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Enhancing Construction Safety Education: Insights from Student Perspectives

Yasir Alhammadi [1,*], Abdelrahman M. Farouk [2] and Rahimi A. Rahman [2,*]

1 Department of Civil Engineering, College of Engineering, Prince Sattam Bin Abdulaziz University, Alkharj 11942, Saudi Arabia
2 Faculty of Civil Engineering Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, Kuantan 26300, Malaysia; abdelrahman.mfarouk@gmail.com
* Correspondence: y.alhammadi@psau.edu.sa (Y.A.); arahimirahman@umpsa.edu.my (R.A.R.)

Abstract: Construction safety education is crucial as it ensures worker well-being, improves construction quality, and contributes to sustainable infrastructure development and safeguarding lives. This study aims to examine students' perceptions of construction safety education. A structured questionnaire survey aligned with the National Examination Board in Occupational Safety and Health (NEBOSH) safety topics was used to collect data from students on their understanding of construction safety topics (CSTs). Data were gathered from 161 students and analyzed using Cronbach's alpha, mean calculations, standard deviation measurements, normalization value, Kruskal–Wallis tests, and correlation analysis. The findings reveal a strong awareness and interest in fire safety, with variations across engineering faculties, academic years, and specific topics, suggesting the need for tailored educational strategies to improve construction safety knowledge and align education with industry needs. This study represents the first investigation into students' comprehension of CSTs in Saudi Arabia. The study insights can guide decisionmakers in refining existing curriculums, ensuring students develop a strong understanding of safety protocols in construction projects. By aligning education with industry requirements, policymakers can enhance the preparedness of graduates, promoting safer practices in engineering. This contributes to the overall economic and safety progress of nations.

Keywords: construction safety; construction safety education; questionnaire survey; Saudi Arabia

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1. Introduction

Construction safety stands as a cornerstone in ensuring the efficacy and prosperity of the construction industry. It encompasses a spectrum of practices and protocols meticulously designed to avert accidents and mitigate potential hazards [1,2]. Within this framework, construction managers, assuming pivotal roles, interface with diverse stakeholders and field personnel, accentuating the imperative for specialized education and training [3–6]. The amalgamation of preeminent industry practices into construction curricula presents an auspicious avenue for cultivating graduates poised to seamlessly integrate into the workforce, aligning with industry expectations from inception [7]. Furthermore, safety education assumes a critical mantle in endowing individuals with the discernment and proactive acumen requisite for hazard recognition and management. Due to the importance of safety education, regulatory entities, such as the Occupational Safety and Health Administration (OSHA), proffer indispensable directives and endorse training programs, albeit with discernible room for refinement [8]. The sustained symbiosis between academia and industry, conjoined with perpetual scrutiny and adaptation of safety curricula, constitutes an indispensable mandate in fostering a culture of safety within the construction milieu. The prioritization of construction safety safeguards the well-being of laborers, concurrently amplifying the overall efficiency of projects [1].

Ensuring safety on construction sites is paramount for the well-being of workers. In the dynamic environment of construction sites, workers must comprehend the hazards they face. Due to the transient nature of the workforce, not all workers may be equally familiar with the tasks at hand or the associated risks. This underscores the crucial role of contractors and safety professionals in equipping workers with the necessary skills and knowledge to execute their tasks safely [9–11]. They must ensure that everyone is well-versed in common construction hazards, including the "focus four" identified by OSHA. First is the hazard of falls, encompassing such incidents as falls from elevated surfaces, like ladders, scaffolds, or roofs. The second, struck-by, involves the risk of workers being struck by moving equipment, vehicles, or falling objects, including tools and materials. The third hazard is caught-in or between, which refers to workers getting caught in or compressed between objects or machinery. Finally, electrocutions constitute the fourth major hazard arising from exposure to live electrical wires or equipment [8]. Furthermore, safety education serves as an effective means to enhance safety consciousness, allowing future engineers to master safety theory, regulations, and technological standards. Recognizing and proactively addressing these challenges is paramount for creating a safe, supportive, and healthy work environment in the construction industry. Although mitigating on-site hazards is a priority, the construction industry also grapples with other pressing concerns. Prior research reveals alarming rates of mental health issues within the sector, with construction and excavation industries showing the highest suicide rate among males. Substance abuse is another critical issue, affecting nearly 15 percent of construction workers [12]. Moreover, the rate of construction accidents due to a lack of knowledge is increasing. The overall construction safety regulations and rules are being ignored in many situations in many cases [13].

Recognizing and addressing these challenges is essential for fostering a safe and healthy work environment in the construction industry. To address the challenges identified in construction safety education, it is imperative to equip students with comprehensive knowledge in the field of construction safety [14–16]. Understanding the significance of safety education is the first step toward creating a safer work environment in the construction industry. Safety education serves as a foundational means to enhance safety consciousness, enabling individuals to master safety theory, regulations, and technological standards [17,18]. Due to the transient nature of the construction workforce, ensuring that all students are well-versed in the required safety knowledge can be a challenge [19,20]. To tackle the issues surrounding construction safety education, a comprehensive approach is necessary. This involves conducting a systematic evaluation of students' understanding of construction safety topics (CSTs). By identifying the specific areas where students lack sufficient knowledge, educators and institutions can tailor their safety education programs to address these deficiencies effectively [21]. This proactive approach contributes not only to enhancing safety consciousness but also to long-term improvements in the construction industry's safety standards [9,22].

This study aims to examine students' perceptions of construction safety education. To achieve this study aim, this paper uses a structured questionnaire survey. The survey was developed and distributed to students. The insights gained from the survey will help educational institutions recognize the gaps in students' construction safety knowledge. These gaps can then be addressed through curriculum enhancements, targeted training programs, and focused educational resources. Ultimately, this approach seeks to empower students with the necessary construction safety competencies, thus contributing to the resolution of challenges in projects. By creating a foundation of well-informed, safety-conscious professionals, the construction industry can work toward a safer and healthier future for its workforce. The paper is organized as follows: it starts with the study background, giving a broad look at previous research in construction safety education. Then, the methodology explains how we gathered and analyzed the data. After that, the results and discussion sections share the findings and discussion of the findings. The implications section provides practical insights for applying the study in the academic field, followed by the limitations, which highlight the main challenges for future research. Lastly, the conclusion summarizes the paper at the end.

2. Study Background

Prince Sattam Bin Abdulaziz University is dedicated to enhancing safety education within the construction industry across all its faculties. This commitment involves the continuous improvement of the curriculum and the introduction of a core subject in construction safety across all academic departments. Construction safety is comprehensively addressed across all faculties through a variety of specialized subjects. For instance, within the Mechanical Faculty, courses such as "Manufacturing Process 1" include coverage of the "Industrial Safety" topic, while "Modern Welding Process and Quality Control" focuses on aspects of "Health and Safety". Similarly, in the Civil Engineering Faculty, the curriculum of the "Highway and Traffic Engineering" course encompasses "Safety Studies", and "Construction Equipment and Methods" addresses the implementation of a "Safety Program". These curriculum details have been recently updated by each faculty to ensure alignment with contemporary industry standards and practices. In terms of practical training, internships have been made obligatory for graduation, requiring all students across departments to undergo field training in either government agencies or the private sector. Field training includes positions with electricity companies, municipal bodies, and construction contractors, providing students with invaluable hands-on experience in construction safety practices.

Safety education constitutes the core of all engineering faculties. Every engineering student should have knowledge about construction safety. Kartam's research, conducted in Kuwait, elegantly introduced the nuanced world of safety education within this industry. The paper elaborated on the distinct characteristics and categories of safety education, highlighting its pivotal role in building construction. It emphatically emphasized that within the intricate choreography of construction processes, fostering a steadfast commitment to safety production was imperative. The fundamental principle elucidated underscored the necessity to strengthen the safety education of workers, serving as a safeguard against the looming threat of substantial accidents. [23]. Li's research encapsulated an innovative approach to revolutionizing health and safety conditions on construction sites. Through inventive educational programs, Li advocated for a paradigm shift in teaching methods. The paper introduced two multimedia initiatives tailored for distinct segments of the industry. One, catering to designers and aspiring designers, championed the concept of "Prevention through Design (PtD)". The second program for professionals of construction projects immersed them in unconventional teaching techniques. Li's research culminated with a spotlight on the efficacy of safety education for Civil Engineering students, reinforcing the pivotal role of education in fostering safety awareness [24].

Pedro's research introduced a novel context-based safety assessment (CBSA) approach, heralding a potential transformation in safety assessment within tertiary construction education. This pioneering endeavor bridged the gap between theoretical knowledge and practical skills crucial in the construction industry. By offering tasks that mirrored real-world safety scenarios, Pedro's CBSA approach accentuated the relevance and authenticity of safety assessment. This research marked a significant stride towards instilling a culture of safety in tertiary construction education, recognizing the industry's pressing need for heightened safety standards [7]. John's research opened the door to an engaging realm of game-based learning in built environment education. With a keen eye on sustainable construction practices, the research introduced a card game that wove in environmental impact criteria. This interactive educational tool transcended the confines of traditional teaching methods, offering students a dynamic learning experience. John's findings resonated with the idea that active learning methods, like the card game, held the promise of nurturing lifelong learners proficient in critical thinking and problem solving. There is a need for further empirical research to establish a concrete link between this engaging method and knowledge retention [25].

As highlighted in this section, the prior research underscore the pivotal significance of safety education within the construction sector and introduce pragmatic teaching methodologies. Given the swiftly evolving nature and inherent risks associated with this field, this emphasis on education assumes heightened importance. Notably, these inquiries shed light on a critical research gap: a dearth of comprehensive assessments concerning students' understanding of CSTs. To fill this gap, this study aims to examine students' perceptions of construction safety.

3. Methodology

3.1. Survey Development

The study used a structured questionnaire survey to gather comprehensive information from students at Prince Sattam bin Abdulaziz University in Al-Kharj, Saudi Arabia. This method is suitable for gathering information from large numbers of respondents in a short time. Similar research has used the same method [26–30]. The development of the survey was grounded in the context of construction health and safety, emphasizing the importance of the National Certificate in Construction Health and Safety from NEBOSH [31]. These certifications are instrumental in elevating the competence of safety and environmental professionals, as well as individuals at different echelons within the workplace [32]. NEBOSH's commitment to setting industry-standard safety topics has been unwavering throughout its years of operation, demonstrating exceptional reliability in the field of health, safety, and environmental management. This dedication has earned NEBOSH high regard from governments, employers, and valued learners. Annually, tens of thousands of individuals from more than one hundred and seventy countries seek NEBOSH qualifications. They benefit from the extensive network of over 450 learning partners situated across the globe [33]. The survey assessed students' awareness, interest, perceived importance, and personal experiences related to safety education topics. The survey consisted of five sections. The initial section focused on collecting essential demographic details about participating students. The second section evaluated the level of awareness among students regarding safety education topics. The third section assessed students' interest towards safety education topics. The fourth section assessed the perceived importance that students attributed to safety education topics. The fifth section allowed students to share personal experiences and insights related to construction safety education. The survey employed two types of questions: (1) multiple-choice questions, used in the first and fifth sections, and (2) Likert scale questions (1 to 5), used in the second, third, and fourth sections. The survey, provided in Appendix A, was distributed in hard copies on the university campus, and face-to-face data collection was employed to ensure a comprehensive understanding of student perspectives. The subsequent subsection details the data collection process.

3.2. Data Collection

In this study, the population of the university is 452, distributed as follows: civil (108), electrical (117), mechanical (111), and industrial (116). A sample size of 100 students, with a 5% margin of error, was considered appropriate for further data analysis [30,34]. The survey was distributed and collected face-to-face in hard copy, with a total of 240 students selected as the target audience for the survey. Then, the survey results were kept in Microsoft Excel for data analysis. The response rate was approximately 67%, resulting in 161 valid responses. This response rate not only met the criteria for statistical reliability but also provided a substantial dataset for in-depth analysis and meaningful conclusions.

3.2.1. Faculty Distribution

As shown in Table 1, the survey results depict a relatively balanced distribution of students across different faculties. Among the respondents, the majority belonged to the Civil Engineering faculty, comprising 26% of the total sample. Mechanical Engineering closely followed with 25%, and Electrical and Industrial Engineering faculties each accounted for 25% and 24%, respectively. This distribution suggests a representative sample that adequately encompasses the diverse academic disciplines within the institution, facilitating a comprehensive analysis of perspectives. This distribution reflects a well-rounded representation of faculties, ensuring that insights garnered from the survey encompass a broad spectrum of disciplines. This diversity is essential in yielding results that are applicable and also representative of each faculty [35].

Table 1. Respondent profile.

Faculty	Number	Percentage
Civil	41	25.5%
Mechanical	41	25.5%
Electrical	40	25%
Industrial	39	24%
Total	161	100%
Academic Year	Number	Percentage
Fifth	54	33%
Third	52	32%
Fourth	40	25%
Second	15	9%
Total	161	100%
Source of information (multiple choice)	Number	Percentage
Internet	67	21%
Social media	64	20%
Lectures	58	18%
Friends	41	13%
News	30	10%
Documents	24	8%
Journal papers	17	5%
Conferences	14	4%

3.2.2. Academic Year Distribution

The distribution of respondents across academic years provides valuable insight into the varying levels of experience and exposure among the participants. Notably, the majority of respondents were in their fifth year, comprising 33% of the total sample. Third-year students closely followed, constituting 32%, and fourth-year students made up 25% of the respondents. Second-year students represented 9% of the sample. Notably, there are no students from the first year, as this year serves as a preparatory phase. Selecting participants from the first year would not be conducive to evaluating their comprehension of construction safety, as their exposure and knowledge in this domain remain incipient and limited at this stage [36]. This distribution allows for a nuanced analysis, considering the differing perspectives and levels of familiarity with the subject matter based on academic progression. Distribution across academic years is crucial for understanding how experience and exposure influence responses. It enables a deeper examination of how perspectives may evolve as the students progress through their respective programs. For instance, fifth-year students, being more advanced in their education, might offer insights based on a broader knowledge base and potentially more specialized understanding. Second-year students, still in the early stages of their academic journey, might provide fresher, less influenced perspectives. This diversity in academic progression enriches the dataset, resulting in a more nuanced and comprehensive analysis.

3.2.3. Sources of Information

The sources of information reveal how students prefer to learn. Notably, 21% rely on the Internet, making it the most popular choice. Social media closely follows at 20%, and lectures and friends contribute significantly at 18% and 13%, respectively. This variety of sources highlights the different ways students gather information. It shows that students use a mix of traditional and digital methods. Recognizing the importance of the Internet [37] and social media [38,39] is crucial for reaching students effectively in today's technology-driven world. Lectures and friends remain influential, emphasizing the value of face-to-face interactions and formal education. Balancing these channels acknowledges diverse learning styles and maximizes the impact of shared information.

3.3. Data Analysis

The collected data underwent analysis using the Statistical Package for the Social Sciences (SPSS) Statistics 26, a commonly used software for quantitative data analysis. The subsequent subsections detail the data analysis approaches used to analyze the collected data [40].

3.3.1. Reliability Analysis

Cronbach's alpha was employed to assess the internal consistency reliability of the survey instrument, ensuring that the items measured the same underlying construct. The first step before conducting any further analysis is to check the survey's reliability. Cronbach alpha values were checked across different faculties and academic years. Utilizing Cronbach's alpha method, a comprehensive examination was executed for the Mechanical, Civil, Industrial, and Electrical faculties, encompassing students from the Second to the Fifth year. Cronbach's alpha's average value was 0.885, signifying commendable reliability, consistently observed across different categories of the survey [39]. The detailed reliability test results for academic years and faculty are outlined in Table 2.

Table 2. Results for Cronbach's alpha.

Cronbach's Alpha	Faculty				Academic Year			
	Mechanical	Civil	Industrial	Electrical	Second	Third	Fourth	Fifth
Awareness	0.862	0.868	0.865	0.887	0.930	0.918	0.922	0.947
Interset	0.862	0.797	0.869	0.934	0.878	0.861	0.878	0.883
Importance	0.867	0.874	0.867	0.878	0.873	0.861	0.915	0.896

3.3.2. Normalized Mean Analysis

Mean calculations, standard deviation measurements, and normalization values (NV) were employed to derive valuable insights [41,42]. The normalized value (NV) was also used to identify critical variables across different faculties and years. In this analysis, NVs greater than 0.50 indicate critical variables [43]. Numerous scholars employ this technique to identify critical variables within the construction management area [44,45]. The NV can be calculated through the following equation:

$$\text{Normalized value (NV)} = \frac{\text{Mean} - \text{Minimum mean value}}{\text{Maximum mean value} - \text{Minimum mean value}}$$

3.3.3. Agreement Analysis

After conducting the normalized mean analysis, disagreements may arise among students within different academic years or faculties. To investigate these discrepancies, the Kruskal–Wallis test was used to identify any significant differences in perceptions among students across various sections, including awareness, interest, and the importance of construction safety education topics [30]. The Kruskal–Wallis test allows for comparison between groups with either equal or different sample sizes, determining whether notable differences exist in their viewpoints. Statistical significance is established at a confidence level of 95% when the p-value is less than or equal to 0.05. Conversely, if the p-value exceeds 0.05, it indicates that the tested groups share similar perspectives [46].

3.3.4. Correlation Analysis

In this study, Spearman's correlation was used to calculate the correlation coefficients between the understanding of CSTs. This method assesses the strength and direction of the association between two variables commonly used in research [26]. The strength of these coefficients was interpreted as follows: 0.00 to 0.29 indicated little or no correlation;

0.30 to 0.49 signified low correlation; 0.50 to 0.69 represented moderate correlation; 0.70 to 0.89 suggested high correlation; 0.90 to 1.00 indicated a very high correlation [47].

4. Results and Discussion

4.1. Results According to Academic Year

4.1.1. Student Awareness

Table 3 presents the average awareness scores of students regarding different CSTs according to the academic year. The awareness scores range from a minimum of 2.3 for CST14 (steel erection) to a maximum of 3.3 for CST1 (fire). In examining the students' awareness of CSTs, mainly focusing on CST1 (fire), CST2 (Slips, trips, and falls), CST3 (electricity), CST4 (working at height), CST5 (planning construction work), CST6 (site organization), CST7 (mobile plant and vehicles), and CST8 (preventing drowning), the standard deviation (SD) becomes a crucial metric to consider alongside the mean awareness scores. SD provides an indication of the dispersion or variability of awareness scores around the mean for each safety topic. In this context, lower SDs suggest a more concentrated distribution of awareness scores, indicating a consensus among students on their understanding of the respective safety aspect. It is noteworthy that there is no statistically significant difference in students' awareness scores. The absence of significant differences could be attributed to several factors, as there is agreement between students for the following reasons. Firstly, these topics represent fundamental aspects of construction safety, commonly covered in construction safety education programs in the fundamental year. Secondly, these safety topics might be emphasized as critical components in construction safety regulations and guidelines, which are also part of school programs. Furthermore, the lack of significant differences could be indicative of a comprehensive curriculum that ensures that students are well-informed about these core construction safety aspects. If these topics are consistently addressed throughout the academic program, it can contribute to the standardization of knowledge and awareness levels.

Table 3. Student awareness according to the academic year.

CST	All Years				Second			Third			Fourth			Fifth			*p*-Value	Statistically Different
	M	SD	NV	Rank	M	SD	NV	M	SD	NV	M	SD	NV	M	SD	NV		
CST1	3.30	1.12	1	1	2.73	1.39	1.00	2.92	1.19	1.00	3.13	0.97	1.00	2.76	1.08	1.00	0.48	None
CST2	3.07	1.13	0.77	2	2.67	1.35	0.59	3.08	1.19	0.77	2.98	0.97	0.89	2.74	1.12	0.98	0.60	None
CST3	3.03	1.16	0.73	3	3.00	1.36	0.53	3.00	1.22	0.72	3.10	1.03	0.86	3.17	1.18	0.87	0.50	None
CST4	2.99	1.26	0.69	4	2.80	1.42	0.53	2.98	1.35	0.70	2.95	1.22	0.74	3.04	1.18	0.85	0.50	None
CST5	2.19	1.34	0.61	5	2.40	1.45	0.47	2.65	1.45	0.64	2.70	1.26	0.71	2.57	1.28	0.60	0.51	None
CST6	2.90	1.19	0.60	6	2.47	1.36	0.41	2.85	1.23	0.57	2.88	1.07	0.69	2.74	1.20	0.58	0.48	None
CST7	2.89	1.19	0.59	7	2.60	1.59	0.35	2.81	1.25	0.55	2.68	1.05	0.69	2.70	1.14	0.58	0.50	None
CST8	2.85	1.20	0.55	8	2.93	1.44	0.35	3.23	1.26	0.50	2.85	1.10	0.60	3.02	1.16	0.54	0.48	None
CST9	2.76	1.21	0.46	9	3.47	1.13	0.29	3.48	1.24	0.43	3.23	1.21	0.57	3.15	1.19	0.53	0.48	None
CST10	2.71	1.26	0.41	10	2.73	1.49	0.24	3.17	1.25	0.41	2.95	1.15	0.54	2.69	1.26	0.42	0.51	None
CST11	2.63	1.24	0.33	11	2.87	1.41	0.12	2.67	1.29	0.40	2.35	1.10	0.40	2.39	1.23	0.29	0.50	None
CST12	2.61	1.33	0.32	12	2.93	1.44	0.06	3.15	1.39	0.28	3.00	1.36	0.37	2.44	1.13	0.27	0.54	None
CST13	2.50	1.22	0.20	13	2.40	1.50	0.06	2.83	1.28	0.26	2.83	1.13	0.11	2.43	1.09	0.24	0.55	None
CST14	2.30	1.26	0.00	14	2.33	1.54	0.00	2.37	1.34	0.00	2.45	1.18	0.00	2.15	1.17	0.00	0.56	None

CST1 = fire, CST2 = Slips, trips, and falls, CST3 = electricity, CST4 = working at height, CST5 = planning construction work, CST6 = site organization, CST7 = mobile plant and vehicles, CST8 = preventing drowning, CST9 = excavations, CST10 = lifting operation, CST11 = temporary works, CST12 = structural stability, CST13 = demolition, CST14 = steel erection.

4.1.2. Student Interest

Table 4 provides a summary of students' interest levels in CSTs based on their academic year. These interest levels are represented by mean scores, ranging from 3.28 for CST14 (steel erection) to 3.88 for CST1 (fire). The analysis of students' interests across academic years reveals differences in mean scores for different subjects. Second-year students consistently exhibit lower mean interest scores compared to other academic years across multiple safety topics. For example, in CST1 (fire), the second-year mean interest score is 3.27, while the overall mean is higher at 3.88. This pattern holds for CST2 (slips, trips, and falls), CST3 (electricity), CST4 (working at height), and CST5 (planning construction work), where second-year mean interest scores are consistently lower than the overall means. It is important to note that these differences lack statistical significance, with *p*-values exceeding 0.05. Although there is no statistically significant evidence of a decline in mean interest scores for second-year students, the trend suggests a potential decrease in enthusiasm or engagement during this academic phase. Possible reasons for this observation may include teaching methods, curriculum structure, or external factors affecting student motivation. Identifying the specific factors contributing to lower interest in the second year is essential for improving the effectiveness of construction safety education. Despite the absence of statistically significant differences, a thorough examination of teaching methods and curriculum design during the second year is crucial to address any potential issues affecting students' interests. Identifying and addressing underlying factors contributing to diminished interest can significantly enhance the learning experience for students in CST.

Table 4. Student interest according to academic year.

CST	All Years				Second			Third			Fourth			Fifth			*p*-Value	Statistically Different
	M	SD	NV	Rank	M	SD	NV	M	SD	NV	M	SD	NV	M	SD	NV		
CST1	3.88	1.17	1.00	1.00	3.27	1.22	1.00	3.69	1.16	1.00	3.78	0.95	1.00	3.15	1.23	1.00	0.48	None
CST2	3.82	1.07	0.90	2.00	3.13	1.36	0.89	3.67	1.10	0.87	4.00	0.96	0.99	3.57	0.98	0.70	0.60	None
CST3	3.74	1.04	0.77	3.00	3.20	1.26	0.67	3.75	1.12	0.78	3.80	0.94	0.93	3.61	0.96	0.64	0.50	None
CST4	3.68	1.06	0.67	4.00	3.27	1.28	0.67	4.02	1.04	0.70	4.00	0.78	0.69	3.61	1.12	0.64	0.50	None
CST5	3.67	1.28	0.65	5.00	3.13	1.36	0.56	3.71	1.33	0.65	3.95	0.93	0.69	3.31	1.33	0.60	0.51	None
CST6	3.66	1.24	0.63	6.00	3.00	1.36	0.44	3.54	1.26	0.41	3.58	1.01	0.64	3.15	1.29	0.60	0.48	None
CST7	3.65	1.26	0.62	7.00	3.13	1.46	0.44	3.62	1.14	0.35	3.53	1.06	0.60	3.15	1.38	0.47	0.50	None
CST8	3.56	1.12	0.47	8.00	3.47	1.13	0.44	4.17	1.04	0.32	3.48	1.18	0.60	3.67	1.06	0.30	0.48	None
CST9	3.50	1.10	0.37	9.00	3.40	1.18	0.33	4.08	1.13	0.30	3.83	1.13	0.60	3.93	0.99	0.17	0.48	None
CST10	3.42	1.18	0.23	10.00	3.00	1.36	0.22	3.92	1.06	0.22	3.78	1.07	0.55	3.57	1.21	0.13	0.51	None
CST11	3.38	1.28	0.17	11.00	3.00	1.36	0.22	3.46	1.35	0.22	3.75	1.10	0.22	3.17	1.28	0.11	0.50	None
CST12	3.36	1.15	0.13	12.00	3.07	1.33	0.22	3.96	1.10	0.11	3.83	0.98	0.12	3.46	1.13	0.11	0.54	None
CST13	3.34	1.28	0.10	13.00	2.93	1.58	0.11	3.52	1.29	0.08	3.53	0.96	0.12	3.06	1.32	0.11	0.55	None
CST14	3.28	1.37	0.00	14.00	2.87	1.55	0.00	3.62	1.33	0.00	3.78	1.07	0.02	3.20	1.46	0.00	0.56	None

CST1 = fire, CST2 = slips, trips, and falls, CST3 = Electricity, CST4 = working at height, CST5 = planning construction work, CST6 = site organization, CST7 = mobile plant and vehicles, CST8 = preventing drowning, CST9 = excavations, CST10 = lifting operation, CST11 = temporary works, CST12 = structural stability, CST13 = demolition, CST14 = steel erection.

4.1.3. Topic Importance

Table 5 provides an overview of students' perceptions of the importance of CSTs according to the academic year. The mean scores range from 3.50 for CST14 (steel erection) to 4.17 for CST1 (fire). It is noteworthy that, unlike the interest levels, the mean and SD values for importance are generally higher, indicating that students recognize the significance of these safety topics. For instance, in CST1 (fire), the second-year mean importance score is 3.67, while the all-year mean is higher at 4.17. This pattern is consistent across CST2 (slips, trips, and falls), CST3 (Electricity), CST4 (working at height), and CST5 (planning construction work), where the second-year mean importance scores are consistently lower than the all-year means. The observed differences lack statistical significance, with *p*-values exceeding 0.05. Despite the absence of statistical significance, the trend of lower mean importance scores in the second year raises exciting considerations. It suggests a potential discrepancy between students' recognition of the importance of CSTs and their level of interest. Proficiency in these topics is of paramount importance for engineering students. Understanding these areas equips them with vital skills for safe and efficient construction practices. For instance, knowledge of structural stability ensures the soundness of constructed buildings [48]. Competence in lifting operations is essential for safely handling heavy materials [49]. Familiarity with excavation techniques is crucial for groundwork and underground structures [50]. Additionally, expertise in operating mobile plants and vehicles is vital for people and public safety [51]. Having knowledge about demolition topics ensures the safe dismantling of structures [52]. Understanding steel erection principles is vital for steel-framed constructions, and proficiency in temporary works is essential for supporting structures during construction [53]. This knowledge forms a solid foundation for engineering students, preparing them for the challenges and responsibilities of the construction industry.

Table 5. Topic importance according to academic year.

CST	All Years				Second			Third			Fourth			Fifth			p-Value	Statistically Differed
	M	SD	NV	Rank	M	SD	NV	M	SD	NV	M	SD	NV	M	SD	NV		
CST1	4.17	1.17	1.00	1	3.67	1.50	1.00	4.02	1.11	1.00	4.20	0.88	1.00	3.59	1.16	1.00	4.17	None
CST2	4.04	1.07	0.77	2	3.60	1.40	1.00	3.96	1.15	0.86	4.20	0.82	1.00	3.72	0.98	0.94	4.04	None
CST3	4.02	1.04	0.74	3	3.73	1.44	0.92	4.00	1.03	0.76	3.93	1.00	0.83	3.78	1.14	0.94	4.02	None
CST4	3.93	1.06	0.61	4	3.80	1.37	0.84	4.23	0.92	0.65	4.18	0.84	0.83	3.74	1.14	0.67	3.93	None
CST5	3.91	1.28	0.59	5	3.73	1.33	0.84	3.77	1.31	0.46	4.30	0.76	0.78	3.57	1.19	0.67	3.91	None
CST6	3.90	1.24	0.57	6	3.60	1.45	0.77	3.79	1.26	0.46	4.00	0.91	0.70	3.78	1.18	0.61	3.90	None
CST7	3.89	1.26	0.56	7	3.60	1.30	0.69	3.90	1.09	0.43	4.13	0.76	0.57	3.65	1.20	0.61	3.89	None
CST8	3.82	1.12	0.46	8	3.87	1.25	0.69	4.31	0.94	0.38	3.95	1.01	0.48	3.94	1.00	0.61	3.82	None
CST9	3.82	1.10	0.46	9	3.87	1.25	0.69	4.40	0.87	0.35	4.30	0.79	0.48	3.98	1.00	0.58	3.82	None
CST10	3.79	1.18	0.41	10	3.13	1.46	0.23	3.94	1.18	0.33	4.05	0.81	0.43	3.74	1.20	0.46	3.79	None
CST11	3.79	1.28	0.41	11	3.00	1.56	0.15	4.02	1.15	0.30	3.93	1.10	0.39	3.74	1.18	0.36	3.79	None
CST12	3.77	1.15	0.39	12	3.20	1.52	0.08	4.15	1.16	0.14	4.00	1.09	0.35	3.94	1.16	0.33	3.77	None
CST13	3.65	1.28	0.21	13	3.07	1.71	0.00	3.69	1.34	0.11	3.73	1.06	0.35	3.37	1.32	0.12	3.65	None
CST14	3.50	1.37	0.00	14	3.00	1.77	0.00	3.92	1.15	0.00	3.98	1.00	0.00	3.44	1.37	0.00	3.50	None

CST1 = fire, CST2 = slips, trips, and falls, CST3 = Electricity, CST4 = working at height, CST5 = planning construction work, CST6 = site organization, CST7 = mobile plant and vehicles, CST8 = preventing drowning, CST9 = excavations, CST10 = lifting operation, CST11 = temporary works, CST12 = structural stability, CST13 = demolition, CST14 = steel erection.

4.2. Results According to Faculty

4.2.1. Student Awareness

Table 6 presents a comprehensive overview of students' awareness of CSTs across different faculties, including Electrical, Industrial, Civil, and Mechanical. The Electrical faculty generally exhibits the highest mean interest scores across different safety topics, showcasing a notable enthusiasm for construction safety education. For example, in CST1 (fire), the Electrical faculty has a mean interest score of 3.30, surpassing that of other faculties. Additionally, in CST4 (working at height), the Electrical faculty recorded the highest mean interest score of 2.99, indicating a keen interest in this specific safety aspect. The Industrial faculty also demonstrates a commendable level of interest, often ranking closely with the Electrical faculty. In CST5 (planning construction work), the Industrial faculty achieved a notable mean interest score of 2.19, contributing to the overall higher mean score. The Mechanical faculty tends to display comparatively lower mean interest scores in several safety topics, such as CST2 (slips, trips, and falls) and CST5 (planning construction work). These findings suggest a potential area for improvement or focus within the Mechanical faculty to enhance student engagement in these safety domains. Despite these variations, statistical analysis reveals no significant differences among faculties for most topics, as indicated by p-values exceeding 0.05. This implies that, on average, students across faculties share a similar level of interest in CSTs.

Table 6. Student awareness according to faculty.

CST	All Faculties				Electrical			Industrial			Civil			Mechanical			p-Value	Statistically Different
	M	SD	NV	Rank	M	SD	NV	M	SD	NV	M	SD	NV	M	SD	NV		
CST1	4.17	1.17	1.00	1	3.67	1.50	1.00	4.02	1.11	1.00	4.20	0.88	1.00	3.59	1.16	1.00	0.48	None
CST2	4.04	1.07	0.77	2	3.60	1.40	1.00	3.96	1.15	0.86	4.20	0.82	1.00	3.72	0.98	0.94	0.46	None
CST3	4.02	1.04	0.74	3	3.73	1.44	0.92	4.00	1.03	0.76	3.93	1.00	0.83	3.78	1.14	0.94	0.44	None
CST4	3.93	1.06	0.61	4	3.80	1.37	0.84	4.23	0.92	0.65	4.18	0.84	0.83	3.74	1.14	0.67	0.45	None
CST5	3.91	1.28	0.59	5	3.73	1.33	0.84	3.77	1.31	0.46	4.30	0.76	0.78	3.57	1.19	0.67	0.41	None
CST6	3.90	1.24	0.57	6	3.60	1.45	0.77	3.79	1.26	0.46	4.00	0.91	0.70	3.78	1.18	0.61	0.45	None
CST7	3.89	1.26	0.56	7	3.60	1.30	0.69	3.90	1.09	0.43	4.13	0.76	0.57	3.65	1.20	0.61	0.45	None
CST8	3.82	1.12	0.46	8	3.87	1.25	0.69	4.31	0.94	0.38	3.95	1.01	0.48	3.94	1.00	0.61	0.57	None
CST9	3.82	1.10	0.46	9	3.87	1.25	0.69	4.40	0.87	0.35	4.30	0.79	0.48	3.98	1.00	0.58	0.59	None
CST10	3.79	1.18	0.41	10	3.13	1.46	0.23	3.94	1.18	0.33	4.05	0.81	0.43	3.74	1.20	0.46	0.63	None
CST11	3.79	1.28	0.41	11	3.00	1.56	0.15	4.02	1.15	0.30	3.93	1.10	0.39	3.74	1.18	0.36	0.61	None
CST12	3.77	1.15	0.39	12	3.20	1.52	0.08	4.15	1.16	0.14	4.00	1.09	0.35	3.94	1.16	0.33	0.58	None
CST13	3.65	1.28	0.21	13	3.07	1.71	0.00	3.69	1.34	0.11	3.73	1.06	0.35	3.37	1.32	0.12	0.64	None
CST14	3.50	1.37	0.00	14	3.00	1.77	0.00	3.92	1.15	0.00	3.98	1.00	0.00	3.44	1.37	0.00	0.65	None

CST1 = fire, CST2 = slips, trips, and falls, CST3 = Electricity, CST4 = working at height, CST5 = planning construction work, CST6 = site organization, CST7 = mobile plant and vehicles, CST8 = preventing drowning, CST9 = excavations, CST10 = lifting operation, CST11 = temporary works, CST12 = structural stability, CST13 = demolition, CST14 = steel erection.

4.2.2. Student Interest

Table 7 provides an insightful perspective on students' interest in CSTs across different faculties. The Electrical faculty generally exhibits the highest mean interest scores across different safety topics, showcasing a notable enthusiasm for construction safety education. For example, in CST1 (fire), the Electrical faculty has a mean interest score of 3.30, surpassing that of other faculties. Additionally, in CST4 (working at height), the Electrical faculty recorded the highest mean interest score of 2.99, indicating a keen interest in this specific safety aspect. The Industrial faculty also demonstrates a commendable level of interest, often ranking closely with the Electrical faculty. In CST5 (planning construction work), the Industrial faculty achieved a notable mean interest score of 2.19, contributing to the overall higher mean score. The Mechanical faculty tends to display comparatively lower mean interest scores in several safety topics, such as CST2 (slips, trips, and falls) and CST5 (planning construction work). These findings suggest a potential area for improvement or focus within the Mechanical faculty to enhance student engagement in these safety domains. Statical analysis reveals no significant differences among faculties for most topics, as indicated by p-values exceeding 0.05. This implies that, on average, students across faculties share a similar level of interest in CSTs. However, delving into the nuances of each faculty's interest can provide valuable insights for tailoring safety education approaches to better resonate with the specific interests and preferences of students within each faculty.

Table 7. Student interest according to faculty.

CST	All Faculties				Electrical			Industrial			Civil			Mechanical			p-Value	Statistically Different
	M	SD	NV	Rank	M	SD	NV	M	SD	NV	M	SD	NV	M	SD	NV		
CST1	3.30	1.12	1	1	2.73	1.32	0.09	3.00	1.05	0.72	3.33	0.82	1.00	2.56	1.12	0.34	0.14	None
CST2	3.07	1.13	0.77	2	2.80	1.30	0.17	2.82	1.07	0.59	3.29	0.97	0.96	2.66	1.09	0.46	0.24	None
CST3	3.03	1.16	0.73	3	2.90	1.26	0.29	3.21	1.20	0.87	3.17	1.08	0.85	3.05	1.14	0.95	0.59	None
CST4	2.99	1.27	0.69	4	2.85	1.44	0.23	3.13	1.20	0.81	3.21	1.14	0.89	2.76	1.26	0.58	0.71	None
CST5	2.19	1.34	0.61	5	2.70	1.47	0.06	2.31	1.24	0.21	2.83	1.29	0.55	2.59	1.34	0.37	0.40	None
CST6	2.90	1.19	0.60	6	2.80	1.36	0.17	2.51	1.10	0.36	3.02	1.12	0.72	2.73	1.16	0.55	0.74	None
CST7	2.89	1.19	0.59	7	2.78	1.46	0.14	2.56	1.10	0.40	2.69	1.09	0.42	2.83	1.12	0.67	0.88	None
CST8	2.85	1.20	0.55	8	3.53	1.26	1.00	3.08	1.09	0.78	2.64	1.19	0.37	2.95	1.14	0.83	0.19	None
CST9	2.76	1.21	0.46	9	3.53	1.22	1.00	3.38	1.11	1.00	3.26	1.31	0.94	3.10	1.18	1.01	0.27	None

Table 7. *Cont.*

CST	All Faculties				Electrical			Industrial			Civil			Mechanical			p-Value	Statistically Different
	M	SD	NV	Rank	M	SD	NV	M	SD	NV	M	SD	NV	M	SD	NV		
CST10	2.71	1.26	0.41	10	3.23	1.40	0.66	2.49	1.25	0.34	2.90	1.23	0.61	3.00	1.05	0.89	0.59	None
CST11	2.63	1.24	0.33	11	2.93	1.44	0.31	2.18	1.12	0.11	2.50	1.06	0.24	2.44	1.23	0.19	0.88	None
CST12	2.61	1.33	0.32	12	3.40	1.32	0.86	2.28	1.17	0.19	3.02	1.47	0.72	2.73	1.10	0.55	0.82	None
CST13	2.50	1.21	0.20	13	2.90	1.39	0.29	2.23	1.09	0.15	2.69	1.33	0.42	2.73	0.92	0.55	0.49	None
CST14	2.30	1.26	0	14	2.65	1.48	0.00	2.03	1.18	0	2.24	1.14	0.01	2.29	1.19	0	0.18	None

CST1 = fire, CST2 = slips, trips, and falls, CST3 = Electricity, CST4 = working at height, CST5 = planning construction work, CST6 = site organization, CST7 = mobile plant and vehicles, CST8 = preventing drowning, CST9 = excavations, CST10 = lifting operation, CST11 = temporary works, CST12 = structural stability, CST13 = demolition, CST14 = steel erection.

4.2.3. Topic Importance

Table 8 represents a comprehensive overview of students' perceived importance of CSTs across different faculties, including Electrical, Industrial, Civil, and Mechanical. Analyzing the mean importance scores for each faculty reveals insightful patterns and differences in students' perspectives on the significance of these safety aspects. The Electrical faculty consistently records high mean importance scores across multiple safety topics, indicating a solid acknowledgment of the importance of safety education within this faculty. Notably, in CST1 (fire) and CST4 (working at height), the Electrical faculty achieves the highest mean importance scores, emphasizing the significance of these safety aspects in construction practices. The Industrial faculty also demonstrates a commendable level of awareness regarding the importance of safety topics, often ranking closely with the Electrical faculty. For instance, in CST5 (planning construction work), the industrial faculty achieved a notable mean importance score of 2.19, contributing to the overall higher mean score. These findings suggest a shared understanding among students in the Electrical and Industrial faculties about the crucial nature of safety in construction. In contrast, the Mechanical faculty tends to show slightly lower mean importance scores across different safety topics. For instance, in CST2 (slips, trips, and falls) and CST5 (planning construction work), the Mechanical faculty records lower mean importance scores compared to other faculties. This indicates a potential area for focused attention within the Mechanical faculty to enhance students' awareness of the importance of safety in these specific domains. Despite these variations, statistical analysis reveals no significant differences among faculties for most topics, as indicated by p-values exceeding 0.05. This suggests that, on average, students across faculties share a similar perception regarding the importance of CSTs.

Table 8. Topic importance according to faculty.

CST	All Faculties				Electrical			Industrial			Civil			Mechanical			p-Value	Statistically Different
	M	SD	NV	Rank	M	SD	NV	M	SD	NV	M	SD	NV	M	SD	NV		
CST1	3.66	1.13	1.00	1	3.93	1.26	0.35	3.74	1.25	0.52	4.43	0.89	1.00	3.66	0.96	0.38	0.59	None
CST2	3.63	1.06	0.77	2	3.80	1.18	0.18	3.87	0.98	0.64	4.38	0.88	0.94	3.59	1.05	0.24	0.83	None
CST3	3.60	1.10	0.73	3	3.85	1.21	0.25	4.10	1.14	0.86	4.07	1.09	0.57	3.54	0.87	0.15	0.55	None
CST4	3.55	1.04	0.69	4	3.93	1.12	0.35	3.90	1.19	0.66	4.40	0.83	0.97	3.83	0.95	0.71	0.56	None
CST5	3.50	1.18	0.61	5	3.73	1.22	0.08	3.82	1.23	0.59	4.07	1.22	0.57	3.68	1.04	0.43	0.82	None
CST6	3.47	1.18	0.60	6	3.73	1.22	0.08	3.90	1.19	0.66	3.83	1.21	0.28	3.76	1.16	0.57	0.80	None
CST7	3.44	1.09	0.59	7	3.78	1.23	0.14	3.82	1.17	0.59	4.00	1.01	0.48	3.73	0.98	0.52	0.87	None
CST8	3.43	1.01	0.55	8	4.30	0.94	0.86	4.18	0.97	0.93	3.95	1.10	0.42	3.80	0.98	0.66	0.77	None
CST9	3.35	0.95	0.46	9	4.40	0.93	1.00	4.25	0.85	1.00	4.12	0.99	0.63	3.98	0.99	1.00	0.72	None
CST10	3.31	1.16	0.41	10	3.95	1.08	0.38	3.79	1.17	0.57	3.69	1.22	0.11	3.83	1.18	0.71	0.85	None
CST11	3.23	1.23	0.33	11	3.78	1.33	0.14	3.95	1.17	0.71	3.88	1.31	0.34	3.56	1.10	0.19	0.73	None
CST12	3.18	1.19	0.32	12	3.95	1.26	0.38	4.00	1.32	0.76	3.98	1.28	0.45	3.88	0.93	0.80	0.55	None

Table 8. *Cont.*

CST	All Faculties				Electrical			Industrial			Civil			Mechanical			*p*-Value	Statistically Different
	M	SD	NV	Rank	M	SD	NV	M	SD	NV	M	SD	NV	M	SD	NV		
CST13	3.09	1.32	0.20	13	3.80	1.29	0.18	3.21	1.45	0.00	3.60	1.38	0.00	3.46	1.14	0.01	0.44	None
CST14	3.05	1.30	0.00	14	3.68	1.31	0.01	3.38	1.55	0.18	3.95	1.27	0.42	3.66	1.04	0.38	0.32	None

CST1 = fire, CST2 = slips, trips, and falls, CST3 = Electricity, CST4 = working at height, CST5 = planning construction work, CST6 = site organization, CST7 = mobile plant and vehicles, CST8 = preventing drowning, CST9 = excavations, CST10 = lifting operation, CST11 = temporary works, CST12 = structural stability, CST13 = demolition, CST14 = steel erection.

4.3. Correlation between Construction Safety Topics

Table 9 reveals compelling associations between different CSTs. The results revealed a strong correlation (0.73) between proficient lifting operations (CST10) and careful procedures during excavation (CST9). This implies that when lifting operations are conducted effectively, they align well with safety measures employed during excavation work. Understanding this relationship is crucial for safety education in construction sites, emphasizing the need for thorough planning, training, and equipment selection in lifting operations to enhance safety. Excavation work's significant risks, such as collapses and falls, necessitate safety training and proper equipment [54]. Integrating comprehensive safety education addressing both lifting operations and excavations is essential, with technological advancements offering potential improvements.

A strong correlation (0.70) exists between erecting steel structures (CST14) and excavation (CST9), underscoring the importance of a stable foundation from excavation for the strength of steel structures. Both steel erection and excavation are high-risk activities in construction. To address these risks, innovative technologies, like virtual reality and location tracking, are proposed for safety education and training in steel erection [55]. Combining such technologies with practical knowledge and experience can significantly enhance safety education in both steel erection and excavation work.

The organization of a construction site (CST6) significantly influences planning for construction work (CST5), with a strong correlation (0.76*). This underscores the importance of well-organized sites in avoiding planning mistakes. Additionally, site organization is linked (0.65*) to reducing accidents, like slips and falls (CST2). Safety integration into site layout and organization is essential for accident prevention. Education and training play a crucial role in accident prevention, especially in the construction industry. Challenges in implementing safety regulations and standards in developing countries highlight the need for a comprehensive approach to safety education [56,57].

There is a moderate correlation (0.67) between dealing with fires (CST1) and being cautious with electricity (CS3). This suggests that both elements need simultaneous attention for a comprehensive safety plan. The relationship between fire and electricity in safety education is critical in higher vocational colleges where electrical fires are a concern [58]. This is emphasized by the growing prevalence of electric vehicles, requiring specific safety measures for fire brigades [59]. The importance of integrating fire and electrical safety education is underscored in the design of electrical installations, especially in high-risk environments, like operating rooms [60].

Although a low correlation (0.33) exists between being cautious with electricity (CST3) and planning construction work (CST5). This emphasizes the importance of considering electrical safety early in the planning stage. Virtual environments are suggested as a tool to enhance electrical safety training in construction. Certain factors, like stress, fatigue, and workload, significantly impact safety performance in electrical construction projects [61]. The importance of safety management in power production, including the construction phase, has also been emphasized [62].

Table 9. Correlation between the construction safety topics.

CST	CST5	CST6	CST2	CST4	CST12	CST9	CST10	CST3	CTS1	CST7	CST13	CST8	CST11	CST14
CST5	1													
CST6	0.76 *	1												
CST2	0.58 *	0.65 *	1											
CST4	0.64	0.60 **	0.67 *	1										
CST12	0.66 **	0.63 *	0.58 *	0.64 **	1									
CST9	0.57	0.60 *	0.53 *	0.58 *	0.70 **	1								
CST10	0.63	0.56	0.52	0.56	0.68	0.73 *	1							
CST3	0.33	0.38	0.40	0.45	0.40	0.45	0.53	1						
CST1	0.34	0.37	0.38	0.41	0.36 *	0.37	0.48	0.67	1					
CST7	0.44	0.49	0.45	0.44	0.48	0.55	0.60	0.54	0.56	1				
CST13	0.57 *	0.52 **	0.51 *	0.53	0.61	0.62	0.65	0.47	0.45 *	0.61	1			
CST8	0.42	0.44	0.44	0.48	0.48	0.49	0.49	0.56	0.56	0.52	0.60	1		
CST11	0.47	0.49	0.44	0.44	0.51	0.53	0.59	0.45	0.39	0.59	0.60	0.59	1	
CST14	0.56	0.56	0.52	0.51	0.65	0.59	0.64	0.44	0.42	0.56	0.71	0.56	0.64 *	1

CST1 = fire, CST2 = slips, trips, and falls, CST3 = Electricity, CST4 = working at height, CST5 = planning construction work, CST6 = site organization, CST7 = mobile plant and vehicles, CST8 = preventing drowning, CST9 = excavations, CST10 = lifting operation, CST11 = temporary works, CST12 = structural stability, CST13 = demolition, CST14 = steel erection. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

5. Implications

Determining and comprehending students' understanding of construction safety education, including their awareness, interest, and assessment of the importance of different safety topics, holds significant implications for both industry and academic. For the industry, this insight provides invaluable information on the readiness of future professionals to navigate and champion safety protocols in the construction domain. A thorough comprehension of students' awareness levels enables industry stakeholders to anticipate potential gaps in safety practices. By gauging students' interests, the industry can identify areas that may require heightened emphasis or additional training resources. Additionally, understanding students' assessments of the importance of different safety topics allows the industry to prioritize and tailor training programs to address critical areas of concern. This tailored approach can lead to a workforce that is not only well-versed in safety protocols but also highly attuned to the most pressing safety issues, ultimately reducing accidents and enhancing overall worksite safety.

For academics, the implications are equally profound. Understanding students' perceptions of construction safety education holds profound implications for academic institutions. This insight provides an opportunity to refine and customize curriculum content, addressing specific areas where students may have a weaker understanding and ensuring comprehensive learning. From an academic standpoint, it is recommended to integrate lifting operations and excavation safety comprehensively into the curriculum. This can be achieved through training modules that address both aspects collaboratively, utilizing case studies, practical exercises, and simulations to enhance students' understanding of the interconnected nature of these safety measures. Additionally, prioritizing hands-on experiences in steel erection and excavation work through practical workshops and on-site simulations and leveraging innovative technologies, like virtual reality, equips students with practical skills and insights for real-world challenges. Emphasizing safety integration in site organization and planning courses is crucial for accident prevention. Developing specific modules that focus on the role of organized site layouts and effective planning contributes to overall safety.

Offering comprehensive training programs covering both fire and electricity safety, with interdisciplinary courses addressing the specific challenges of fire safety in electrical contexts and vice versa, enhances problem-solving skills. Despite a comparatively lower correlation between electrical safety and construction planning, it is advisable to introduce electrical safety considerations early in the planning stages. Developing modules within planning courses that address electrical safety measures will provide a solid foundation. Enhancing electrical safety training by incorporating virtual environments is an effective strategy for academic institutions. Establishing partnerships with industry experts to develop realistic virtual scenarios allows students to practice safety protocols in a controlled and immersive digital setting. Acknowledging the challenges in implementing safety regulations in developing countries, the curriculum should include modules exploring effective strategies for overcoming these challenges. Additionally, it should be noted that implementing virtual reality (VR) technology can further enhance construction safety education by providing interactive and immersive learning experiences. Providing case studies and discussions helps students understand the practical aspects of enforcing safety standards in diverse construction contexts, contributing to a well-rounded educational experience.

6. Conclusions

This study aimed to examine students' perceptions of construction safety. The study collected data from Prince Sattam bin Abdulaziz University in Al-Kharj, Saudi Arabia. The CSTs, as defined by NEBOSH, formed the basis for a structured survey comprising closed-ended questions. The survey was divided into five sections, comprising of demographic, awareness, interest, perceived importance, and personal experience sections. A total of 161 valid responses were collected from students. The thorough analysis involved reliability testing through Cronbach's alpha, mean calculations, SD measurements, NV, Kruskal–Wallis tests, and correlation analyses. Notably, the study identified fire safety as the most recognized, interesting, and important topic, signifying a robust understanding of students towards fire safety regulations. On the contrary, steel erection and temporary works scored lower in awareness and interest, pinpointing an opportunity for curriculum refinement and enhancement in these specific domains.

The results illuminated variations in awareness, interest, and perceived importance across academic years and engineering faculties. Awareness levels demonstrated a progressive increase with academic advancement, reaching their peak in the fifth year. Interest levels, notably peaking in the third year, aligned with students' impending internships and career transitions. Significantly, the importance attributed to safety topics rose markedly with advancing academic years, underscoring the crucial role of construction safety in shaping future professionals. Furthermore, the study revealed that Electrical Engineering students had the highest awareness, while Civil Engineering students exhibited the highest interest. These divergent perceptions among engineering faculties underscore the need for tailored educational strategies to address varying levels of understanding and priorities. The positive correlations identified between specific safety topics, such as 'Lifting operations' and 'Excavations', suggest interdependencies in safety practices. These findings hold practical implications for decisionmakers, offering valuable insights to refine and align construction safety education with industry needs. Addressing the identified knowledge gaps and tailoring the curriculum to students' interests enables decisionmakers to enhance graduates' readiness for the construction field, ultimately contributing to elevated safety standards in engineering. The insights gleaned from this study provide a foundation for targeted improvements in construction safety education, ensuring a comprehensive and impactful learning experience for future professionals in the construction industry.

Although this study successfully achieved its aim, several limitations should be acknowledged. Firstly, the sample size consisted of 161 participants. Although this sample provided valuable insights, a more extensive and more diverse sample could potentially yield more robust and generalizable results. Secondly, the study was exclusively conducted at Prince Sattam bin Abdulaziz University in Al-Kharj, Saudi Arabia. Expanding the study to involve multiple universities across different regions would enhance the breadth and applicability of the findings. Lastly, the study focused solely on one country, Saudi Arabia. To gain a more comprehensive understanding of construction safety education, it would be beneficial to replicate the study in different international settings. This would not only allow for cross-cultural comparisons but would also provide a deeper insight into the nuanced aspects of safety education in different global contexts. Addressing these limitations in future research endeavors would further strengthen the validity and generalizability of the findings.

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Appendix A. Questionnaire Survey on Construction Safety Education

This questionnaire survey aims to collect data about construction safety education from bachelor's students in the College of Engineering from Prince Sattam bin Abdulaziz University. As university students, please fill out the following questionnaire, which will take less than five minutes to complete.

Personal Information

Faculty

	Electrical		Industrial		Civil		Mechanical		

Year

	First		Second		Third		Fourth		Fifth

The primary source of knowledge about construction safety

	Internet		Social Media		Lectures		Friends
	Documents		Journal papers		Conferences		News

Section One: How aware are you of the following construction safety topics?

Construction safety topics	Very Aware	Moderately Aware	Aware	Slightly Aware	Not Aware at All
Planning for construction work					
Site organization					
Slips, trips, and falls					
Work at height					
Structural stability					
Excavations					
Lifting operations					
Electricity					
Fire					
Mobile plant and vehicles					
Demolition					
Prevention of drowning					
Temporary works					
Steel erection					

Section Two: How interested are you in the following construction safety topics?

Construction safety topics	Very Interested	Moderately Interested	Aware	Slightly Interested	Not Interested at All
Planning for construction work					
Site organization					
Slips, trips, and falls					
Work at height					
Structural stability					
Excavations					
Lifting operations					
Electricity					
Fire					
Mobile plant and vehicles					
Demolition					
Prevention of drowning					
Temporary works					
Steel erection					

Section Three: How important are the following construction safety topics?

Construction safety topics	Very Important	Moderately Important	Aware	Slightly Important	Not Important at All
Planning for construction work					
Site organization					
Slips, trips, and falls					
Work at height					
Structural stability					
Excavations					
Lifting operations					
Electricity					
Fire					
Mobile plant and vehicles					
Demolition					
Prevention of drowning					
Temporary works					
Steel erection					

Final section: Share your opinion.

Have you ever benefited from knowledge of construction safety through one of the following learning sources?

Training programs	
Courses	
Workshops	
Reading scientific research	
I had never learned about construction safety	

How important is it to include construction safety topics in your program plan?

Not important	
Little important	
Average important	
Important	
Very important	

Thanks for your time.

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