INTERNATIONAL JOURNAL OF SUSTAINABLE CONSTRUCTION ENGINEERING AND TECHNOLOGY
ISSN: 2180-3242 e-ISSN: 2600-7959

IJSCET

Vol. 15 No. 1 (2024) 287-298
https://publisher.uthm.edu.my/ojs/index.php/ijscet

Students' Perception and Exploring Technological Roles in Solid Waste Engineering and Management Education

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DOI: https://doi.org/10.30880/ijscet.2024.15.01.020

Article Info

Received: 27 February 2024
Accepted: 25 March 2024
Available online: 15 July 2024

Keywords

Technology integration in teaching, solid waste management, descriptive analysis

Abstract

A comprehensive understanding of students' perceptions within the Solid Waste Engineering and Management course contributes valuable insights to educators, institutions, and policymakers, facilitating the enhancement of waste management education through enriched teaching methods and technology integration that align with students' evolving needs. This study investigates students' perceptions in the context of the Solid Waste Engineering and Management course, analyzing demographic characteristics, impressions, lecturer professionalism, teaching and learning activities, and technology utilization. The sample encompasses diverse age groups, genders, semesters, and educational backgrounds, enhancing the study's comprehensiveness. Employing a quantitative approach, the research combines a survey questionnaire with statistical analyses. Descriptive statistics and correlation analysis unveil intricate relationships among variables and perceptions, offering nuanced insights. The results reveal positive impressions among students regarding knowledge enhancement, content relevance, increased confidence, and effective assessment methods. Lecturer professionalism is highlighted through attendance monitoring, academic guidance, and language use. Teaching and learning activities garner favorable responses, with active involvement, effective explanations, and challenging delivery styles appreciated. Technology's role in enhancing engagement and leveraging online resources is acknowledged. Correlation analysis underscores the strong associations between lecturer professionalism and effective teaching, learning activities, and course impression. Positive perceptions of teaching and learning activities correlate with a positive course impression.

1. Introduction

In an era marked by heightened environmental awareness and a growing urgency to address waste-related challenges, the field of Solid Waste Engineering and Management has emerged as a critical discipline in the pursuit of sustainable development [1]. As societies grapple with the escalating complexities of waste generation, disposal, and environmental impact, the education imparted to future waste management professionals becomes increasingly significant [2].

This research paper delves into a pivotal aspect of this educational endeavor: the perceptions of students enrolled in Solid Waste Engineering and Management courses [3]. The course of Solid Waste Engineering and Management plays a foundational role in equipping students with the knowledge and competencies required to navigate the intricate landscape of waste management practices [4].

Beyond theoretical foundations, this course offers students a practical understanding of waste collection, treatment, disposal, and innovative strategies for sustainable waste management [5-6]. However, the effectiveness of any educational program lies not only in its content but also in the way it is perceived and experienced by the learners (Khairuddin, Hassan, et al., 2022) [5]. Assessing student perceptions of the Solid Waste Engineering and Management course is crucial to gauging the overall student experience and identifying areas for improvement [7].

This study aims to explore students' perceptions of the Solid Waste Engineering and Management course, delving into their insights, experiences, and attitudes toward various dimensions of the course. By analyzing these perceptions, the paper seeks to uncover valuable feedback that can inform pedagogical improvements, enhance teaching methods, and enrich the overall learning experience [1 ,8]. Additionally, the research delves into the integration of technological roles within the course, recognizing the evolving role of technology in revolutionizing waste management practices.

In recent years, technological advancements have introduced innovative tools and approaches that hold the potential to reshape waste management strategies. Technologies such as sensor-based monitoring, data analytics, and smart waste collection systems have the capacity to optimize efficiency, reduce environmental impact, and promote sustainable waste management solutions [5, 9-13]. By examining how students perceive and interact with these technological roles within the course, this study contributes to the broader discourse on aligning waste management education with contemporary industry demands [14-17].

Through a comprehensive analysis of students' perceptions and the exploration of technological roles, this paper aims to shed light on the strengths and areas for improvement within Solid Waste Engineering and Management education. By understanding the dynamics between pedagogy, technological integration, and student engagement, this research strives to contribute to the ongoing enhancement of waste management education, equipping future professionals with the expertise and adaptability needed to tackle the formidable waste management challenges of our time.

2. Literature Review

Solid waste management is a critical aspect of environmental sustainability. As urbanization and industrialization continue to accelerate globally, the need for effective waste management strategies becomes increasingly urgent. Education plays a pivotal role in equipping future professionals with the knowledge and skills required to address complex waste management challenges. Solid waste management education is essential for fostering sustainable practices and addressing environmental degradation caused by improper waste disposal. Effective waste management education equips students with the necessary expertise to develop innovative solutions, implement best practices, and mitigate environmental impacts associated with waste generation.

Understanding students' perceptions is crucial for enhancing waste management education programs. Research indicates that students often perceive waste management as a peripheral or niche field within environmental studies. The research in [3] highlights the pivotal role of students in Higher Educational Institutions (HEIs) as agents of societal transformation and contributors to sustainable development, particularly in addressing solid waste management challenges. Focused on a rural-based educational institution, the study investigates the knowledge, attitude, and perception (KAP) of students regarding solid waste management and explores the institution's current practices in this area. Surveying 376 students from nine schools, the findings reveal a low level of knowledge on solid waste management among students but a strong willingness to engage in recycling initiatives. Additionally, the study identifies the need for motivational incentives, particularly economic incentives, to encourage greater participation in recycling projects. Recommendations include enhancing environmental education, implementing participatory environmental programs, and reinforcing sustainability competencies to foster a transition towards a circular economy within the institution.

Research conducted in [8] elucidates the pivotal role of solid waste management in sustainable development and underscores the importance of effective educational strategies in equipping future engineers with necessary knowledge and skills. Through a descriptive analysis involving 51 participants, this study delves into engineering students' preferences for teaching and learning methods within the realm of solid waste management education. The findings unveil a strong inclination towards active learning approaches, emphasizing hands-on activities and real-life case studies, indicative of a preference for practical and experiential learning. Moreover, students exhibit positive attitudes towards the integration of technology and online resources, advocating for engaging and interactive digital tools. The study highlights students' desire for a

student-centered environment by valuing their feedback and suggestions in educational design, alongside a preference for engaging teaching methods that boost motivation. These insights offer educators and institutions valuable guidance for refining instructional strategies, enhancing curriculum design, and fostering engaging and effective learning environments tailored to students' preferences.

Another study in [19] underscores the importance of gathering student feedback to ensure effective teaching and learning in university settings for courses in project risk management. Through a survey and questionnaire administered to 132 students, the study explores students' perceptions of course materials, lecturer professionalism, teaching methods, and learning environment. The analysis reveals positive opinions among students regarding the course content, lecturer professionalism, and infrastructure quality. Importantly, the study identifies a clear connection between infrastructure, teaching effectiveness, lecturer professionalism, and course content quality. These findings offer valuable insights for educators to refine their teaching methods and enhance instructional quality, ultimately improving the educational experience for students.

Solid waste management education emerges as a critical component in addressing environmental sustainability challenges amid rapid urbanization and industrialization. Effective educational strategies play a vital role in equipping future professionals with the knowledge and skills needed to tackle complex waste management issues. Understanding students' perceptions and preferences is key to enhancing waste management education programs, as evidenced by research focusing on students' knowledge, attitudes, and perceptions (KAP) in solid waste management. This study underscores the importance of students' perceptions and technological exploration in solid waste engineering and management education. By addressing these aspects, educational institutions can nurture a new generation of professionals equipped to tackle the complex challenges of waste management in a rapidly evolving global landscape.

3. Methodology

This research employs a quantitative approach, employing a survey research design to delve into the perceptions and level of engagement among students enrolled in the Solid Waste Engineering and Management course. The primary objective is to comprehensively explore the sentiments and interests of students in relation to the course offerings. The study population encompasses students undertaking the Solid Waste Engineering and Management course during the specified March 2023-August 2023 session at a prominent local university in Malaysia. A well-structured questionnaire was employed as the principal data collection instrument for a holistic analysis. The questionnaire is adapted from [18] and [19].

This research paper is comprised of five sections of the questionnaire. Section A: Participant Profile-Collects vital demographic information about the respondents, aiding in contextualizing the findings within specific student cohorts. Section B: Course Perceptions-Focuses on eliciting insights regarding the overall impressions and opinions of the students concerning the Solid Waste Engineering and Management course. It encompasses various aspects, including perceived knowledge enhancement, the relevance of course content to their field of study, the efficacy of assessment methods, and the elevation of confidence levels within the course context. Section C: Lecturer Professionalism–Explores lecturer's behavior, accessibility, communication, and commitment to instruction. It probes into the students' perceptions of various aspects of the lecturer's professionalism within the context of the Solid Waste Engineering and Management course. Section D: Teaching and Learning Activities-Explores the level of engagement and interest exhibited by students towards the teaching and learning activities within the course. It probes into multiple dimensions, encompassing instructional strategies, and the overall efficacy of teaching and learning experiences. The final Section E: The Incorporation of Technological Roles to gauge participants' perceptions in their learning experiences regarding the utilization of technology within the context of the Solid Waste Engineering and Management course.

The total number of students taking the subject is 51 students. However, an aggregate of 50 respondents actively participated in the survey, providing valuable perspectives that contributed to a comprehensive understanding of the student experience in the Solid Waste Engineering and Management Course. Krejcie and Morgan's Sample Size Table [20] is used to determine the appropriate sample size for this study. The table helps to determine the minimum sample size needed to ensure a representative and reliable sample. According to the Krejcie and Morgan Sample Size Table, given the population under consideration, a sample size of 44 individuals would have been sufficient to achieve the desired level of confidence and precision for this study. However, this study has obtained a sample size of 50 individuals. This indicates that this study is able to gather data from a slightly larger sample than the recommended 44 individuals. While exceeding the recommended sample size can be beneficial in providing additional data and potentially increasing the study's robustness, it is important to ensure that the larger sample still represents the population accurately.

The collected data underwent rigorous analysis utilizing IBM SPSS version 28.0 software, employing both descriptive statistical techniques and correlation analysis. Descriptive analysis facilitates the examination of central tendencies, variability, and patterns within the collected data, thereby providing a robust overview of student perceptions and engagement levels. The correlation analysis was employed to examine and quantify the

relationship among the variables. This statistical technique used to determine the strength of students' perceptions towards the key variables in the context of the Solid Waste Engineering and Management course. Using this analysis, the assessment of direction (positive or negative) and strength of the relationship between all variables can be determined.

Through this methodological research approach, this study aims to offer a profound insight into the intricate dynamics that shape student perceptions and engagement within the domain of Solid Waste Engineering and Management education. The outcomes of this study stand to enrich the ongoing discourse on effective pedagogical practices, ultimately enhancing the educational environment for aspiring professionals in waste management. The interpretation of perceptions and levels of interest among the students are presented in Table 1 and Table 2.

Table 1 *Perception interpretation (Bakhary et al., 2023 [18])*

Mean	Interpretation
3.01-4.00	Strongly Agree
2.01-3.00	Agree
1.01-2.00	Disagree
0.01-1.00	Strongly Disagree

Table 2 *Level of interest interpretation (Bakhary et al., 2023 [18])*

Mean	Interpretation
3.01-4.00	High
2.01-3.00	Moderate
0.01-2.00	Low

This study focused on Solid Waste Engineering and Management education; the perception assessment framework was employed to comprehend students' overarching impressions of the course. This assessment is summarized in Table 1, where assessment indicators are classified into five levels ranging from "Strongly Agree" to "Strongly Disagree," signifying the spectrum of agreement. The levels are defined by mean ranges, with "Strongly Agree" corresponding to a mean range between 3.01 and 4.00, and "Strongly Disagree" between 0.01 and 1.00. Additionally, Table 2 presents an evaluation of students' level of interest in the same course, utilizing a three-level classification. The categories, "Low," "Moderate," and "High," are based on mean ranges of 0.01-2.00, 2.01-3.00, and 3.01-4.00 respectively. These classifications provide insights into students" perspectives and engagement, enabling a comprehensive understanding of their experiences in the realm of Solid Waste Engineering and Management education.

4. Results

4.1 Demographic Information

Fig. 1 embodies a comprehensive analysis of the demographic information garnered from the participants. The tabulated data furnishes crucial insights into the distribution of participants across diverse demographic categories, thereby contributing to a nuanced comprehension of the sample's characteristics that underpin the research endeavour.

4.1.1 Age Distribution

Fig. 1(a) meticulously delineates the age distribution of the participants. Notably, a significant portion, accounting for 46% of the sample, comprises individuals aged between 20 and 22 years. In tandem, the remaining 54% represent those aged 23 years and above. This discernible division in age brackets signifies a heterogeneous spectrum, suggesting a multifaceted cross-section of students engaged in the course.

4.1.2 Gender Distribution

Remarkably, in Fig. 1(b) gender parity is achieved within the study, with both male and female participants making up 50% of each of the total sample. This equilibrium in gender representation enhances the study's credibility by affording a balanced perspective across gender lines, a crucial aspect when exploring nuanced subjects such as perceptions of educational experiences.

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4.1.3 Semester Distribution

Noteworthy in Fig. 1(c) is the preponderance of participants, a striking 94%, hailing from the 8th semester. This prevalence underscores the presence of participants at an advanced stage of their academic journey, potentially shaping their perspectives with a culmination of coursework and experience. This aspect of the distribution is complemented by smaller cohorts, 2% from the 7th semester and 4% from the 9th semester, thus providing insight into the diverse temporal phases that students engage with the Solid Waste Engineering and Management Course.

4.1.4 Previous Institution Distribution

Of particular significance, Fig. 1(d) shows that 48% of participants have a background in diplomas from UiTM, whereas 28% emanate from foundation programs. Furthermore, 22% hail from matriculation programs, adding to the mosaic of diverse pathways that converge in the context of this course. A minor of 2% but a noteworthy proportion has diplomas from other institutions. This eclectic mix of educational antecedents contributes to the rich diversity of perspectives and experiences within the study which has also been found in another study [21].

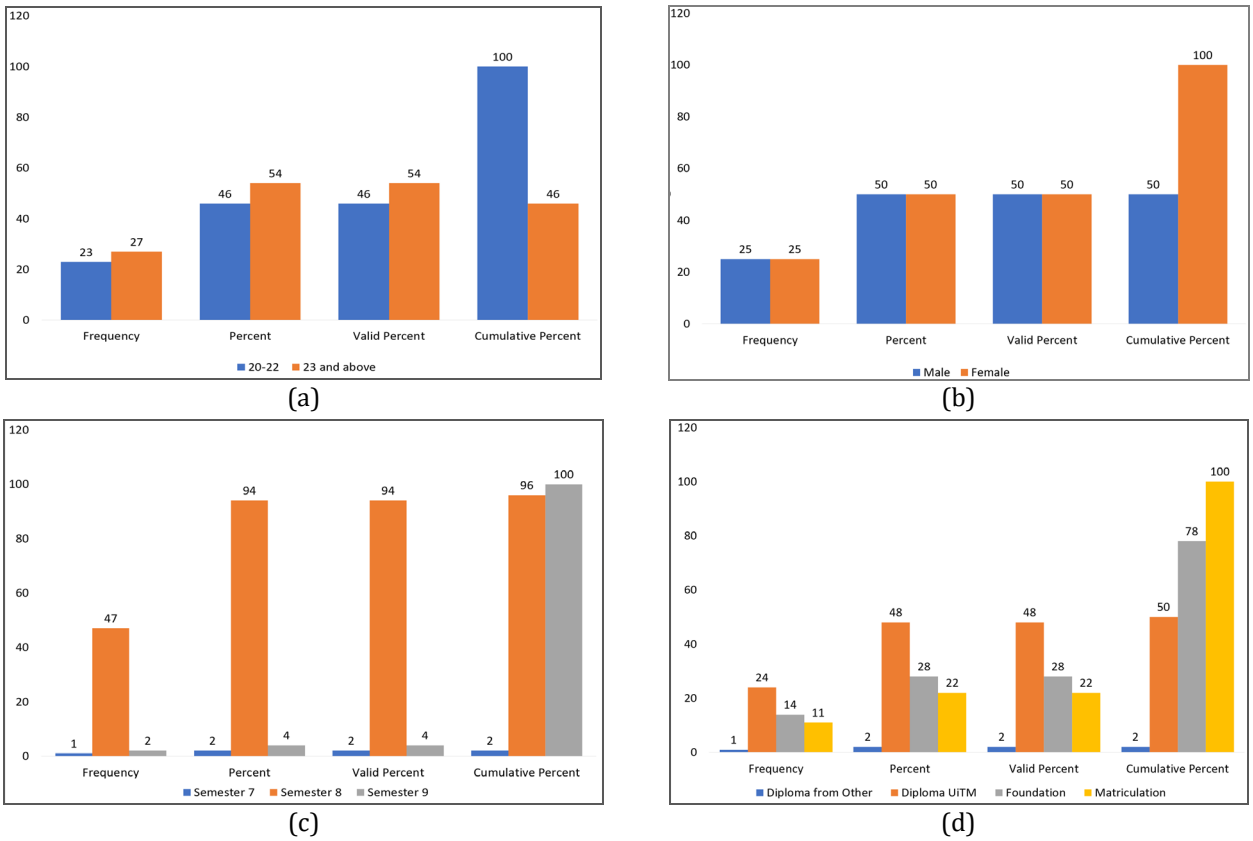

Fig. 1 *Frequency analysis of the demographic information for (a) Age; (b) Gender; (c) Semester; (d) Previous Institutions*

4.2 Student Impression on Subject

The provided descriptive statistics in Table 3 offer a comprehensive overview of students' impressions regarding various aspects of the subject. This section of the research focuses on four key statements, each contributing to a deeper understanding of the student's experiences within the Solid Waste Engineering and Management course.

The first statement, "I have increased my knowledge by taking the course," garnered responses from all 50 participants. The scores range from a minimum of 3 to a maximum of 4, indicating a relatively narrow distribution of responses. The mean score of 3.80 suggests that, on average, students perceive a notable increase in their knowledge as a result of participating in the course. The low standard deviation of 0.404 indicates a relatively consistent agreement among participants on this particular aspect.

The second statement, "The course content is related to my field of study," also received responses from the entire sample. The range of scores extends from 2 to 4, with a mean score of 3.76. This mean value reflects a general consensus that the course content has relevance to students' field of study. The standard deviation of .476 indicates a reasonable level of agreement among participants, with minor variations in their perceptions.

Similarly, the third statement, “My confidence level in this course has increased," and the fourth statement, "The method of assessments in this course has enhanced my learning ability,” both gathered responses from the complete sample of 50 participants. These statements yielded mean scores of 3.72, and the data demonstrate a range of scores from 2 to 4 for both statements. The relatively low standard deviations of .497 indicate consistent perceptions among students about the increase in confidence and the effectiveness of assessment methods.

The “Valid N (listwise)” row indicates that all 50 responses were considered valid for this analysis. Overall, the descriptive statistics highlight a generally positive perception among students regarding the course’s impact on knowledge enhancement, content relevance, increased confidence, and the effectiveness of assessment methods. The analysis underscores the importance of these factors in shaping students' experiences within the Solid Waste Engineering and Management course. The impression of the students towards the subject is mainly shaped by the experiences of the student during the lecture as mentioned previously by other studies [22, 23].

Table 3 *Student impression on subject*

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
I have increased my knowledge by taking the course.	50	3	4	3.80	.404
The course content is related to my field of study.	50	2	4	3.76	.476
My confidence level in this course has increased.	50	2	4	3.72	.497
The method of assessments in this course has enhanced my learning ability.	50	2	4	3.72	.497
Valid N (listwise)	50				

4.3 Lecturer Professionalism

The “Lecturer Professionalism” section of the research investigates students' perceptions of various aspects of the lecturer's professionalism within the context of the Solid Waste Engineering and Management course. This section comprises six statements that shed light on the lecturer's behavior, accessibility, communication, and commitment to instruction.

In Table 4, the first statement, “The lecturer monitors student attendance,” is supported by responses from all 50 participants. The responses vary from a minimum score of 2 to a maximum of 4, with a mean score of 3.72. This mean value suggests that, on average, students view the lecturer's efforts to monitor attendance positively. The relatively low standard deviation of .497 indicates a relatively consistent agreement among participants on this matter.

Similarly, the second statement, “The lecturer is ever ready to provide academic guidance to students,” also received responses from the entire sample. The range of scores spans from 2 to 4, with a mean score of 3.72. This mean value reflects a general consensus among students that the lecturer is approachable and responsive when it comes to academic guidance. The standard deviation of .497 indicates a reasonable level of agreement among participants, with minor variations in their perceptions.

The next three statements, “The lecturer completes the scheduled hours of instruction,” “The lecturer is accessible for discussion,” and “The lecturer is approachable,” garnered responses from all 50 participants as well. These statements achieved mean scores of 3.72 and 3.64, respectively. The data display a range of scores from 2 to 4 for each of these statements. The standard deviations of .454 and .631 suggest that while there is a degree of consistency in students’ perceptions, there are also varying viewpoints about the extent to which the lecturer fulfills these professionalism aspects.

Lastly, the statement “The lecturer uses English as a medium of instruction during the lectures except for CITU and Third Language courses” gathered responses from the entire sample, resulting in a mean score of 3.64. The range of scores extends from 3 to 4, and the standard deviation of .485 indicates a moderate level of agreement among students about the lecturer's language of instruction. The descriptive statistics provide insights into students’ positive perceptions of lecturer professionalism, encompassing aspects such as attendance monitoring, academic guidance, adherence to scheduled hours, accessibility, approachability, and language use [24]. These findings contribute to a deeper understanding of the lecturer's role in fostering a conducive learning environment within the Solid Waste Engineering and Management course that has previously been discussed by other studies [25-26].

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Table 4 *Lecturer professionalism*

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
The lecturer monitors student attendance.	50	2	4	3.72	.497
The lecturer is ever ready to provide academic guidance to students.	50	2	4	3.72	.497
The lecturer completes the scheduled hours of instruction.	50	3	4	3.72	.454
The lecturer is accessible for discussion.	50	1	4	3.64	.631
The lecturer is approachable.	50	1	4	3.64	.631
The lecturer uses English as a medium of instruction during the lectures except for CITU and Third Language courses.	50	3	4	3.64	.485
Valid N (listwise)	50				

4.4 Teaching and Learning Activities

In Table 5, the participants reported that the lecturer consistently creates an environment conducive for students to ask questions and share their opinions, with a mean rating of 3.76 and a relatively low standard deviation of .431. Additionally, the lecturer's active involvement in the learning process received positive feedback, as indicated by a mean rating of 3.74 and a standard deviation of .487.

Furthermore, participants perceived that the lecturer effectively explained both the outcomes of the course and the course content, with mean ratings of 3.74 each and standard deviations of .487. The alignment between teaching and planned content was also acknowledged, with a mean rating of 3.70 and a standard deviation of .505.

The lecturer's clarity in explaining the methods of assessment for the course garnered a mean rating of 3.70, accompanied by a slightly higher standard deviation of .544. Participants appreciated the lecturer's assistance in helping them master the learning content, as demonstrated by a mean rating of 3.68 and a standard deviation of .513.

Furthermore, the lecturer's provision of feedback for assessments and assignments received positive feedback, with a mean rating of 3.68 and a standard deviation of .513. The delivery of content in an interesting manner was also acknowledged, as indicated by a mean rating of 3.66 and a standard deviation of .519.

Lastly, participants noted that the lecturer's delivery style often challenges their cognitive engagement, with a mean rating of 3.64 and a standard deviation of .485. The results showcase the participants' overall positive perceptions of the teaching and learning activities in the course. The good feedback and perceptions by students in a course with a lot of teaching and learning activities also have been previously discussed in other studies [27-28].

Table 5 *Teaching and learning activities*

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
The lecturer creates an environment for students to ask questions and offer opinions.	50	3	4	3.76	.431
The lecturer actively involves students in the learning process.	50	2	4	3.74	.487
The lecturer explains the outcomes of the course.	50	2	4	3.74	.487
The lecturer explains the course content.	50	2	4	3.74	.487
The lecturer teaches according to plan.	50	2	4	3.70	.505
The lecturer explains the methods of assessment for the course.	50	2	4	3.70	.544

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
The lecturer helps students master the learning content.	50	2	4	3.68	.513
The lecturer provides feedback for each assessment/assignment/test/project.	50	2	4	3.68	.513
The lecturer delivers the content interestingly.	50	2	4	3.66	.519
The lecturer's delivery style challenges the mind.	50	3	4	3.64	.485
Valid N (listwise)	50				

4.5 Technology Roles

Table 6 shows the "Technology Roles" section of the survey aimed to gauge participants' perceptions regarding the utilization of technology in their learning experiences within the context of the Solid Waste Engineering and Management course. The collected data, based on responses from a total of 50 participants, has been presented in the form of descriptive statistics to provide insights into various aspects of technology integration. Each statement was rated on a scale from 2 to 4, encompassing a range of perceptions from agreement to higher agreement.

The analysis of the data reveals interesting insights. Participants expressed a notably high mean score of 3.90 for the statement "Multimedia presentations (videos, interactive content) make learning more engaging." This underscores the positive impact of multimedia tools in enhancing engagement and comprehension among learners. Similarly, the statement "Technology should be used more frequently in the classroom" received a mean score of 3.88, reflecting participants' inclination toward greater technology integration in the instructional environment.

In terms of online resources, participants indicated a mean score of 3.66 for the statement "Online learning resources enhance my learning experience." This suggests that participants recognize the added value of digital resources in enriching their educational journey. Additionally, the statement "Online learning platforms enhance my learning experience" garnered a mean score of 3.60, further affirming the perceived effectiveness of online platforms in supporting the learning process.

The minimum and maximum scores observed across the statements indicate a relatively consistent level of agreement among participants. The standard deviation values, ranging from .328 to .670, reflect the dispersion of participants' responses around the mean, suggesting varying degrees of consensus in their perceptions.

Overall, the descriptive statistics for the "Technology Roles" section provide valuable insights into participants' views on technology's role in enhancing engagement, classroom experiences, and the use of online resources within the context of the Solid Waste Engineering and Management course. These findings contribute to a deeper understanding of how technology can positively influence the learning journey in this specific academic domain.

Table 6 *Technology roles*

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Multimedia presentations (videos, interactive content) make learning more engaging.	50	2	4	3.90	.364
Technology should be used more frequently in the classroom.	50	3	4	3.88	.328
Online learning resources enhance my learning experience.	50	2	4	3.66	.593
Online learning platforms enhance my learning experience.	50	2	4	3.60	.670
Valid N (listwise)	50				

Table 7 presents the correlation coefficients among key variables in the context of the Solid Waste Engineering and Management course. The variables under consideration include "TECH_SUM" (Technology Sum), "PROF_SUM" (Professionalism Sum), "TL_SUM" (Teaching and Learning Sum), and "IMPRES_SUM"

(Impression Sum). Correlation analysis is performed to examine the relationships and associations between these variables.

Starting with the "TECH_SUM" variable, it is observed that the correlation coefficient with "PROF_SUM" is .093, which is not statistically significant (p=.521). Similarly, the correlation coefficients with "TL_SUM" and "IMPRES_SUM" are .090 (p=.535) and .055 (p=.705), respectively. These findings suggest weak and non-significant relationships between students' perceptions of technology-related aspects and their perceptions of overall professionalism, teaching and learning effectiveness, and the course's overall impression.

Moving on to the "PROF_SUM" variable, it is notable that a highly significant positive correlation of .990** (p<.001) is observed with "TL_SUM." This indicates a strong association between students' perceptions of the lecturer's professionalism and their perceptions of effective teaching and learning activities. Similarly, a significant positive correlation of .949** (p<.001) is found between "PROF_SUM" and "IMPRES_SUM," implying that a positive perception of the lecturer's professionalism is linked to a favorable overall impression of the course.

For the "TL_SUM" variable, a substantial positive correlation of .967** (p<.001) is noted with "IMPRES_SUM." This indicates that positive perceptions of teaching and learning activities are strongly associated with a positive overall impression of the course.

In conclusion, the correlation analysis reveals nuanced relationships among the variables. While perceptions of technology-related aspects show limited associations with other variables, students' perceptions of the lecturer's professionalism are significantly linked to perceptions of effective teaching and learning activities as well as overall course impression. Additionally, positive perceptions of teaching and learning activities are strongly related to a positive overall impression of the course. These findings underscore the interconnectedness of various aspects in shaping students' experiences and perceptions in the context of the Solid Waste Engineering and Management course.

Table 7 *Correlations*

Correlations					
		TECH_SUM	**PROF_SUM**	**TL_SUM**	**IMPRES_SUM**
TECH_SUM	Pearson Correlation	1	.093	.090	.055
	Sig. (2-tailed)		.521	.535	.705
	N	50	50	50	50
PROF_SUM	Pearson Correlation	.093	1	.990**	.949**
	Sig. (2-tailed)	.521		<.001	<.001
	N	50	50	50	50
TL_SUM	Pearson Correlation	.090	.990**	1	.967**
	Sig. (2-tailed)	.535	<.001		<.001
	N	50	50	50	50
IMPRES_SUM	Pearson Correlation	.055	.949**	.967**	1
	Sig. (2-tailed)	.705	<.001	<.001	
	N	50	50	50	50

**Correlation is significant at the 0.01 level (2-tailed)

5. Discussion

The presented study's findings are discussed comprehensively based on the results derived from various sections of the research. The demographics of the participants are meticulously analyzed in Fig. 1 above, revealing distinctive characteristics of the sample. Age distribution highlights a diverse range, with 46% aged between 20 and 22 years, and 54% aged 23 and above. Gender distribution showcases a balanced representation of both male and female participants, each comprising 50% of the sample. Semester distribution underscores the prevalence of participants from the 8th semester (94%), indicating an advanced academic stage. The distribution of participants from varied previous educational institutions further contributes to the study's heterogeneity. These demographics collectively lay the foundation for understanding the diverse perspectives shaping the study's outcomes [7].

Moving to student impressions in Table 3, participants' views on the subject are discussed based on four key statements. The analysis reveals a positive perception of the course's impact on knowledge enhancement, content relevance, increased confidence, and assessment effectiveness. The mean scores and low standard deviations indicate consistent agreement among students, underscoring the course's effectiveness in addressing these aspects. These findings align with previous research that has shown the positive effects of environmental courses on students' conceptual knowledge about solid waste pollution and management [4].

Lecturer professionalism, explored in Table 4, delves into six statements assessing various dimensions of the lecturer's behavior and interaction. Participants' feedback signifies the lecturer's commitment to professionalism, evident in attendance monitoring, accessibility, guidance, and language of instruction [29]. Mean scores and standard deviations offer insights into the variations and consensus in students' perceptions of these attributes [30].

The teaching and learning activities, as highlighted in Table 5, depict participants' views on various dimensions of the lecturer's instructional methods. These insights underscore the positive impact of the lecturer's strategies in creating an engaging and effective learning environment [31-32] In particular, participants expressed satisfaction with the lecturer's ability to stimulate critical thinking, create interactive learning experiences, provide clear explanations, and incorporate real-life examples to enhance understanding. Additionally, the participants acknowledged the lecturer's efforts in promoting student participation and encouraging collaboration among peers [31, 33].

Technology's role is discussed based on participants' perceptions, as presented in Table 6. The analysis reveals a strong acknowledgment of technology's impact on learning engagement, with multimedia presentations receiving the highest mean score [31, 34]. Participants also express a preference for greater technology integration and recognize the value of online resources and platforms in enhancing their learning experiences [7-8].

The correlation analysis in Table 7 examines relationships between key variables. Notably, while technology-related perceptions show limited associations, students' positive views of lecturer professionalism significantly correlate with effective teaching and learning activities and a favorable course impression [29, 32, 35]. Positive perceptions of teaching and learning activities strongly relate to a positive overall course impression.

6. Conclusion

In conclusion, this study embarked on a comprehensive exploration of students' perceptions within the framework of the Solid Waste Engineering and Management course. The analysis of demographic information unveiled a diverse sample, comprising individuals across various age groups, gender representations, academic semesters, and educational backgrounds. This diversity underscores the course's ability to attract a wide array of students, enriching the study's validity and depth. The study delved into students' impressions of the course, revealing positive perceptions across multiple dimensions. Participants acknowledged a significant increase in knowledge, highlighting the course's effectiveness in imparting valuable insights. Moreover, the relevance of course content to their field of study was strongly recognized, fostering a sense of purpose and practical applicability. The course's impact on confidence enhancement and assessment effectiveness was also favorably perceived, reflecting its ability to bolster students' self-assurance and learning outcomes.

The exploration of lecturer professionalism unraveled the commendable efforts of instructors in fostering an environment conducive to learning. Students affirmed the lecturer's commitment to professionalism, as evidenced by their attentiveness to attendance, approachability for academic guidance, and consistent adherence to scheduled hours. The lecturer's proficiency in using English as the medium of instruction further contributed to a positive learning environment.

Teaching and learning activities emerged as a critical cornerstone of the course's success. Students lauded the lecturer's prowess in explaining course outcomes and content, actively engaging them in the learning process, and aligning teaching strategies with planned content. The provision of timely feedback and assistance in mastering learning content further reinforced the course's efficacy in nurturing students' comprehension and skill development. The lecturer's delivery style, characterized by its challenge to cognitive engagement, underscored the course's capacity to stimulate critical thinking.

Technology's role in the learning process was examined, revealing a strong appreciation for multimedia presentations and a desire for increased technology integration. Participants valued the use of technology as a means to enhance engagement and leverage online resources and platforms for enriched learning experiences.

Correlation analysis elucidated the interconnectedness of various aspects. While technology-related perceptions displayed limited associations, lecturer professionalism demonstrated a strong linkage to effective teaching and learning activities, culminating in a favorable course impression. Positive perceptions of teaching and learning activities were also strongly linked to an overall positive course impression.

In essence, this study casts a comprehensive spotlight on students' perceptions in the context of the Solid Waste Engineering and Management course. The positive feedback across demographics, impressions, lecturer professionalism, teaching and learning activities, and technology underscores the course's efficacy in fostering an enriching and effective learning experience. These insights hold significance for educators, institutions, and policymakers seeking to enhance educational approaches and adapt to students' evolving needs in the realm of waste management education.

Acknowledgement

The authors would like to thank the School of Civil Engineering and School of Electrical Engineering, College of Engineering, Universiti Teknologi MARA, Shah Alam, for providing support for this study.

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Dzulaikha Khairuddin, Musmuliadi Kamaruding,;* ***data collection:*** *Dzulaikha Khairuddin, Nik Hakimi Nik Ali;* ***analysis and interpretation of results:*** *Dzulaikha Khairuddin, Nik Hakimi Nik Ali, Musmuliadi Kamaruding, Norfarah Nadia Ismail;* ***draft manuscript preparation:*** *Dzulaikha Khairuddin, Musmuliadi Kamaruding, Nik Hakimi Nik Ali. All authors reviewed the results and approved the final version of the manuscript.*

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