JOURNAL OF INTERDISCIPLINARY PERSPECTIVES

*ISSN Print: 2984-8288, ISSN Online: 2984-8385*
*Vol. 4 No. 1, pp. 76-86, January 2026*

Original Article

# Assessing the Level of Laboratory Safety Awareness Among Science Education Students

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**Article History:**

Date received: November 8, 2025
Date revised: November 28, 2025
Date accepted: December 10, 2025

**Recommended citation:**

Sumile, M., & Malinao, R. (2026). Assessing the level of laboratory safety awareness among science education students. *Journal of Interdisciplinary Perspectives*, 4(1), 76-86. https://doi.org/10.69569/jip.2025.742

**Abstract.** This study examined the level of laboratory safety awareness among Science Education students at Davao del Sur State College in the Philippines. Although science students frequently conduct experiments and practical investigations, there is limited attention to how well they understand and apply laboratory safety practices, which are essential for preventing accidents. To address this gap, the study aimed to measure students' safety awareness and determine whether it varied across learner groups. A quantitative descriptive research design was employed, and data were collected from 147 BSEd Science students using a modified and validated questionnaire. The results showed that students generally demonstrated a high level of awareness of laboratory rules and procedures. Statistical analyses revealed no significant differences in safety awareness across gender, age, prior laboratory experience, or type of safety training. However, year level was a significant predictor, indicating that safety awareness improves as students progress through the program. These findings highlight the need for continuous, developmentally appropriate safety instruction and for stronger integration of safety practices across all laboratory courses. The study also recommends exploring safety awareness in other disciplines that involve laboratory work to broaden the understanding of safety culture in higher education.

***Keywords:*** *Laboratory safety awareness; Science education students.*

Students pursuing science-related courses are inevitably exposed to laboratory sessions as part of their formal education. Laboratories play a crucial role in helping learners apply theoretical knowledge through practical experimentation and investigation. However, while these spaces support intellectual growth and discovery, they also pose hazards that may compromise students' safety. This underscores the need to strengthen laboratory safety awareness to minimize accidents and foster a culture of responsible laboratory conduct (Ponferrada et al., 2017; Abdullah & Abd Aziz, 2020). Notably, the Occupational Safety and Health Administration (OSHA) reports that academic laboratories are 11 times more likely to experience accidents than industrial laboratories (Lestari et al., 2019), underscoring the urgent need for improved safety education in schools and universities.

Globally, laboratory accidents remain a persistent issue. High-profile incidents in academic institutions have resulted in serious injuries and even fatalities among students and laboratory personnel (Ménard & Trant, 2020). A report by the U.S. Chemical Safety and Hazard Investigation Board (2018) documented 261 laboratory incidents in universities across the United States from 2001 to 2018. Similarly, the Science Education Section and Manpower Bureau (2013) found that 97 percent of school laboratory accidents were linked to students' lack of awareness and disregard for established safety protocols. These global contexts reflect a recurring pattern of preventable mishaps tied to inadequate safety practices.

The same concerns are evident in the Philippines, where laboratory accidents continue to surface. One reported case involved four students who sustained serious injuries during a distillation activity in a science laboratory (Asuncion et al., 2019). Another incident in Monkayo, Davao de Oro, involved three students who were injured during an experiment to separate components of a saltwater solution by evaporation (Rita, 2022). These cases, arising from the neglect of safety procedures, underscore the need to strengthen safety training and awareness in local educational institutions (Ziara et al., 2021). Connecting these national incidents to global trends highlights a consistent need for proactive safety education.

Ensuring student safety in laboratory environments requires the ability to recognize potential hazards, assess and reduce risks, and respond appropriately to emergencies (Hill & Finster, 2016). Research also suggests that establishing a strong safety culture through consistent training and supervision can significantly reduce risks and promote safer learning environments (Olewski & Snakard, 2017). In the study by Ali et al. (2018), five essential components of laboratory safety awareness were identified: hazard identification, personal protective equipment (PPE), handling experiments, chemical waste management, and emergency response and equipment. While these components outline the expected level of safety awareness, the extent to which students consistently understand and practice them remains unclear and warrants further examination.

Despite the existence of safety guidelines and training programs, studies focusing specifically on laboratory safety awareness among science education students remain limited, especially in Philippine higher education. This gap underscores the need to assess how well students comprehend and apply safety measures in laboratory work, given their future roles as science educators who will guide younger learners. To address this gap, the present study aims to determine the level of laboratory safety awareness among Science Education students of Davao del Sur State College, Philippines. The findings are expected to provide valuable insights to improve institutional safety measures, strengthen safety training programs, and foster a culture of safety consciousness among aspiring science teachers.

## Methodology

**Research Design**

The study utilized a descriptive research design to assess the level of laboratory safety awareness among science education students. According to Siedlecki (2020), descriptive research involves observing and collecting data on a particular phenomenon without manipulating variables. It aims to describe the existing conditions as they naturally occur. Similarly, Kaliyadan and Kulkarni (2019) explained that descriptive research focuses on portraying the characteristics or status of a variable, making it suitable for studies that seek to identify patterns and levels within a population. In the context of the present study, the descriptive design was appropriate, as it allowed the researcher to systematically assess and describe the extent of students' awareness of laboratory safety practices without any intervention or experimental treatment.

**Participants and Sampling Technique**

The respondents in this study were Bachelor of Secondary Education students in science, from first to fourth year, enrolled at Davao del Sur State College during the 2023-2024 academic year. They were selected because their program involves frequent laboratory activities, making it essential to assess their laboratory safety awareness for professional development. The study used stratified random sampling, dividing the population into strata by year level to ensure each group was fairly represented. Random samples were drawn from the official list of enrolled students in each year level. Using Slovin's formula with a margin of error of 0.05 (5%), a total of 147 respondents were selected, comprising 15 first-year, 28 second-year, 41 third-year, and 63 fourth-year students. This method ensured proportional representation across all year levels and enabled the researcher to collect data that accurately reflected the overall population of Science Education students at the college.

**Research Instrument**

The research instrument used in this study was an adapted, patterned survey questionnaire from Ali et al. (2018) that assessed students' awareness of laboratory safety. The researcher modified the questionnaire to ensure the items were appropriate for Science Education students and aligned with the study's objectives. To establish the instrument's validity, a panel of content validators reviewed the items for clarity, relevance, and alignment with the identified safety components. Their feedback was incorporated to ensure that the instrument accurately measured laboratory safety awareness. In addition to content validation, the reliability of the modified questionnaire was confirmed through internal consistency testing. The instrument obtained acceptable reliability coefficients, indicating the items consistently measured the intended constructs and were suitable for data collection. The final survey questionnaire consisted of two parts. The first part collected demographic information from respondents, including gender, age, year level, prior laboratory experience, and laboratory training or workshops attended. The second part assesses respondents' laboratory safety awareness, focusing on their knowledge and familiarity with hazard identification, personal protective equipment, experimental handling, chemical waste management, and emergency response and equipment. Each indicator consisted of seven items rated on a five-point Likert scale, with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Weighted means for each indicator were obtained by averaging the results to produce a general assessment for each variable.

**Data Gathering Procedure**

The researcher first obtained official permission from the Dean of the Institute of Teacher Education and the President of Davao del Sur State College through formal letters of approval. Informed consent letters were also distributed to the respondents, explaining the purpose, benefits, and potential risks of participation. Following approval, data were collected face-to-face using printed survey questionnaires distributed to Bachelor of Secondary Education Science students. The researcher personally facilitated the process, coordinating with instructors to distribute and retrieve questionnaires. Respondents were given sufficient time to complete the survey, ensuring accurate and complete responses.

**Data Analysis Procedure**

Following data collection, the researcher compiled and tabulated the responses to obtain the students' demographic profile and their assessed level of laboratory safety awareness. The data were analyzed and interpreted quantitatively using statistical tools to determine frequencies, percentages, and mean scores. To ensure validity and reliability, the survey instrument underwent expert validation before distribution, and data were carefully checked for consistency and accuracy during processing with the assistance of a statistician. The results were then systematically interpreted to yield meaningful conclusions aligned with the study's objectives.

**Ethical Considerations**

At every stage of the study, the researcher strictly adhered to the ethical standards set by Davao del Sur State College to ensure the integrity and credibility of the research process. Ethical principles, including confidentiality, anonymity, and informed consent, were carefully observed throughout the study. Before data collection, the researcher obtained formal permission from the college authorities and distributed informed consent letters to all participants, clearly explaining the study's objectives, purpose, and potential benefits and risks. Respondents were assured that participation was entirely voluntary and that they had the right to withdraw or decline to answer at any time. To safeguard privacy, no names or identifiable information were included in the research output, and all completed questionnaires were securely stored and accessible only to the researcher. Confidentiality was maintained by ensuring that no data were shared with individuals outside the study. The researcher respected the respondents' right to anonymity and protected all collected information from unauthorized access. By adhering to these ethical guidelines, the study ensured that respondents' dignity, privacy, and trust were fully protected while maintaining the reliability and credibility of the research findings.

## Results and Discussion

**Demographic Profile of Participants**

***In Terms of Gender***

Table 1 presents the gender distribution of the Science Education students in the study. The table shows the representation of male and female respondents in the sample and provides demographic context for interpretation.

**Table 1.** *Socio-Demographic Profile of Science Education Students in Terms of Gender*

| Gender | Frequency | Percentage (%) |
|---|---|---|
| Male | 109 | 74.10% |
| Female | 38 | 25.90% |
| **Total** | **147** | **100%** |

The predominance of female respondents in the study's narrative reflects a broader trend in science education, in which women are increasingly pursuing teaching and science-related careers. The results align with Ali et al. (2018), who found that most respondents in their study on laboratory safety awareness in Pahang, Malaysia, were female, a finding they attributed to rising female participation in science education programs. This pattern parallels global movements promoting gender equality in STEM, suggesting that the composition of Science Education students at DSSC is not an isolated case but part of a broader shift in the teaching and science professions.

***In Terms of Age***

Table 2 summarizes the respondents' age distribution, grouped by age bracket. This information helps situate the findings within typical stages of higher education and understand the maturity level of students involved in laboratory work.

**Table 2.** *Socio-Demographic Profile of Science Education Students in Terms of Age*

| Age | Frequency | Percentage (%) |
|---|---|---|
| 16-20 | 50 | 34.0% |
| 21-25 | 94 | 63.9% |
| 26-30 | 1 | 0.7% |
| 31 and above | 2 | 1.4% |
| **Total** | **147** | **100%** |

The concentration of respondents in the 21-25 age group aligns with the typical age range of undergraduate students nearing completion of their degree programs. These data are consistent with the observations of Ayi and Hone (2018) and Ammar et al. (2024), who found that students in this age bracket are often the most actively engaged in higher-education coursework, including intensive laboratory subjects. The tiny proportion of older students is consistent with Krug (2023), who noted that learners aged 26 and above are often returning students who re-enter higher education after a break. Thus, the age profile suggests that most respondents are at a stage of study where more advanced laboratory experiences and, therefore, higher expectations for safety awareness are the norm.

***In Terms of Year Level***

Table 3 presents the distribution of respondents by year level, indicating which cohorts are most represented in the study. This is important as exposure to laboratory work and safety training often increases as students progress through their program.

**Table 3.** *Socio-Demographic Profile of Science Education Students in Terms of Year Level*

| Year Level | Frequency | Percentage (%) |
|---|---|---|
| 1st | 15 | 10.2% |
| 2nd | 28 | 19.0% |
| 3rd | 41 | 27.9% |
| 4th | 63 | 42.9% |
| **Total** | **147** | **100%** |

The prominence of fourth-year students suggests that many respondents are in the final stages of their teacher education programs, during which laboratory activities and research requirements are more intensive. Similar patterns were observed in studies by Walter et al. (2017) and Abu-Siniyeh et al. (2021), in which upper-year students accounted for most participants in laboratory-based studies because of their greater engagement in practical and research-oriented courses. In addition, Velarde et al. (2022) noted that the lingering effects of the COVID-19 pandemic on instructional delivery shaped year-level differences in academic exposure. These insights support the idea that year level is not just a demographic variable but a meaningful factor influencing the depth and frequency of students' laboratory experiences.

***In Terms of Laboratory Experience before Undergraduate Studies***

Table 4 presents the respondents' prior laboratory experience before entering their undergraduate program. This indicates how early exposure to laboratory environments may shape their current safety awareness.

**Table 4.** *Socio-Demographic Profile of Science Education Students in Terms of Laboratory Experience Prior to Undergraduate Studies*

| Experience | Frequency | Percentage (%) |
|---|---|---|
| With Experience | 143 | 97.3% |
| Without Experience | 4 | 2.7% |
| **Total** | **147** | **100%** |

The overwhelming majority of respondents with prior laboratory experience reflects the impact of the K-12 curriculum, particularly the STEM strand, which intentionally integrates laboratory activities in basic education. This trend is supported by the argument that the K-12 reforms have strengthened students' early engagement with experimental work (Guiamalon & Hariraya, 2021; Togou et al., 2020). The small group without prior experience may include learners from alternative tracks such as the Alternative Learning Systems (ALS), as discussed by Tindowen et al. (2017). Taken together, these findings suggest that for most students, laboratory exposure and initial safety awareness begin well before college, providing a foundation for higher education.

### *In Terms of Training/Workshop Attended on Laboratory Safety Rules and Procedures*

Table 5 summarizes whether students have attended training or workshops specific to laboratory safety rules and procedures. This information helps contextualize their reported levels of awareness.

**Table 5.** *Socio-Demographic Profile of Science Education Students in Terms of Training /Workshop Attended on Laboratory Safety Rules and Procedures*

| Training/Workshop | Frequency | Percentage (%) |
|---|---|---|
| With Training/Workshop | 102 | 69.4% |
| Without Training/Workshop | 45 | 30.6% |
| **Total** | **147** | **100%** |

The finding that most students have already attended safety-related trainings reflects a positive institutional effort to institutionalize safety practices. A study by Al-Zyoud et al. (2019) found high participation in laboratory safety workshops in their context, underscoring the role of structured programs in developing safety awareness. In contrast, another study documented lower participation rates during blended learning periods, noting that pandemic-related restrictions limited opportunities (Manuel et al., 2021). Moreover, Muller and Tyler (2019) argued that institutional initiatives and student engagement jointly determine the success of safety programs. In DSSC, the relatively high participation rate indicates that safety training is prioritized and relatively accessible, which may contribute to the generally high awareness levels found in subsequent sections.

### *In Terms of the Mode of Laboratory Training/Workshop Attended*

Table 6 provides a breakdown of how students received their laboratory safety training, distinguishing between school-based, online, and other modes.

**Table 6.** *Socio-Demographic Profile of Science Education Students in Terms of Mode of Laboratory Training/Workshop Attended*

| Mode of Training/Workshop Attended | Frequency | Percentage (%) |
|---|---|---|
| Laboratory Workshop | 3 | 2.0% |
| Internet (E-learning) | 9 | 6.1% |
| School | 90 | 61.2% |
| Not Applicable | 45 | 30.6% |
| **Total** | **147** | **100%** |

The predominance of school-based training suggests that DSSC treats the classroom and campus laboratory as the primary venues for safety instructions. This observation agrees with Manuel et al. (2021) and Leung (2021), who both highlighted that schools remain central in delivering structured safety education. Additionally, in-person training within actual laboratory environments promotes more meaningful learning than purely online modes because it allows students to practice procedures using real equipment and setups (Miller & Tyler, 2019). A relatively small proportion of students who are exposed to external workshops or e-learning may indicate limited access to such programs or a preference for institution-led training. Overall, this pattern points to the school's key role in cultivating a shared safety culture among students.

## Level of Laboratory Safety Awareness

Table 7 presents the overall level of laboratory safety awareness of BSEd Science students across five key components: hazard identification, personal protective equipment (PPE), handling experiments, chemical waste management, and emergency response and equipment.

**Table 7.** *Level of BSED Science Students' Laboratory Safety Awareness*

| Indicators | Mean | Verbal Description |
|---|---|---|
| Hazard Identification | 4.48 | High |
| Personal Protective Equipment | 4.52 | Very High |
| Handling Experiments | 4.51 | Very High |
| Chemical Waste Management | 4.46 | High |
| Emergency Response and Equipment | 4.24 | High |
| **Overall Mean** | **4.44** | **High** |

**Note:** 4.51 - 5.00 Very High, 3.51 - 4.50 High, 2.51 - 3.50 Moderate, 1.51 - 2.50 Low, 1.00 - 1.50 Very Low

The overall results suggest that students consistently demonstrate a high level of awareness in crucial areas of laboratory safety, with the strongest performance in the proper use of PPE and in the safe handling of experiments. This pattern implies that everyday laboratory routines, such as wearing protective clothing and following stepwise procedures, are well established among the respondents. Emergency response awareness, although still high, is an area where confidence could be further strengthened, possibly through more hands-on practice. This trend is consistent with earlier findings. In a report by Walter et al. (2017), firm adherence to PPE protocols was observed. Comparable conclusions were drawn by Amoo and Ezoke (2020), Oludipe and Etobro (2018), and Schröder et al. (2016), who found that students tend to comply with safety attire requirements.

Meanwhile, as Manuel et al. (2021) noted, fewer students feel fully capable of responding during emergencies despite recognizing safety tools. This insight aligns with the relatively low scores observed on these dimensions. Taken together, the results reinforce the importance of continuous reinforcement and practical safety engagement as emphasized by Al-Zyoud et al. (2019).

***In Terms of Hazard Identification***

Table 8 presents students' explicit awareness related to hazard identification, focusing on their familiarity with safety symbols and responses to various hazard signs in the laboratory.

**Table 8.** *Level of Students' Laboratory Safety Awareness in Terms of Hazard Identification*

| Questions | Mean | Verbal Description |
|---|---|---|
| 1. I am familiar with the different laboratory safety symbols and hazard signs. | 4.08 | High |
| 2. I should observe proper protocols inside the laboratory, especially around areas with hazard signs. | 4.56 | Very High |
| 3. If I see a toxic sign on the chemical bottle, I avoid direct contact with my skin, nose, and eyes. | 4.63 | Very High |
| 4. I should proceed with caution in areas in the laboratory that have biohazard and radiation hazard signs. | 4.43 | High |
| 5. Whenever I see an environmental hazard sign on a chemical bottle, I always proceed with caution to avoid spilling it outside the laboratory. | 4.52 | Very High |
| 6. I should be careful in tampering with chemicals that have flammable hazard signs. | 4.54 | Very High |
| 7. I avoid touching chemicals that have a corrosive hazard sign. | 4.60 | Very High |
| **Overall Mean** | **4.48** | **High** |

**Note**: 4.51 - 5.00 Very High, 3.51 - 4.50 High, 2.51 - 3.50 Moderate, 1.51 - 2.50 Low, 1.00 - 1.50 Very Low

Students demonstrated a strong capacity to recognize hazardous substances and respond appropriately based on the displayed signs. Their caution regarding toxic, corrosive, flammable, and environmentally dangerous materials reflects a clear understanding of the fundamental implications of hazard. However, the lower familiarity with the full range of laboratory safety symbols suggests that although students understand high-risk signs well, they may benefit from exposure to less common symbols. Similar patterns have been documented in prior research. According to Wangdi and Tshomo (2016), students generally show high recognition of significant hazard signs, and Hill and Finster (2016) also highlighted students' appropriate risk-mitigating behaviors in laboratory environments. Studies by Mehrifar et al. (2016) and Bahtiti et al. (2021) similarly found that students are knowledgeable about common hazard symbols. On the other hand, Abu-Siniyeh and Al-Shehri (2021) emphasized that understanding more specialized symbols remains limited, a finding that resonates with the lower familiarity recorded in this indicator.

***In Terms of Personal Protective Equipment***

Table 9 describes students' awareness and use of personal protective equipment (PPE) during laboratory activities.

**Table 9.** *Level of Students' Laboratory Safety Awareness in Terms of Personal Protective Equipment*

| Questions | Mean | Verbal Description |
|---|---|---|
| 1. I wear a laboratory coat whenever we experiment in the laboratory. | 4..59 | Very High |
| 2. I wear safety goggles whenever we conduct experiments in the laboratory to protect my eyes from chemical splashes. | 4.33 | High |
| 3. I wear closed-toe shoes in the laboratory to protect my feet from chemical splashes. | 4.59 | Very High |
| 4. I wear a medical mask to protect myself from inhaling toxic fumes. | 4.52 | Very High |
| 5. I wear gloves during laboratory experiments to protect my hands from hot beakers and chemical splashes. | 4.50 | High |
| 6. I should ensure that my personal protective equipment is clean before experimenting to avoid contamination. | 4.57 | Very High |
| 7. I wear my laboratory coat responsibly and at a certain distance from flammable equipment like a Bunsen burner. | 4.54 | Very High |
| **Overall Mean** | **4.52** | **Very High** |

**Note**: 4.51 - 5.00 Very High, 3.51 - 4.50 High, 2.51 - 3.50 Moderate, 1.51 - 2.50 Low, 1.00 - 1.50 Very Low

The results indicate very high awareness and substantial compliance with PPE, especially with laboratory coats, closed-toe shoes, and masks. Students also demonstrate responsible practices, such as ensuring PPE is clean and maintaining safe distances from heat sources. However, the slightly lower consistency in wearing safety goggles highlights a common challenge across many institutions, stemming from the availability of goggles, their comfort, or habit formation. This pattern aligns with consistent findings in the broader literature. As highlighted by Aljamali et al. (2021), most students consistently use basic PPE, such as laboratory coats, gloves, and appropriate closed-toe footwear. Parallel observations were reported by Rofifa et al. (2019) and Oludipe and Etobro (2018), who documented high compliance with standard laboratory safety protocols among science learners, reinforcing the strong ratings obtained in the present study. These studies collectively suggest that when PPE is readily available and expectations are clearly communicated, students tend to demonstrate responsible and habitual use.

In contrast, variations in access and availability remain a persistent concern in the literature. In the study by Ali et al. (2018), inconsistent supply of specialized terms, such as goggles, often contributes to sporadic usage and lower adherence among students. This concern aligns with the comparatively lower rating of goggle use observed in the current findings, suggesting that availability continues to shape safety behavior. Such patterns highlight the importance of ensuring equitable access to all required PPE to support uniform compliance across all safety indicators.

***In Terms of Handling Experiments***

Table 10 presents students' laboratory safety awareness regarding handling experiments, including preparation, chemical handling, and post-experiment practices.

**Table 10.** *Level of Students' Laboratory Safety Awareness in Terms of Handling Experiments*

| Questions | Mean | Verbal Description |
|---|---|---|
| 1. I read the manual in advance of experimenting. | 4..43 | High |
| 2. I handle chemicals carefully to prevent wastage and spills. | 4.54 | Very High |
| 3. I wait for my instructor and classmates before experimenting. | 4.63 | Very High |
| 4. I should place the excess chemicals in an empty container or bottle. | 4.50 | High |
| 5. I gently fan the vapors towards my nose when asked to smell a chemical. | 4.20 | High |
| 6. I avoid mixing chemicals that are not part of the steps of the experiment to avoid dangerous chemical reactions. | 4.57 | Very High |
| 7. I should clean all the materials used in our experiment along with our workspace. | 4.63 | Very High |
| **Overall Mean** | **4.51** | **Very High** |

**Note**: 4.51 - 5.00 Very High, 3.51 - 4.50 High, 2.51 - 3.50 Moderate, 1.51 - 2.50 Low, 1.00 - 1.50 Very Low

The results show that students display a high level of discipline when conducting experiments, particularly in waiting for instructions, handling chemicals carefully, and maintaining clean workspaces. These behaviors indicate that students recognize their shared responsibility in preventing accidents. However, the slightly lower awareness of the correct method of wafting vapors suggests the need for additional reinforcement of techniques involving volatile substances.

Several studies support these findings. As reported by Ali et al. (2018), students often exhibit strong compliance with laboratory protocols, a trend mirrored by Binti Bakhtiar et al. (2020), who emphasized students' responsible conduct during the experiment. In addition, Sukri et al. (2023) highlighted the importance of repeated orientation to strengthen proper laboratory practices, particularly in areas requiring technical precision. Moreover, Brewster et al. (2023) and Manuel et al. (2021) emphasized that ongoing, hands-on training can significantly improve students' readiness to follow proper laboratory procedures, a finding with implications for the current results.

***In Terms of Chemical Waste Management***

Table 11 shows students' awareness regarding chemical waste management, including guidelines, segregation, and proper disposal practices.

**Table 11.** *Level of Students' Laboratory Safety Awareness in Terms of Chemical Waste Management*

| Questions | Mean | Verbal Description |
|---|---|---|
| 1. The school science laboratory has guidelines for waste disposal. | 4..44 | High |
| 2. I listen to the teacher's instructions on the disposal of certain hazardous chemicals. | 4.59 | Very High |
| 3. I avoid flushing chemicals down the sink. | 4.41 | High |
| 4. It is important to identify and segregate the waste after experiments. | 4.59 | Very High |
| 5. I am capable of segregating and disposing of the waste from our experiment. | 4.50 | High |
| 6. The laboratory has a sound waste management system. | 4.33 | High |
| 7. I never return unused chemicals to their original containers to prevent contamination. | 4.36 | High |
| **Overall Mean** | **4.51** | **High** |

**Note**: 4.51 - 5.00 Very High, 3.51 - 4.50 High, 2.51 - 3.50 Moderate, 1.51 - 2.50 Low, 1.00 - 1.50 Very Low

The results suggest that students consistently practice safe waste management, particularly by segregating waste and following teacher instructions. This reflects responsible laboratory behavior and an understanding that waste management is integral to both safety and environmental protection. The relatively lower familiarity with the overall waste management system indicates a need for more transparent institutional disposal processes.

Consistent findings have been reported in earlier studies. Studies of Ali et al. (2018) and Binti Bakhtiar et al. (2020) documented adherence to proper waste disposal guidelines among students, especially when clear instructions were provided. Moreover, Ho and Chen (2018) and Siril et al. (2022) emphasized that robust institutional waste management systems contribute significantly to safety and environmental sustainability, underscoring an area for further improvement to strengthen awareness among DSSC students.

***In Terms of Emergency Equipment and Response***

Table 12 presents students' perceptions of their awareness of emergency procedures and the availability and use of emergency equipment in the laboratory.

**Table 12.** *Level of Students' Laboratory Safety Awareness in Terms of Emergency Equipment and Response*

| Questions | Mean | Verbal Description |
|---|---|---|
| 1. In the school science laboratory, the locations of the alarm, telephone, and exit are clearly marked in case of emergency. | 4..44 | High |
| 2. The laboratory has a ready first aid kit, fire blanket, fire extinguisher, eye wash station, and safety showers. | 4.59 | Very High |
| 3. The laboratory has vapor traps, such as fume hoods, whenever we conduct experiments with strong vapors or fumes. | 4.41 | High |
| 4. The names of officers who should be called in case of emergency are prepared in my school science laboratory. | 4.59 | Very High |
| 5. The procedure for emergency aid is prepared in my school science laboratory (e.g., posters, pamphlets, books, etc.). | 4.50 | High |
| 6. When a chemical comes into contact with my skin, I immediately rinse with running water. | 4.33 | High |
| 7. When my clothes catch fire in the laboratory, I must immediately use a fire blanket to neutralize them. | 4.36 | High |
| **Overall Mean** | **4.51** | **High** |

**Note**: 4.51 - 5.00 Very High, 3.51 - 4.50 High, 2.51 - 3.50 Moderate, 1.51 - 2.50 Low, 1.00 - 1.50 Very Low

Students demonstrated a solid understanding of emergency equipment and appropriate first-aid responses, particularly in responding to chemical exposure and in using available protective equipment. Their recognition of emergency signage and procedures indicates understanding of the laboratory's safety instructions. Still, the results suggest that familiarity with emergency contact information could benefit from more visibility and reinforcement.

Comparable conclusions were drawn in previous research. In the study by Bai (2022), high levels of emergency preparedness awareness among students were observed. In contrast, Ali et al. (2018) found that students generally recognized emergency tools, even if they lacked confidence in using them. In addition, Broussard (2018) emphasized the importance of immediate first-aid responses, such as rinsing chemical spills with water, which aligns with the stronger items in this category. Meanwhile, Diberardinis (2013), Karahan and Aydoğmuş (2023), and Powell (2023) all argued that practical drills are essential to transforming awareness into decisive action, an important implication of the present results.

## Difference in Students' Awareness Towards Laboratory Safety When Grouped According to Profile

### *When Grouped According to Gender, Laboratory Experience, and Laboratory Training*

Table 13 presents the results of an independent-samples t-test examining whether laboratory safety awareness differs significantly across groups receiving laboratory safety training.

**Table 13.** *Differences in Laboratory Safety Awareness When Grouped According to Gender, Laboratory Experience, and Laboratory Training*

| Variables | T-test | P-value | Remarks | Decision |
|---|---|---|---|---|
| Gender | .978 | .330 | Not Significant | Failed to Reject $H_o$ |
| Laboratory Experience | .375 | .709 | Not Significant | Failed to Reject $H_o$ |
| Laboratory Training | .810 | .419 | Not Significant | Failed to Reject $H_o$ |

The analysis shows that none of these variables produced significant differences in awareness levels, suggesting a relatively uniform distribution of safety understanding among the respondents. This indicates that, regardless of whether students are male or female, have prior laboratory experience, or have attended formal safety training, their reported level of laboratory safety awareness remains comparable. The absence of significant differences across these variables suggests that institutional safety initiatives and classroom-based orientations at DSSC may be consistently teaching all student groups. Similar findings were reported by Oludipe and Etobro (2018) and Binti Bakhtiar et al. (2020), who also did not observe meaningful differences in laboratory safety awareness across gender or training background groups. In addition, safety instruction is standardized and inclusive, helping equalize awareness among students with varied demographic profiles (Prabhakaran et al., 2018). In the context of this study, the results may therefore reflect effective dissemination of safety protocols and practices within the institution.

However, it is important to interpret these findings alongside evidence from the literature that is in contrast. According to Gutiérrez et al. (2013) and Fagihi (2018), demographic characteristics, including prior experience and access to safety training, can influence laboratory safety behavior when learning conditions or resource distribution are unequal. Compared with those settings, DSSC may provide more uniform access to laboratory safety orientations, which could explain the non-significant differences. Nevertheless, the results underscore the need for continued institutional monitoring to ensure that all students, regardless of background, remain equally supported in maintaining and improving their safety awareness.

### *When Grouped According to Age, Year Level, and Training Received*

Table 14 presents the ANOVA results, which show differences in laboratory safety awareness across age, year level, and training mode.

**Table 14.** *Differences in Laboratory Safety Awareness When Grouped According to Age, Year Level, and Training Received*

| Variables | T-test | P-value | Remarks | Decision |
|---|---|---|---|---|
| Age | .928 | .503 | Not Significant | Failed to Reject $H_o$ |
| Year Level | 3.240 | .024 | Significant | Reject $H_o$ |
| Training Received | 1.240 | .299 | Not Significant | Failed to Reject $H_o$ |

The findings reveal that age and training mode do not significantly influence students' safety awareness, whereas year level does. This suggests that, while students of different ages and training modes generally share similar levels of awareness, their academic standing within the program is associated with measurable differences in how they understand and apply safety principles. The lack of significant difference by age and training mode is consistent with the observation that safety awareness may be shaped more by the cumulative learning environment than by age alone. According to Alahmadi's (2017) study, there were no significant differences in safety awareness across demographic groups, including age. In this study, the finding implies that younger and older students alike are benefiting from similar safety messages and learning experiences. Likewise, the non-significant result for mode of training suggests that whether students received safety instruction through workshops, e-learning, or school-based sessions, their overall awareness levels were comparable, possibly due to overlapping content or reinforcement from multiple institutional sources.

By contrast, the significant difference observed across year levels points to the influence of academic progression on safety awareness. In a study by Abu-Siniyeh and Al-Shehri (2021), students at higher educational levels tend to exhibit stronger safety awareness due to repeated exposure to laboratory activities, increased responsibility, and more advanced coursework. However, the literature is not entirely uniform. Based on Fayazi et al. (2020), both age and training can significantly affect safety awareness, whereas Wu et al. (2020) found no significant variation across year levels. These inconsistencies highlight how institutional context, curriculum design, and implementation of safety policies shape outcomes. In the case of DSSC, the findings suggest that as students advance through the Science Education program, their laboratory experiences and safety training likely become more frequent and meaningful, leading to enhanced awareness that distinguishes upper-year students from their lower-year counterparts.

## Conclusion

This study examined the level of laboratory safety awareness among Science Education students of Davao del Sur State College. The findings showed that students generally possess a high level of safety awareness, particularly in the use of personal protective equipment, handling experiments, and identifying hazardous materials. Although awareness of emergency response procedures was also high, it could benefit from further reinforcement. The results also revealed that safety awareness did not differ by gender, age, prior laboratory experience, or training participation, but did vary significantly across year levels, suggesting that sustained academic exposure strengthens safety practices.

The findings contribute to existing knowledge by highlighting that early laboratory experiences and consistent institutional safety orientations help establish a strong baseline of safety awareness among future science teachers. The significant role of year level underscores the importance of progressive and scaffolded safety instruction throughout the teacher education program. By identifying which components are strongest and which require improvement, the study offers practical insights into how safety education can be more effectively integrated into science curricula. Future research may further explore safety awareness across different laboratory-based disciplines, examine the impact of hands-on safety drills, and investigate how institutional policies shape safety culture in higher education. Strengthening laboratory safety is essential not only for preventing accidents but also for preparing future educators to guide younger learners in safe and responsible scientific practice. In this way, the study underscores the critical role of laboratory safety education in shaping competent, safety-conscious science teachers.

## Contributions of Authors

Author 1: conceptualization, proposal writing, paper writing, data gathering, data analysis
Author 2: paper writing, proofreading, data interpretation

## Funding

This study received no external funding or financial support from government agencies, private institutions, or organizations. All expenses incurred during the conduct of the research were shouldered entirely by the researchers as part of the academic requirements of the Bachelor of Secondary Education major in science program.

## Conflict of Interests

The researcher declares no conflicts of interest related to the conduct, analysis, or reporting of this study. All procedures and decisions were carried out with academic honesty, impartiality, and integrity.

## Acknowledgment

The researcher extends his utmost gratitude to all individuals who contributed to the successful completion of this study, whether directly or indirectly. Deep appreciation is given to Dr. Augie E. Fuentes, President of Davao del Sur State College, and Dr. Cindy B. Rosil, Dean of the College of Teacher Education, for granting approval and institutional support necessary for undertaking this research. The researcher also expresses profound appreciation to the panel members, Harold E. Fuentes, MAEd, and Jayson R. Pucot, MSBio, for their valuable insights, recommendations, and professional critique, which strengthened the overall quality of the study. Heartfelt thanks are extended to the chairperson, Rikka Bianca Condes, MST, for her diligent oversight, encouragement, and unwavering commitment to ensuring the study's rigor and completeness. The researcher also conveys his gratitude to the statistician, Allyn Mae D. Rubio, MAEd, for her expertise and assistance in data analysis, which significantly contributed to the clarity and accuracy of the results. Special thanks are extended to the respondents whose honest participation made data collection possible, as well as to the researcher's family, especially Teresita Timosan and Emily Timosan, for their moral and financial support throughout the research journey. Above all, the researcher expresses profound gratitude to the Almighty Father for the guidance, protection, provisions, and strength that enabled the completion of this work. Finally, heartfelt thanks are given to all individuals who, though not explicitly mentioned, contributed meaningfully to this research.

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