



Knowledge Analysis of High School Students on Work Safety in Laboratory

Mila Trisna^{1*}, R. Susanti¹, Retno Sri Iswari¹

¹Pendidikan IPA, Pascasarjana, Universitas Negeri Semarang. Sekaran, Gunung Pati, Semarang City, Central Java, Indonesia 50229

*Correspondent Email: milatriska053@students.unnes.ac.id



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ABSTRAK

Background: A laboratory is a learning tool for conducting experiments or observations. Knowledge of workplace safety procedures and laboratory tools and materials can simplify and streamline the learning process. This study aims to analyze the understanding of high school students on laboratory work safety material. **Methods:** This study is a quantitative study that describes students' knowledge of laboratory work safety. The research subjects were class X MIA 1 and MIA 2 SMAN 7 Jambi City students, class X students of SMAS Insan Madani Jambi. Primary data on students' abilities about work safety in the laboratory were measured by a multiple-choice test consisting of 4 choices, namely A, B, C, and D. Secondary data were taken using an interview sheet for class X biology. Data were analyzed according to Miles and Huberman, namely data reduction, display data, and conclusions. **Results:** High school students' knowledge of work safety materials in the laboratory is still low, namely 61.86%. Students' understanding of using the tools and their functions showed the lowest percentage, 55.36% (poor category). In contrast, the safety aspect of laboratory work showed the highest rate, namely 73.71% (the suitable type). **Conclusion:** High school students have common knowledge in understanding work safety material in the laboratory. It is necessary to deepen the material so that students' knowledge of laboratory work safety increases.

Analisis Pengetahuan Siswa SMA terhadap Keselamatan Kerja di Laboratorium

ABSTRACT

Background: Laboratorium merupakan sarana pembelajaran untuk melakukan percobaan atau pengamatan. Pengetahuan tentang prosedur keselamatan kerja serta alat dan bahan laboratorium dapat mempermudah dan memperlancar proses pembelajaran. Penelitian ini bertujuan menganalisis pengetahuan siswa SMA pada materi keselamatan kerja laboratorium. **Metode:** Penelitian kuantitatif yang menggambarkan pengetahuan siswa tentang keselamatan kerja laboratorium. Subjek penelitian ialah siswa kelas X MIA 1 dan MIA 2 SMAN 7 Kota Jambi dan siswa kelas X SMAS Insan Madani Jambi. Data primer kemampuan siswa tentang keselamatan kerja di laboratorium diukur menggunakan soal bentuk pilihan ganda terdiri dari 4 alternatif pilihan yaitu A, B, C, dan D. Data sekunder diambil dengan lembar wawancara pada guru biologi kelas X. Data dianalisis menurut Miles dan Huberman yaitu reduksi data, menampilkan data, dan kesimpulan. **Hasil:** Pengetahuan siswa SMA pada materi keselamatan kerja di laboratorium masih rendah yaitu 61,86%. Pengetahuan siswa tentang cara penggunaan alat dan fungsinya menunjukkan persentase paling rendah yaitu 55,36% (kategori kurang), sedangkan aspek keselamatan kerja laboratorium menunjukkan persentase tertinggi yaitu 73,71% (kategori cukup). **Kesimpulan:** Siswa SMA memiliki pengetahuan yang rendah dalam memahami materi keselamatan kerja di laboratorium. Perlu adanya pendalaman materi sehingga pengetahuan siswa tentang keselamatan kerja laboratorium meningkat.



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Introduction

A good education can facilitate students to the maximum. Facilities and infrastructure become components that must exist in creating a good education. Based on the Regulation of the Minister of National Education No. 40 of 2008 on Standards of Facilities and Infrastructure, bringing the laboratory is a means that supports learners' success in experimental activities. It is

also supported by the Regulation of the Minister of Education and Culture No. 32 of 2013 on National Standards of Education that the laboratory is one of the standards of facilities needed to support the learning process in meeting learning achievements.

The condition of laboratory facilities and infrastructure of some schools has differences. Some schools have

complete laboratories, but there are some schools with minimal laboratory conditions. This will affect the quality of the practice learning process in the laboratory. Learning with a laboratory involves interactions between students, equipment and materials (Gobaw, 2016). Tools and materials in the laboratory must be utilized optimally in practicum activities. Laboratory accidents generally occur in students because they do not know how much risk if they do not understand the safety of workers in the laboratory. (Yuliani et al., 2020). Some chemicals that come into direct contact with the skin, eyes or interactions between chemicals can cause injury (Cimera et al., 2020).

Interviews with biology teachers at N 7 Kota Jambi High School and SMAS Insan Madani Jambi obtained data that students have been taught safety in the laboratory in classroom learning. However, there are still accidents due to student negligence. Some accidents that occur due to student carelessness include (1) the rupture of glass instruments such as test tubes, measuring cups, glass objects and Petri dishes, (2) mouldy microscopes due to improper storage methods, (3) improper practicum ways such as heating substances that are too close to the heating source so that the test tube breaks, (4) the abundance of substances, and (5) irritation of the skin of students' hands due to alcohol exposure 96%. Often students are negligent and do not use work safety equipment in conducting experiments resulting in school and self-harm.

The role of teachers and learning resources used to make students understand occupational safety in the laboratory will be well-formed. The interview results mentioned that students were given biology handbooks and LKPD for use in the classroom. LKPD teaching materials are considered less attractive to students because they only contain descriptions of subject matter so that students are less interactive in the teaching and learning process (Li et al., 2015).

Knowing how to use laboratory equipment is an essential factor in supporting practice training. Misuse of laboratory tools by students can result in errors or errors in the use of tools and errors in obtaining practicum results. Knowledge of operating laboratory equipment is essential to be passed on to avoid laboratory accidents to students from the start as a critical skill for performing exercises and improving process skills. Moreover, the practice of biology in the laboratory is a form of laboratory utilization following its function.

Awareness of work safety can be grown one of them with knowledge of work safety (Tarawi et al., 2020). Students with good work safety knowledge will know the risks that can occur if ignored. Students' compliance with safety regulations on using available equipment, materials, and substances in the laboratory may reduce the risk of accidents (Salazar-Escoboza et al., 2020). With sufficient knowledge of workplace safety procedures in the

laboratory, students can anticipate and handle cases of accidents and care for laboratory facilities. Given the critical role of the laboratory as a means of learning, this study aims to analyze students' knowledge of occupational safety in the laboratory.

Methods

The study used quantitative descriptive methods to describe high school student's knowledge of laboratory work safety materials.

Population and sample

The subjects in this study were students of class X SMAN 7 Kota Jambi and SMAS Insan Madani, which amounted to three classes with a total of 87 students who were included in saturated sampling (Table 1).

Table 1. Number of student samples

| No. | Class | Σ |
|-------|-------------------------------|----------|
| 1. | X MIA 1 SMAN 7 Kota Jambi | 30 |
| 2. | X MIA 2 SMAN 7 Kota Jambi | 29 |
| 3. | X MIA SMAS Insan Madani Jambi | 28 |
| Total | | 87 |

Instrument

The instruments used in this study are test sheets developed from learning indicators (3.1.1) students' understanding of aspects of laboratory safety, (3.1.2) how tools are used and their functions, and (3.1.3) symbols of the dangers of chemicals in the laboratory. The number of question items on the test sheet is 20 items of multiple-choice questions with four alternative options, namely A, B, C, and D. If the correct answer gets a score of 1 and 0 if the answer is wrong. Secondary data is obtained by way of interviews with biology teachers.

Data Analysis

Data analyzed with the Miles & Huberman (1994) model is data reduction, presentation, and conclusion withdrawal. Reducing data means summarizing and selecting essential things. Once the information is reduced, the next step presents the data in the form of a table. Continued withdrawal of conclusions and verification. According to Arikunto (2007) the criteria for knowledge assessment are divided into three.

Results

The results showed that high school students' knowledge of work safety materials in the laboratory was relatively low (Table 2).

Table 2. Student knowledge of laboratory work safety materials

| Indicator | Knowledge | Information |
|-----------|-----------|-------------|
| 3.1.1 | 73,71% | Enough |
| 3.1.2 | 55,36% | Less |

| | | |
|---------|--------|------|
| 3.1.3 | 56,51% | Less |
| Average | 61.86% | Low |

Table 2 shows that high school students' knowledge of work safety materials in the laboratory is relatively low. The average student knowledge is 61.86%. Each school presents different knowledge results (Table 3).

Table 3. The number of correct answers in each school

| Class | Indicator | Correct answer frequency | Percentage |
|-------------------|-----------|--------------------------|------------|
| X MIA 1 SMAN 7 | 3.1.1 | 191 | 79,58 |
| | 3.1.2 | 101 | 56,11 |
| | 3.1.3 | 106 | 58,89 |
| X MIA 2 SMAN 7 | 3.1.1 | 155 | 66,81 |
| | 3.1.2 | 106 | 60,92 |
| | 3.1.3 | 95 | 54,60 |
| X SMAS INSAN | 3.1.1 | 167 | 74,55 |
| | 3.1.2 | 82 | 48,81 |
| MADANI | 3.1.3 | 94 | 55,95 |

Discussion

Knowledge of workplace safety procedures and laboratory tools and materials can facilitate and facilitate the learning process. Knowledge of the operation of laboratory equipment is essentially passed on to students from the beginning before starting the practicum. This is to ensure the practice and safety of work is carried out appropriately in the laboratory.

Indicators of laboratory work safety aspects

Based on the results in Table. 1, the learning indicator with the highest value is the aspect of work safety in the laboratory, while the lowest indicator is how the tool is used and its function. The average student's knowledge of occupational safety in the laboratory is 73.71% (good category). Based on the results of the interview, this happens because every learning in the teacher's practicum method reminds students of the crucial things that students need to do so that the practicum runs smoothly such as (1) using laboratory uniforms, (2) not eating and drinking during the learning process, (3) working carefully and (4) not joking while in the laboratory.

To introduce occupational safety materials in the laboratory, students are given materials in presentations using PowerPoint and learning videos. Students are introduced to all potential hazards, such as (1) unsafe actions performed in the laboratory, (2) work procedures in the laboratory, (3) personal protective equipment and, (4) emergency response procedures in the event of an accident. Learning videos teach students to use personal protective equipment, wash their hands before and after activities, laboratory standard procedures and follow instructions from practicum instructors, namely teachers.

Laboratory use of biological learning processes is required in some materials, including (1) observation of

cell shape, (2) photosynthesis experiments, and (3) experiments to determine blood type. Research shows that students who are taught using laboratory methods achieve better average results than those taught using conventional methods in school (Emda, 2017)

Based on biology teacher interviews, due to lack of understanding of safety aspects, a student experiencing irritation of the skin of the hands due to alcohol exposure 96%. As a result of neglect, the student experienced hand irritation for not using gloves (hand stones). This is an example of students' lack of understanding of self-harming safety rules. The safety and security of the laboratory aim to ensure that the staff, community and environment of laboratory users can always work in a healthy, comfortable, safe, productive and prosperous condition (Rahmantiyoko et al., 2019).

Indicators of the use of tools and their functions

Based on the results in Table.1, indicators of students' knowledge of how the tool is used and its function show a low percentage of 55.36% (less category). Factors that affect the standard ability of students about how to use the tool is the lack of practicum experience due to the habit of working groups so that only a few students focus on observing. The teacher confirmed this is a deficiency due to the limitations of equipment in the laboratory, so that it cannot be sufficient for every student. Incomplete equipment and the presence of tools available but not used according to their function lead to a common understanding of the use and function of laboratory equipment (Khaerunnisa et al., 2019).

As for some mistakes made by students in explaining the function of laboratory tools such as (1) students know the name of laboratory tools but do not know their function, (2) cannot classify laboratory tools based on basic materials of production, (3) students do not understand how to use tools properly. In general, the lack of knowledge of students in the use of tools includes (1) how to hold a test tube in the heating process, (2) how to use bunsen, (3) handling microscopes.

Good student knowledge in using tools and materials in the laboratory can facilitate students in the learning process. The absence of laboratory assistants makes students know every part of the tool and how to handle it to maintain and maintain laboratory facilities. Some laboratory tools such as chemical glasses, microscopes, thermometers, Petri cups, wash bottles, skeletons, and materials such as agar, benedict, iodine, alcohol need special handling (Umar, 2017)

Knowledge of tools is an essential factor in supporting laboratory learning. Students have practical skills when knowledge of laboratory tools, including tool names, tool functions and how to use them is good (Juvitasari et al., 2018). Knowledge of the usefulness of laboratory tools

aims so that students can minimize the occurrence of errors and accidents during practicum. Errors in operating the device are one reason for the inaccurate data generated in practice (Sari, 2016).

Based on the research results on the use of laboratory equipment and its functions, high school students lack understanding or are unable to classify exactly the type of laboratory equipment and its functions. The results of this study are in line with the research (Lase, 2020), that knowledge of laboratory equipment and its functions is relatively adequate and requires improvement, as well as several factors that contribute to it (a) the amount of equipment and materials that are still lacking and some tools are damaged; (b) limited time; c) less actively involved in the preparation of tools and materials; (d) the evaluation system and practice report are rudimentary.

Indicator of hazard symbols in the laboratory

Based on the results in Table. 1, student knowledge indicators identifying symbols of safety hazards show a low percentage of 56.51% (less category). No laboratory assistant helps students know the harmful materials used so as not to negatively affect students and the environment, such as how to dispose of substances that have been used so as not to harm the environment. Keeping the environment from polluting hazardous substances is critical to laboratory safety, while toxic and dangerous gas concentrations significantly impact laboratory accidents (Zhang et al., 2020).

Chemicals are the largest source of laboratory work accidents. Students in the laboratory need an understanding of the types, properties, and handling of chemicals. Lack of knowledge about chemicals can harm students' health and the laboratory environment. Chemical accidents can occur when substances enter the body through the mouth, skin, and respiratory tract. First aid skills in accidents due to chemical contamination in the laboratory are needed in the event of chemical contamination (Lasia et al., 2017).

In general, the lack of knowledge of students in understanding hazardous materials, among others (1) classifying the type of hazardous materials, (2) how to handle hazardous materials, and (3) understanding the meaning of safety symbols. According to an interview with biology teachers, material about workplace safety in the laboratory has been explained during the classroom learning process, which is a sub-chapter of the Biology Scope material. Still, the lack of learning time in the classroom resulted in discussions about workplace safety in the laboratory not being delivered to the maximum. In addition, the absence of practicum guides is a factor in low student knowledge. Some teaching materials that can be used as guidelines in the safety of learners in the laboratory include (1) modules, (2) practicum guides, (3) magazines

and, (4) e-books. Laboratory guideline magazines have a higher percentage of basic process science skills than integrated process science skills (Wei et al., 2020). In the magazine inserted material describing chemical warning signs including (1) symbols of health hazards, (2) irritants, (3) toxic, (4) explosive, (5) corrosive, (6) flammable, (7) oxidizing, (8) compressed gases, and (9) hazards to the environment (Al-Zyoud et al., 2019).

Conclusion

The results showed that respondents had low knowledge of laboratory work safety materials, especially in indicators (3.1.2) of tools used and their functions. In general, the lack of understanding of respondents about the safety of laboratory work includes (1) how to hold a test tube in the heating process, (2) how to use bunsen, (3) handling microscopes (4) classifying the types of hazardous materials, (5) how to handle hazardous materials, and (6) understanding the meaning of safety symbols. While the safety aspect of laboratory work is the indicator that respondents most easily understand.

Declaration statement

The authors reported no potential conflict of interest.

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