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E-Book of Risk Management in High School Chemistry Laboratories as an Effort to Enhance Occupational Safety and Health

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Abstract
Chemistry laboratory activities at the senior high school level are essential for developing students' conceptual understanding but simultaneously pose significant occupational safety and health (OSH) risks when not supported by adequate safety literacy and systematic risk management. Despite this urgency, accessible and structured learning resources that explicitly address laboratory risk management in school contexts remain limited. This study aimed to develop an e-book on risk management for high school chemistry laboratories as an innovative digital resource to strengthen students' safety awareness and support the implementation of OSH practices during chemistry practicums. Using a Research and Development approach with the 4D model, the e-book was designed, validated by experts, and tested for readability and practicality. The results indicate that the e-book achieved very high validity in terms of content, language, and media, was highly readable (95.6%), and demonstrated strong practicality for classroom use (82.5% by teachers and 96.8% by students). These findings suggest that the developed e-book is an effective and feasible digital learning resource that can contribute to fostering a stronger culture of safety and risk awareness in high school chemistry laboratories.

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INTRODUCTION

Laboratory activities play a central role in chemistry education by enabling students to engage directly with scientific concepts through experimentation and observation (Bretz, 2019). In laboratories, students can observe, test, and evaluate chemical concepts, there by developing a deeper understanding of chemistry (Wiratma, 2015). Through practicum-based learning, students are encouraged to develop higher-order thinking skills and scientific reasoning. However, chemistry laboratories also present inherent risks related to hazardous chemicals, equipment misuse, and inadequate laboratory management, which may threaten the safety and health of laboratory users if not properly managed (Amanah et al., 2011; Setiyanto, 2024; Sudria et al., 2020).

Laboratory accidents generally occur unintentionally and are often caused by human negligence, whether by individuals or others (Lasia et al., 2017). Previous studies have consistently shown that a large proportion of laboratory and workplace accidents stem from unsafe behavior and limited safety awareness. Previous studies have consistently shown that a large proportion of laboratory and workplace accidents stem from unsafe behavior and limited safety awareness. The National Safety Council (2011) reported that approximately 88% of accidents are caused by unsafe actions, while human factors contribute to more than 80% of occupational accidents (Maurits & Widodo, 2008). These findings underscore the importance of cultivating occupational safety and health (OSH) awareness as an integral component of laboratory learning, particularly at the school level, where students are still developing fundamental laboratory skills.

Despite the critical importance of laboratory safety, OSH education in high school chemistry laboratories is often insufficiently addressed. Safety instruction is commonly delivered implicitly through brief verbal explanations by teachers rather than through structured, systematic learning materials. Several studies have reported that students' understanding of laboratory safety remains low to moderate, increasing the likelihood of unsafe behavior during practicums (Pertiwi & Yuliyanto, 2015; Wirasanti, 2020; Trisna et al., 2021). These conditions indicate a fundamental problem: the lack of comprehensive and accessible resources that explicitly integrate OSH principles and risk management into chemistry learning.

From a systemic perspective, laboratory safety issues in high school chemistry programs are also exacerbated by limited teacher training in safety management and the absence of formalized risk management guidelines at the school level (Ezeano & Ezeudu, 2018; Caporossi et al., 2023). Consequently, safety practices are often reactive rather than preventive, and laboratory management tends to focus on administrative aspects such as inventory rather than hazard identification and risk control. This gap highlights the urgent need for pedagogically structured learning resources that can support both teachers and students in developing a proactive safety culture.

Risk management provides a systematic framework for identifying hazards, assessing risks, and implementing control measures to prevent accidents (Aven, 2016). Integrating risk management concepts into school laboratory learning can help students recognize potential dangers and adopt preventive behaviors. However, learning resources that specifically contextualize risk management for high school chemistry laboratories remain scarce. Digital learning media, particularly e-books, offer a promising solution due to their accessibility, flexibility, and potential for multimedia integration (Ruddamayanti, 2019).

This study addresses these gaps by developing an e-book on risk management in high school chemistry laboratories. The novelty of this research lies in its focus on a dedicated digital resource that systematically integrates OSH principles, laboratory hazard identification, and risk management practices tailored to the high school context. By providing an interactive and accessible learning medium, this e-book is expected to enhance students' safety literacy and contribute to the establishment of a stronger safety culture in chemistry laboratories.

METHOD

This study employed a Research and Development (R&D) approach aimed at producing and validating an educational product in the form of an e-book on risk management in senior high school chemistry laboratories. The development process followed the 4D model proposed by Thiagarajan et al. (1974), which consists of define, design, develop, and disseminate stages. Due to time constraints, this study was limited to the develop stage.

At the define stage, a needs analysis was conducted through document analysis of the senior high school chemistry curriculum, existing teaching materials, and practicum guidelines. This analysis aimed to identify potential laboratory hazards, students' safety needs, and gaps between OSH demands and available learning resources.

The design stage focused on determining the structure, content, and visual design of the e-book. The e-book format was selected based on its accessibility across digital devices and its suitability for students who are accustomed to technology-based learning. The content was designed in accordance with the standards for non-text enrichment books outlined in Permendikbudristek No. 22 of 2022, covering six main chapters related to laboratory safety and risk management.

During the develop stage, the e-book underwent expert validation involving two content experts, two language experts, and two media experts. Feedback from these experts was systematically analyzed and used to revise the e-book, including improvements in content organization, language accuracy, visual design, and clarity of hazard identification. Following revision, readability tests were conducted with nine twelfth-grade students representing diverse academic abilities, while practicality tests involved four chemistry teachers, one laboratory assistant, and ten students.

Data were collected using questionnaires and analyzed through qualitative descriptive analysis and descriptive statistics. Validity was interpret-

ed using mean score criteria, while readability and practicality were analyzed using percentage-based categories.

Table 1. Questionnaire Data Scores

Statement	Score
Very good	4
Good	3
Poor	2
Very Poor	1

The feasibility test data of the e-book on risk management in chemistry laboratories at senior high schools were calculated using the following formula (Riduwan & Akdon, 2013).

$$\bar{X} = \frac{\text{sum of all data}}{\text{number of data}}$$

The results obtained can then be interpreted by referring to the assessment criteria shown in the Table 2 (Riduwan, 2013)

Table 2. Validity Data Criteria

Score Range	Category
3,25 - 4,00	Very valid
2,50 - 3,24	Valid
1,75 - 2,49	Less valid
1,00 -1,74	Invalid

The readability and practicality test data were calculated as percentages using the following formula (Riduwan & Akdon, 2013).

$$P = \frac{\sum \text{total scores}}{\text{n} \times \text{maximum score} \times \text{number of respondents}} \times 100\%$$

After that, the obtained percentage can be interpreted by referring to the following assessment criteria (Riduwan & Akdon, 2013):

Table 3. Readability and Practicality Criteria

Achievement Level (%)	Category
81-100	Very readable/very practical
61-80	Readable/practical
41-60	Fairly readable/fairly practical
21-40	Unreadable/impractical
0-20	Very unreadable/very impractical

RESULTS AND DISCUSSION

Define

The defining stage involved document analysis to identify needs, which served as the basis for developing an e-book on risk management in chemistry laboratories at senior high schools. The analysis showed that chemistry practicum activities in senior high schools involve the use of various hazardous chemicals and laboratory equipment, which pose a risk of workplace accidents if not used in accordance with safety procedures. Students' knowledge of OSH remains low, which can lead to unsafe behavior and increase the risk of accidents. Students need to recognize potential hazards, use personal protective equipment, and properly apply OSH procedures.

Design

Based on the results of the needs analysis in the defining stage, the obtained information was used as the basis for the design stage. The selected medium was an e-book accessible on various devices, including laptops, computers, and mobile phones. The selection of the e-book was based on the characteristics of today's students who are accustomed to using digital media and on its flexible, practical, and easily accessible nature. The e-book format was adjusted to the criteria for non-text enrichment books outlined in Permendikbudristek No. 22 of 2022 on book standards, to meet requirements for content feasibility, presentation, language, and graphics. The initial design of the e-book on risk management in chemistry laboratories at senior high schools is presented in Table 4.

Table 4. Initial Design of E-book

Part	Content
Beginning of the Book	A. Cover B. Preface C. User Guide D. Table of Contents E. List of Tables F. List of Figures
Main Content	The main content of the book consists of six main chapters as follows: A. Chapter 1: Types of Laboratories B. Chapter 2: Occupational Safety and Health (OSH) C. Chapter 3: Hazard Identification in Chemistry Laboratories D. Chapter 4: Risk Management in Chemistry Laboratories E. Chapter 5: Personal Protective Equipment and Safety Tools in Chemistry Laboratories F. Chapter 6: Accident Handling in Chemistry Laboratories
End of the Book	A. Glossary B. References C. Back Cover

Develop

The development stage was carried out to produce the e-book on risk management in chemistry laboratories at senior high schools. In this stage, expert validation (content, language, and media) and product testing, which included readability and practicality tests, were conducted. A summary of the validation results by experts is presented in Table 5.

Table 5.Summary of Content, Language, and Media Validation Results

No	Aspect	Mean	Category
1	Content validity	3,7	Very valid
2	Language validity	3,8	Very valid
3	Media validity	3,8	Very valid

Several suggestions from the experts included improving the color contrast on the cover, correcting spelling and punctuation errors, adding reference sources, and clarifying the section on hazard identification in chemistry laboratories to make it more systematic. These suggestions served as material for revising and refining the e-book before conducting field trials.

After the product was revised based on the experts' evaluations and suggestions, a readability test was conducted. The readability test was conducted by involving nine twelfth-grade science students. The selection of students was based on academic ability, including students with high, medium, and low academic performance. Each student was given a PDF of the developed e-book to read before filling out the provided readability assessment sheet. A summary of the students' readability test results is presented in Table 6.

The practicality test aimed to determine whether the developed product was easy to use in learning activities and laboratory practice. The practicality assessment involved four chemistry teachers and one laboratory technician. In addition, the practicality test conducted by students involved ten twelfth-grade science students. A summary of the practicality test results from teachers and students is shown in Tables 7 and 8.

Table 6. Summary of Readability Test Results

No	Statement	Total score
1	The overall appearance of the e-book on risk management is attractive	34
2	The messages or information are delivered in a language that is engaging and commonly used	33
3	The sentences used are simple and easy to understand	35
4	The terms used are easy to understand and can be identified through the glossary explanations	33
5	The instructions for using the e-book are easy to read and follow	35
6	The structure and organization of the content/material in the e-book on risk management in chemistry laboratories are clear	35
7	The images/illustrations presented are informative and help improve understanding	36
	Total score	**241**
	Maximum score	**252**
	Percentage result	**95,6 %**

Table 7. Summary of Practical Test by Teacher

No	Assessment Indicators	Total score
Appearance Aspect		
1	The overall appearance of the e-book on risk management is attractive	18
2	The instructions for using the e-book are easy to read	16
3	The font size and style are appropriate and easy to read	18
4	The images presented are appropriate (neither too many nor too few)	17
5	The images presented correspond to the content of the material	18
Content Aspect		
1	The e-book on risk management helps provide a sense of comfort and safety when conducting chemistry practicums in the laboratory	16
2	The e-book on risk management can help facilitate the implementation of chemistry practicum activities in the laboratory	16
3	The material presented in the e-book on risk management is arranged in a logical and systematic order	18
4	The presentation of the material is interesting	14
5	The sentences used in the e-book on risk management are easy to understand	15
6	The images and illustrations contained in the e-book on risk management help make the	17

No	Assessment Indicators	Total score
	content easier to understand	
Usefulness Aspect		
1	The e-book on risk management makes it easier to identify risks that may occur during laboratory practices	15
2	The e-book on risk management increases awareness of the importance of occupational safety and health (OSH)	17
3	The e-book on risk management is flexible and practical for students because it can be used anywhere and anytime without the assistance of a teacher	16
	Total score	**231**
	Maximum score	**280**
	Percentage result	**82,5%**

Table 8. Summary of Practical Test by Student

No	Statement	Total score
1	The overall appearance of the e-book on risk management is attractive	38
2	The instructions for using the e-book are easy to read and follow	38
3	The e-book on risk management helps me find information about the hazards of tools and materials before conducting laboratory activities	39
4	This e-book helps me understand the risks that may occur during laboratory practices and increases my awareness of the importance of occupational safety and health (OSH)	40
5	The images and illustrations contained in the e-book on risk management help make the material easier to understand	39
6	The types and sizes of fonts used in the e-book are clear and easy to read	40
7	The sentences and paragraphs used in the e-book are clear and easy to understand	40
8	The e-book on risk management is flexible and practical because it can be used anywhere and anytime without the assistance of a teacher	36
	Total score	**310**
	Maximum score	**320**
	Percentage result	**96,8%**

Discussion

The development of the e-book on risk management in chemistry laboratories at senior high schools in this study addresses a fundamental problem in chemistry practicum learning: the high potential for laboratory hazards, which is not yet supported by the availability of learning resources that specifically and systematically discuss risk management and OSH. Although the high school chemistry curriculum for phase E and phase F explicitly requires student participation in practicum activities, safety aspects are often treated as implicit knowledge that depends on teachers' verbal instructions. This finding strengthens the argument for supporting teaching materials, not only informative but also pedagogically structured to build risk awareness and an OSH culture in schools.

The curriculum analysis shows that the chemistry subject outcomes at the high school level are divided into two phases, namely phase E (grade X) and phase F (grades XI and XII) (SK 008/H/KR/2022). In phase E, chemistry practicums focus on basic materials, such as types of chemical reactions and fundamental chemical laws. In phase F, practicums include reaction rate factors, chemical equilibrium shifts, exothermic and endothermic reactions, calorimetry, acids and bases, buffer solutions, acid-base titrations, electrolysis cells, and voltaic cells. The e-book was designed in accordance with high school laboratory standards, including the tools, materials, and facilities used in practicum activities. The e-book structure consists of three sections: the beginning, the main content, and the ending. The main content includes chapters on types of laboratories, occupational safety and health, hazard identification, risk management, personal protective equipment, and accident handling, which reflect international best practices in laboratory education that integrate conceptual learning with risk management and emergency preparedness (Wang, Su, Cao, & Li, 2023) so that students understand the concept of risk management contextually according to practical activities at school.

The validity test was conducted to assess the product's validity before field testing (Pratiwi et

al., 2024). The e-book's validity was assessed based on three aspects: content, media, and language. The validation by content experts evaluated the product on material feasibility and presentation, including content accuracy, relevance, and completeness. The content validity score averaged 3.7 (very valid). Media experts evaluated the design, layout, font, color combination, and overall neatness, obtaining an average score of 3.83 (very valid). Language experts assessed the linguistic appropriateness and readability, yielding an average score of 3.79 (very valid). These results indicate that the e-book met the feasibility standards for content, design, and language. Similar results were reported by Sudiana and Suja (2021), who developed a chemistry practicum handbook emphasizing OSH, demonstrating high validity and feasibility.

The readability test was conducted after the product was validated and revised based on evaluations by content, media, and language experts. The readability test involved nine twelfth-grade students of a senior high school. The selection of the readability test subjects was based on diverse academic abilities, including students with high, medium, and low academic achievement. This is consistent with Buraga's (2025) research, which found a positive relationship between academic achievement and students' reading ability.

This approach was also used by Redhana et al. (2024) in developing a digital book that involved nine students with different academic abilities to obtain a comprehensive overview of the readability test results, which reflected students' overall understanding. Based on the readability test, the readability was 95.6%, which falls into the very good and well-understood category. In general, students found the developed e-book easy to understand.

However, the readability test also found some errors in word spelling. These errors were corrected to improve the e-book's content before it was used in the next stage. The readability test results showed that the developed e-book on risk management in chemistry laboratories was generally easy to understand for students, as assessed.

Based on the practicality test conducted, the percentage of practicality test results from teachers was 82.5%, and from students was 96.8%. Both percentages indicate that the developed e-book on risk management in chemistry laboratories falls into the very good category.

The research result is consistent with the findings of Maulida et al. (2022), who reported that their developed e-book had a high level of practicality, making it very useful as a teaching material. In general, teachers and students reported that the e-book was practical to use in terms of its product application, content, cost, and ease of access. However, several teachers and students suggested adding interactive videos to the presented materials. This suggestion aligns with the research of Anwar et al. (2021), which found that an e-book with video features can help clarify concepts and encourage user interaction during the learning process. In addition, Suarsana (2021) emphasized that the use of interactive digital books with visual and multimedia representations can enhance students' engagement and understanding. Therefore, the addition of learning videos can be used as a recommendation for developing interactive e-books in future research. Within the limitations of this study, the developed e-book has successfully achieved its main objective: to provide enriching learning resources that are valid, easy to understand, and practical to support the implementation of occupational safety and health in high school chemistry laboratories.

Overall, this discussion emphasizes that the e-book on risk management in chemistry laboratories at senior high schools has significant contributions both pedagogically and practically. The research findings consistently support the conclusion that this e-book is feasible to use as supplementary teaching material for chemistry practicums and has direct implications for strengthening the occupational safety and health culture in schools. Thus, this study not only produced a development product but also provided an empirical basis for efforts to improve work safety in secondary school laboratories. While the e-book received high marks for validity, readability, and practicality, further research is needed to evaluate its long-term impact on student safety behavior. Future studies could incorporate interactive features, such as instructional videos, to further enhance engagement and understanding.

CONCLUSION

This study developed an e-book on risk management in high school chemistry laboratories that meets high standards of validity, readability, and practicality. This study demonstrates that the e-book on risk management in chemistry laboratories is a highly effective tool for enhancing occupational safety and health awareness. Its widespread adoption could significantly improve safety practices in high school chemistry labs, fostering a culture of safety and prevention that will benefit both students and teachers. The e-book is a feasible and effective digital learning resource for enhancing occupational safety and health awareness among students. By systematically integrating risk management principles into chemistry practicum learning, the e-book has the potential to foster a proactive safety culture in school laboratories. Its broader adoption may contribute to improving laboratory safety practices and preventing accidents in high school chemistry education.

RECOMMENDATION

This research was limited to the development stage. Therefore, the results obtained can serve as an empirical basis for further studies. Future research is recommended to integrate interactive features and examine the effectiveness of the e-book in improving students' safety behavior in the laboratory. Thus, further development is expected to strengthen this e-book's contribution to occupational safety and health in high school chemistry laboratories and to enrich the study of instructional material development based on risk management in science Education. Further studies are recommended to implement the e-book in broader educational contexts and to evaluate its long-term effectiveness in improving students' safety behavior. The integration of interactive multimedia elements is also suggested to enhance engagement and learning outcomes.

BIBLIOGRAPHY

Almutairi, N. S., Tamrin, S. B. B. M., Guan, N. Y., & How, V. (2020). Review of knowledge, attitude, and practice among laboratory workers towards occupational safety and health. *Malaysian Journal of Medicine and Health Sciences*, *16*(1), 297–303.

Amanah, I., Nugraha, W. D., & Priyambada, I. B. (2011). Identifikasi Bahaya Dan Penilaian Risiko (*Risk Assessment*) di Laboratorium Studi Kasus di Laboratorium Lingkungan. In *Fakultas Teknik Universitas Diponegoro*. Universitas Diponegoro.

Anwar, M., Alimin, & Munawwarah. (2021). An interactive *e-book* development based on green chemistry study on Hydrocarbon. *Journal of Physics: Conference Series*, *1899*(1). https://doi.org/10.1088/1742-6596/1899/1/012161

Aven, T. (2016). Risk assessment and risk management: Review of recent advances on their foundation. *European Journal of Operational Research*, *253*(1), 1–13. https://doi.org/10.1016/j.ejor.2015.12.023

Bretz, S. L. (2019). Evidence for the Importance of Laboratory Courses. *Journal of Chemical Education*, *96*(2), 193–195. https://doi.org/10.1021/acs.jchemed.8b00874

Buraga, C. (2025). The Relationship Between Academic Performance and Reading Ability among Grade 7 Students. *Journal of Interdisciplinary Perspectives*, *3*(5). https://doi.org/10.69569/jip.2025.162

Caporossi, L., Rosa, V., Gatto, M. P., & Papaleo, B. (2023). A Field Survey on Promotion of Safety in School Laboratories. *International Journal of Active Learning*, *8*(1), 60–69.

Caymaz, B. (2021). Secondary School Students' Knowledge and Views on Laboratory Safety. *Journal of Science Learning*, *4*(3), 220–229. https://doi.org/10.17509/jsl.v4i3.30752

Ezeano, Alice ; Ezeudu, Florence. (2018). Application of Laboratory Management Skills by Chemistry Teachers in Enugu State. *Journal of Education and Practice*, *4*(July), 159–165.

SK 008/H/KR/2022 Tentang Capaian Pembelajaran Pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, Dan Jenjang Pendidikan Menengah Pada Kurikulum Merdeka, Kemendikbudristek Bskap RI (2022).

Guldenmund, F. W. (2000). The nature of safety culture: A review of theory and research. *Safety Science*, *34*(1–3), 215–257. https://doi.org/10.1016/S0925-7535(00)00014-X

Kusuma, Y. A., & Bima, A. C. A. (2022). Pengelolaan Laboratorium dengan Menerapkan Analisis Manajemen Risiko. *Jurnal SENOPATI : Sustainability, Ergonomics, Optimization, and Application of Industrial Engineering*, *3*(2), 95–101. https://doi.org/10.31284/j.senopati.2022.v3i2.2903

Lasia, I. K., Gunamantha, I. M., & Budiada, I. K. (2017). Pelatihan Teknik Penggunaan Bahan Kimia Untuk Peningkatkan Keselamatan Kerja Di Laboratorium Kimia. *Jurnal Widya Laksana*, *3*(1), 44. https://doi.org/10.23887/jwl.v3i1.9150

Maulida, S. I., Adnyana, P. B., & Bestari, I. A. P. (2022). Pengembangan *E-book* Berbasis Problem Based Learning pada Materi Perubahan Lingkungan dan

Daur Ulang Limbah untuk Siswa di MAN Karangasem. *Jurnal Pendidikan Biologi Undiksha*, *9*(2), 116–129. https://doi.org/10.23887/jjpb.v9i2.49582

Maurits, L. S., & Widodo, I. D. (2008). Faktor dan Penjadualan Shift Kerja. *Teknoin*, *13*(2), 18–22. https://doi.org/10.20885/teknoin.vol13.iss2.art4

National Safety Council. (2011). *Injury Facts, 2011 Edition*. Itasca, IL: Author.

Permendikbudristek Nomor 22 Tahun 2022 Tentang Standar Mutu Buku, Standar Proses Dan Kaidah Pemerolehan Naskah, Serta Standar Proses Dan Kaidah Penerbitan Buku, Permendikbudristek (2022).

Pertiwi, F.; Yuliyanto, E. (2015). Analisis Pengetahuan Konsep (K3) Laboratorium Kimia Di Man 2 Kota Semarang. *Seminar Nasional Pendidikan, Sains Dan Teknologitifi , Fakultas Matematika Dan Ilmu Pengetahuan Alam , Universitas Muhammadiyah Semarang*, *2011*, 114–123. https://jurnal.unimus.ac.id/index.php/psn12012010/article/view/3051

Pratiwi, N. W. C., Margunayasa, I. G., & Lasmawan. I. W. (2024). Media Pembelajaran Augmented reality Berbasis Profil Pelajar Pancasila Untuk Meningkatkan Minat Belajar IPA Kelas IV SD. *Jurnal Ilmiah Pendidikan Profesi Guru*, *7*(1), 110–122. https://doi.org/10.23887/jippg.v7i1.73179

Redhana, I. W., Sudria, I. B. N., & Suardana, I. N. (2024). A Digital Instructional Book: A Tool for Improving Students' Learning Outcomes on the Reduction and Oxidation Reactions. *Science Education International*, *35*(1), 61–70. https://doi.org/10.33828/sei.v35.i1.7

Riduwan. (2013). *Skala Pengukuran Variabel-Variabel Penelitian*. Alfabeta.

Riduwan, & Akdon. (2013). *Rumus dan Data dalam Aplikasi Statistika* (5th ed.). Alfabeta.

Ruddamayanti. (2019). Pemanfaatan Buku Digital dalam Meningkatkan Minat Baca. *Prosiding Seminar Nasional Pendidikan Program Pascasarjana Universitas PGRI Palembang*, *2*, 1193–1202.

Sartika, R. P., Maisyaroh, Timan, A., & Juharyanto. (2025). Chemistry laboratory management in senior high schools: a competency analysis. *Journal of Education and Learning*, *19*(3), 1510–1518. https://doi.org/10.11591/edulearn.v19i3.21850

Setiyanto, A. (2024). Potensi Kecelakaan Kerja Di Laboratorium Kimia. *Rinjani Natural Science and Technology Journal*, *1*(1), 37–49. https://journal.myrepublikcorp.com/index.php/rinjani/article/view/43%0Ahttps://journal.myrepublikcorp.com/index.php/rinjani/article/download/43/39

Suarsana, I. M. (2021). Developing Interactive Digital Mathematics Book with Multi Representation Approach for Deaf Students. *International Journal of Emerging Technologies in Learning*, *16*(13), 128–141. https://doi.org/10.3991/ijet.v16i13.22459

Sudiana, I. K., & Suja, I. W. (2021). Basic Chemistry Practicum Handbook with Occupational Health and Safety (K3) to Prevent Work Accidents in Laboratory: Validity and Feasibility. *Jurnal Pendidikan Dan Pengajaran*, *54*(1), 181. https://doi.org/10.23887/jpp.v54i1.31934

Sudria, I. B. N., Redhana, I. W., Suja, I. W., & Suardana, I. N. (2020). Self-assessment of chemistry laboratory basic skills using performance scoring rubrics at the chemistry teacher training. *IOP Conference Series: Materials Science and Engineering*, *959*(1). https://doi.org/10.1088/1757-899X/959/1/012005

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). Instructional development for training teachers of exceptional children: A sourcebook. In *Journal of School Psychology*. Center for Innovation in Teaching the Handicapped. https://doi.org/10.1016/0022-4405(76)90066-2

Trisna, M., R. Susanti, & Retno Sri Iswari. (2021). Knowledge Analysis of High School Students on Work Safety in Laboratory. *Bioeduscience*, *5*(2), 137–141. https://doi.org/10.22236/j.bes/526672

Wirasanti, P. (2020). Analisis Tingkat Pemahaman Tentang Keselamatan Kerja Di Laboratorium Kimia Pada Siswa Kelas XI SMA Negeri 1 Gianyar. Universitas Pendidikan Ganesha.

Wiratma, I. G. L. (2015). Pengelolaan Laboratorium Kimia pada SMA Negeri di Kota Singaraja: (Acuan Pengembangan Model Panduan Pengelolaan Laboratorium Kimia Berbasis Kearifan Lokal Tri Sakti). *JPI (Jurnal Pendidikan Indonesia)*, *3*(2). https://doi.org/10.23887/jpi-undiksha.v3i2.4459