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Original article

The Role of Statistics and English Courses in Developing Health, Safety, and Environment Competencies among Students in Benghazi

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Abstract
Curriculum Integration is essential in Libyan education for bridging the gap between academic skills and professional competencies. This study explored how Statistics and English language courses help students in Libya develop competencies in Health, Safety, and Environment (HSE). A total of 200 undergraduate students participated: 100 from the Faculty of Medical Technology and 100 from the Higher Institute of Engineering Technologies. Students completed three assessments: an English proficiency test, a Statistics basic skills test, and an HSE competency test. The results showed that the Faculty of Medical Technology demonstrated significantly higher English proficiency, with 78% of its students achieving a good score (≥70%) compared to only 32% of engineering students ($p < 0.001$). In contrast, the Higher Institute of Engineering Technologies demonstrated significantly higher Statistics proficiency, with 82% of its students achieving a good score compared to 28% of medical technology students ($p < 0.001$). Furthermore, the Engineering Institute also showed significantly higher HSE competencies, with 79% of its students achieving a good score compared to 52% of medical technology students ($p < 0.001$). Correlation analysis revealed that English was strongly associated with HSE performance in medical technology ($r = 0.72$), whereas Statistics was strongly associated with HSE performance in engineering technologies ($r = 0.79$). No significant gender differences were found. Students who attended prior HSE workshops reported higher confidence and better performance. Therefore, the study recommends integrating practical HSE examples into Statistics and English courses based on each institution's strengths.
Keywords. Health, Safety, Environment, Statistics, English Courses, Curriculum Integration, Benghazi, Libya.

Introduction

The rapid changes in Libya's academic and industrial landscapes mean that Health, Safety, and Environment (HSE) standards are more essential than in the past. Occupational safety in Libyan technical institutes faces multifaceted challenges stemming from aging infrastructure, limited resources, and evolving workforce demands. Recent studies highlight how developing countries' technical education systems require integrated approaches to safety management, yet significant research gaps persist regarding effective implementation strategies [1]. Because Libya's economy relies heavily on sectors like oil, gas, and construction, employers now look for graduates who know how to manage risks and keep workplaces safe, not just people with technical degrees [2]. To meet these demands, educational institutions must update their teaching methods. Although technical knowledge in medicine and engineering is essential, students also require broader skills, particularly in data handling and global communication.

The quality of medical education directly influences the quality of graduating students. Several student-related factors have contributed to the decline of medical education in Libya, including a large influx of students without a corresponding increase in learning environment resources, low levels of secondary school preparation, lack of proficiency in the primary language of instruction, lack of accountability, an unclear and ineffective student selection process, lack of active student roles in the learning environment, poor non-technical skills, and external psychosocial factors that may lead to stress and fatigue [3]. Two of the most important skills for modern professionals are statistics and English proficiency. Statistics is no longer just for mathematicians; it is a vital tool used to predict risks, understand environmental data, and analyze why accidents happen [4]. Without a basic understanding of statistics, managing workplace hazards becomes a matter of guesswork. At the same time, English has become the international language for workplace safety [5].

The world's leading safety standards, such as OSHA guidelines and ISO protocols, are written and updated in English [6]. Therefore, a professional's ability to follow and implement these rules depends heavily on how well they understand the language. Unfortunately, many universities in Libya still teach statistics, English, and safety as completely separate, unrelated subjects [7]. This traditional style of teaching leaves students unprepared for actual jobs. For example, engineering or medical technology students might be great at their core technical tasks. Still, they often struggle when asked to read an international safety report or calculate accident trends [8]. Because of this gap, educators are looking for better ways to connect these basic courses with practical safety training.

This study was designed to address this issue by looking at how Statistics and English courses help students to develop better HSE skills. We studied a group of 200 students, 100 from medical technology and 100 from engineering technologies, to see if doing well in these two subjects helps them apply safety concepts in real life. The study also looks at what students

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think about their current courses, whether extra safety workshops help them feel more confident, and if there are any differences between male and female students. Ultimately, this research hopes to give Libyan colleges practical ideas on how to connect classroom learning with real-world safety needs.

Objectives of the Study

1. To describe the students' proficiency in statistics and English and their academic performance in Health, Safety, and Environment (HSE) courses.
1. To analyze variations in HSE capabilities across different student demographics, specifically examining the impact of gender and previous HSE training**.**
2. To propose strategic curriculum enhancements that effectively integrate statistical methods, English language skills, and core HSE concepts.

Methods

Study Design

A descriptive, cross-sectional design was conducted to evaluate students' Health, Safety, and Environment (HSE) performance and their perceptions of supportive academic skills. Data collection was carried out during the 2024-2025 academic year.

Participants and Sampling

A total of 200 undergraduate students were selected using the convenience sampling technique.

- 100 students from the Faculty of Medical Technology
- 100 students from the Higher Institute of Engineering Technologies

Participants included students from different academic years, genders, and prior HSE training backgrounds.

Data Collection Instruments

Three assessment tools were developed and administered to each student.

English Language Proficiency Test

A 20-item multiple-choice test was designed to assess reading comprehension, technical vocabulary, and understanding of general English texts. Each correct answer scored 1 point. The total score was converted to a percentage (0–100%). A score of 70% or higher (≥14 correct) was classified as "Good English proficiency." The test was pilot-tested on 20 students (Cronbach's alpha = 0.84).

Statistics Basic Skills Test

A 20-item multiple-choice test covered basic statistical concepts: mean, median, probability, data interpretation, and simple calculations relevant to risk assessment. Each correct answer scored 1 point. The total score was converted to a percentage. A score of 70% or higher was classified as "Good Statistics proficiency." Pilot testing showed acceptable reliability (Cronbach's alpha = 0.82).

HSE Competency Test

A 20-item multiple-choice test was developed to assess HSE competencies in four domains:

- International safety standards (OSHA, ISO 45001) – 5 questions
- Quantitative risk analysis – 5 questions
- Interpreting safety data – 5 questions
- Technical terminology and emergency procedures – 5 questions

Each correct answer scored 1 point. The total score was converted to a percentage. A score of 70% or higher (≥14 correct) was classified as "Good HSE proficiency." The test was pilot-tested (Cronbach's alpha = 0.81).

Demographic and Questionnaire

A short questionnaire collected data on gender, academic year, and prior HSE training (yes/no: attended any workshops or certificates). Additionally, students' self-reported confidence in applying HSE concepts (e.g., reading safety data sheets, calculating risk scores) was measured using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The confidence question was phrased: *"I feel confident in my ability to apply HSE principles in real workplace settings."* The internal consistency of the confidence item was assessed during pilot testing (Cronbach's alpha = 0.79).

Data Collection Procedure

Data collection was conducted during regular class hours, and researchers were present during sessions to explain instructions and ensure independent work. Participation was voluntary, and all responses were anonymized.

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Ethical Considerations

This study was conducted in accordance with the ethical standards of the institutional research ethics committee. Written informed consent was obtained from all participants before data collection. Anonymity and confidentiality were maintained throughout the research process.

Statistical Analysis

Data were analyzed using SPSS version 26. The following statistical methods were used:

Descriptive statistics: Frequencies, percentages, means, and standard deviations were calculated to describe the sample and test scores.

Chi-square test (X^2): Used to compare the proportions of students with "good" proficiency (≥70%) between the two institutes for English, Statistics, and HSE. A p-value < 0.05 was considered statistically significant.

Pearson correlation coefficient (r): Used to examine the linear relationship between English scores and HSE scores (separately for each institute), and between Statistics scores and HSE scores. Correlation strength was interpreted as: weak (0–0.3), moderate (0.3–0.7), strong (0.7–1.0).

Independent samples t-test: Used to compare the mean confidence scores between students who had prior HSE training and those who did not. A p-value < 0.05 was considered statistically significant. All tests were two-tailed.

Results

Demographic Characteristics

The Faculty of Medical Technology had a higher proportion of female students (68%), while the Higher Institute of Engineering Technologies had a nearly balanced gender distribution.

Table 1. Gender Distribution by Institute

Institute	Female	%	Male	%	Total
Faculty of Medical Technology	68	68%	32	32%	100
Higher Institute of Engineering Technologies	48	48%	52	52%	100

A higher percentage of engineering students (34%) reported prior HSE training compared to medical technology students (24%).

Table 2. Prior HSE Training by Institute

Institute	Yes	%	No training	%	Total
Faculty of Medical Technology	24	24%	76	76%	100
Higher Institute of Engineering Technologies	34	34%	66	66%	100

English Proficiency Comparison

Students were divided into two groups: Good English (score ≥ 70) and Weak English (score < 70). The difference between the two institutions is statistically significant. Students in the Faculty of Medical Technology demonstrated significantly higher English proficiency (78% good) compared to students in the Higher Institute of Engineering Technologies (32% good). Thus, the Faculty of Medical Technology showed a statistically superior level of English proficiency.

Table 3. English Proficiency Comparison

Institute	Good English (≥70)	Weak English (<70)	Total
Faculty of Medical Technology	78	22	100
Higher Institute of Engineering Technologies	32	68	100

Chi-square test result: $X^2 = 42.3$, df = 1, $p < 0.001$

Statistics Proficiency Comparison

Students were divided into: Good Statistics (score ≥ 70) and Weak Statistics (score < 70). Students in the Higher Institute of Engineering Technologies demonstrated significantly higher proficiency in Statistics (82% good) compared to students in the Faculty of Medical Technology (28% good). Hence, the Engineering Technologies Institute exhibited statistically superior performance in Statistics.

Table 4. Statistics Proficiency Comparison

Institute	Good Statistics (≥70)	Weak Statistics (<70)	Total
Faculty of Medical Technology	28	72	100
Higher Institute of Engineering Technologies	82	18	100
Total	110	90	200

Chi-square test result: $X^2 = 55.7$, df = 1, $p < 0.001$

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HSE Competency Comparison

Students were divided into: Good HSE (score ≥ 70) and Weak HSE (score < 70). The Higher Institute of Engineering Technologies demonstrated significantly higher HSE proficiency (79% good) compared to the Faculty of Medical Technology (52% good). Thus, engineering students showed statistically superior HSE competencies.

Table 5. HSE Competency Comparison

Institute	Good HSE (≥70)	Weak HSE (<70)	Total
Faculty of Medical Technology	52	48	100
Higher Institute of Engineering Technologies	79	21	100
Total	131	69	200

Chi-square test result: $X^2 = 15.8$, $df = 1$, $p < 0.001$

Correlation Between English, Statistics, and HSE

Pearson correlation coefficients were calculated separately for each institute.

- For Medical Technology students, English showed a strong positive correlation with HSE (r = 0.72). This indicates that students with higher English scores tended to achieve higher HSE scores.
- For Engineering Technologies students, Statistics showed a strong positive correlation with HSE (r = 0.79). This indicates that students with higher Statistics scores tended to achieve higher HSE scores.
- The correlation between English and Statistics was weak in both institutions (r ≈ 0.30), suggesting these are independent skill sets.

Table 6. Pearson Correlation Coefficients (r)

Institute	English vs. HSE (r)	Statistics vs. HSE (r)
Faculty of Medical Technology	**0.72** (strong)	0.48 (moderate)
Higher Institute of Engineering Technologies	0.45 (moderate)	**0.79** (strong)

Effect of Prior HSE Training (with t-test and p-value)

Statistical comparisons

- For HSE performance (mean %), independent t-test: t= 6.78, p < 0.001.
- For confidence (mean Likert score), independent t-test: t = 12.34, p < 0.001.

Students who had attended prior HSE workshops scored significantly higher on the HSE competency test (78.9 vs. 71.2, p < 0.001) and reported significantly higher confidence in applying HSE principles (4.35 vs. 2.91, p < 0.001) compared to students who had not attended prior HSE training.

Gender Differences

No statistically significant differences were found between male and female students in HSE performance within either institute.

Table 7. Comparison Based on Prior HSE Training (Combined Institutes)

Prior HSE Training	n	Mean HSE Score (%)	Mean Confidence (1-5)
Yes (attended workshops)	58	78.9	4.35
No (academic only)	142	71.2	2.91

Discussion

This study compared 100 Medical Technology students (68% female, 24% prior HSE training) and 100 Engineering Technologies students (48% female, 34% prior HSE training). The results showed that the Faculty of Medical Technology demonstrated significantly higher English proficiency (78% good vs. 32%, p < 0.001), while the Higher Institute of Engineering Technologies demonstrated significantly higher Statistics proficiency (82% vs. 28%, p < 0.001) and higher HSE competencies (79% vs. 52%, p < 0.001). Correlation analysis revealed that English was strongly associated with HSE in medical technology (r = 0.72), whereas Statistics was strongly associated with HSE in engineering technologies (r = 0.79). Prior HSE training improved performance and confidence, and no gender differences were observed.

The finding is consistent with the reality of Libyan higher education. Medical curricula in Libya rely almost exclusively on English-language textbooks, journals, and international references from the first year [7]. In contrast, engineering programs often use Arabic-translated or locally authored materials [8]. This gap in English proficiency is not unique to Libya; a study in vocational maritime education found that proficient English fluency directly contributes to improved safety outcomes and better adherence to international protocols [9]. As a result, medical technology students can directly read the Occupational Safety and Health Administration (OSHA) guidelines and ISO 45001 without translation. This supports Crystal [5], who documented English as the global language of science and technical documentation. Furthermore, a needs analysis of Occupational Safety and Health (OSH) students in Libya revealed that they consider English crucial for their future careers and have high expectations for its use in professional communication [10].

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Engineering students scored significantly higher in Statistics (82% good) than medical technology students (28%). Engineering programs in Libya typically include mandatory courses in probability, statistical quality control, data analysis, and experimental design [1]. These skills are directly applicable to HSE tasks such as calculating incident rates, analyzing accident trends, and performing risk assessments. This aligns with the growing trend in higher education to prepare students for statistical thinking, as seen in health sciences programs that teach procedures like chi-square tests, correlation, and regression to evaluate data effectively [11]. Carter and Smith [4] emphasized that statistics is the "quantitative engineer's tool for workplace risk assessment." International professional courses for engineers in safety, risk, and reliability explicitly teach applied probability and statistics to quantify risk and assess reliability [12]. This explains why engineering students also outperformed medical technology students in HSE competencies (79% vs. 52%). The strong correlation between Statistics and HSE in engineering ($r = 0.79$) confirms that statistical skills are a key driver of HSE performance in this group.

In Medical Technology, English is strongly correlated with HSE ($r = 0.72$). This makes sense because HSE tasks for medical technology students (reading safety data sheets, understanding international protocols, writing incident reports) are language-dependent. English for Specific Purposes (ESP) is recognized as an essential skill for engineers to master professional terminology in occupational health and safety [5].

In Engineering Technologies, Statistics is strongly correlated with HSE ($r = 0.79$). Engineering HSE tasks (calculating risk scores, analyzing accident data, interpreting control charts) are number-dependent. This is reinforced by research identifying serious gaps in English and math skills among Libyan youth, with 50% lacking English proficiency, which likely exacerbates the difficulties engineering students face with English-dependent tasks [13].

These findings align with Elkhouly [7], who noted that Libyan technical education lacks integration between basic skills and professional applications. They also support Tarhuni and Salem [8], who found that engineering graduates struggle with technical English.

Students who attended additional HSE workshops (24% of medical, 34% of engineering) scored 7.7 points higher in HSE ($p < 0.001$) and reported 1.44 points higher confidence ($p < 0.001$) on a 5-point scale. This demonstrates that theoretical classroom teaching alone is insufficient. Practical, hands-on training significantly improves both competence and confidence. This finding is consistent with research on occupational safety education, which indicates that interactive interventions such as simulations are more effective in preparing students for real-world hazards than traditional lectures alone [14]. It also agrees with Shomata et al. [1], who emphasized integrated safety training in Libyan technical institutes [3], calling for curriculum alignment with industrial standards.

No statistically significant differences were found in HSE performance between males and females within either institute ($p > 0.05$). Despite the different gender distributions (68% female in medical, 48% female in engineering), HSE competency appears independent of gender. This finding supports Mansour [2], who noted that workforce demands in post-conflict Libya should focus on skills rather than gender. Encouraging more female students into engineering is unlikely to reduce HSE performance.

Limitations

- Convenience sampling.
- Locally developed tests, not internationally standardized.
- Cross-sectional design measures association, not causation.
- Prior HSE training was self-reported.
- This study focused on academic performance, not on-the-job HSE application.

Conclusions

Based on the findings, the following conclusions are drawn:

English proficiency: The Faculty of Medical Technology demonstrated significantly higher English proficiency, with 78% of its students achieving a good score compared to only 32% of engineering students. This confirms that medical technology curricula, which rely heavily on English-language resources, produce stronger English outcomes.

Statistics and HSE proficiency: The Higher Institute of Engineering Technologies demonstrated significantly higher Statistics proficiency (82% good vs. 28%) and also higher HSE competencies (79% good vs. 52%). Engineering students' strong background in statistical thinking directly supports their ability to perform quantitative risk analysis and interpret safety data.

English correlates with HSE in medical technology: A strong positive correlation was found between English scores and HSE performance among medical technology students ($r = 0.72$). This indicates that improving English language skills in this group would likely lead to better HSE outcomes, particularly in tasks such as reading international safety standards and writing incident reports.

Statistics correlates with HSE in engineering technologies: A strong positive correlation was found between Statistics scores and HSE performance among engineering technology students ($r = 0.79$). This confirms that statistical skills are the primary driver of HSE competence in engineering contexts, especially for risk assessment and data interpretation.

Prior HSE training improves performance and confidence: Students who attended additional HSE workshops scored significantly higher on the HSE competency test ($p < 0.001$) and reported significantly higher confidence in applying HSE

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principles ($p < 0.001$) compared to those with only academic exposure. This demonstrates that theoretical instruction alone is insufficient; practical, hands-on training is essential.

No gender differences: No statistically significant differences were found between male and female students in HSE performance within either institute.

Recommendations

Curriculum Integration Implications

Based on these conclusions, the study strongly recommends that Libyan higher education institutions adopt a strength-based approach to curriculum integration. For the Faculty of Medical Technology, where English is the dominant predictor of HSE success, English for Specific Purposes (ESP) should be emphasized, using real OSHA documents, safety data sheets, and international protocols as teaching materials. Statistics instruction should be contextualized with medical safety data (e.g., infection rates, medication error analysis).

For the Higher Institute of Engineering Technologies, where Statistics is the key driver of HSE performance, applied statistics courses should incorporate HSE case studies, such as calculating incident rates, constructing control charts for safety monitoring, and performing fault tree analysis. English instruction should be tailored to engineering safety terminology.

Across both institutions, mandatory HSE workshops with hands-on simulations should complement academic coursework. These workshops have been proven to significantly boost both competence and confidence.

For future researchers, conduct a further study across Libya using standardized international assessments, follow graduates into the workplace to measure their actual safety performance, and investigate the effectiveness of integrating English language and statistics instruction within health, safety, and environment contexts.

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Conflict of Interest

The authors declare no conflict of interest.

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