, Data curation, Visualization, Investigation. NA: Software, Writing – review & editing, Formal analysis, Methodology, Investigation, Data curation, Writing – original draft, Project administration, Validation, Visualization, Conceptualization, Supervision. ZA-B: Writing – original draft, Data curation. WA: Methodology, Writing – original draft. LA-D: Writing – review & editing, Writing – original draft. ARA: Formal analysis, Writing – original draft, Data curation. LF: Data curation, Formal analysis, Writing – original draft. RA: Data curation, Writing – original draft, Formal analysis. HA-T: Formal analysis, Writing – original draft, Data curation. AA: Writing – original draft, Formal analysis, Data curation.

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