

Comparison of Video and Leaflet Media on Chemical Laboratory Safety Knowledge Among Vocational High School Students in Serang

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Abstract. The likelihood of accidents occurring on the job is much greater in educational labs in comparison to industrial laboratories. In the context of vocational students, the purpose of this research is to evaluate the efficacy of video and leaflet media in terms of enhancing students' understanding of chemical laboratory safety guidelines. The methodology used in this investigation was a pre-experimental study that utilized a two-group pretest-posttest design. An overall sample that was split into two groups: one for video (30 students) and one for leaflet (30 students). In order to examine the data, the Paired Samples Test was used. According to the findings, the average knowledge score of the video groups improved from 54.59 (which is considered to be quite low) to 74.17 (which is considered to be excellent), with a gain of 19.58 points ($p < 0.001$). There was a significant rise of 25.69 points ($p, 0.001$) in the leaflet group's mean score, which went from 63.62 (moderate) to 89.31 (very excellent). Upon doing an investigation of effectiveness, it was determined that video media had a success rate of 74%, while leaflet media achieved a fantastic success rate of 89%. Before beginning their practicums, it is strongly suggested that students make it a habit to familiarize themselves with the safety laws that govern chemical laboratories.

Keywords: Chemical Laboratory Safety, Knowledge, Leaflet, Occupational Health, Video

1 Introduction

Educational laboratories have a higher risk of accidents compared to industrial laboratories. This is because students are still in the learning stage and frequently use different tools and materials for each practicum, whereas activities in industrial laboratories are more repetitive and controlled [1]. Such risks may lead to serious consequences, as demonstrated by the incident at Bogor Agricultural University (IPB). A master's student in the Department of Nutrition and Feed Science at IPB, Laila Atika Sari, tragically passed away in the incident. The accident happened on Friday, August 18, 2023, when Laila was conducting her research using the Soxhlet method for fat analysis in food samples. At around 4:00 PM WIB, a fire broke out in the laboratory, fatally injuring her [2]

According to [3], one of the direct causes of workplace accidents is unsafe actions by individuals. A lack of knowledge regarding occupational safety and health (OSH) in the workplace can make it difficult for individuals to recognize potential hazards in their surroundings. This lack of awareness leads to reduced alertness toward potential risks [4]. Knowledge is something that can be improved through the learning process. An interactive learning process can utilize media as a learning aid. Media is categorized into two types: printed media and electronic media. The use of learning media is expected to help teachers deliver material and make it easier for students to understand school subjects [5].

A leaflet is a type of printed media used to convey information or messages through folded sheets. Leaflets are typically designed to be visually appealing and written in simple language to ensure easy understanding by the readers [6]. Video is a form of electronic media that combines visual and audio technology that can be played simultaneously, making it an engaging and dynamic medium for delivering messages [7]. The use of electronic learning media greatly supports the learning needs of students, especially since many children today are more interested and active in using electronic media, such as smartphones. Electronic learning media can be accessed anytime and anywhere as long as the necessary devices are available in the surrounding environment [8].

SMK Kimia PGRI Serang City is a vocational high school specializing in chemistry education, aimed at producing analytical professionals who are faithful, pious, creative, innovative, high-quality, and nationally competent. Learning at SMK Kimia PGRI Serang City consists of approximately 50% practicum activities conducted in laboratories. The type of laboratory used in the school is an educational chemical laboratory. Educational laboratories have a higher risk of workplace accidents than industrial laboratories. This is because practitioners in educational settings are still in the learning process. In addition, every practicum session involves different tools and materials, whereas in industrial laboratories, activities are repetitive with the same tools and materials [1].

According to data from SMK Kimia PGRI Serang City, a laboratory accident occurred in 2023 involving a student named Adriyan from grade XII. He was conducting an organic chemistry practicum when he was exposed to sulfuric acid (H_2SO_4) in the eye area. According to information from the teacher, the incident occurred because the student was joking during the practicum, causing the acid to splash into his eye. Based on this background, the researcher conducted a study at SMK Kimia PGRI Serang City titled *"Comparison of Video and Leaflet Use on Chemical Laboratory Safety Rules to Improve Occupational Safety and Health Knowledge Among Vocational High School Students of Chemistry at PGRI Serang City in 2024."*

2 Methods

This research is experimental in nature, using a pre-experimental design with the two-group pretest-posttest design model [9]. This design involves conducting a pretest before the treatment and a posttest after the treatment. The design scheme is presented in Table 1.

Table 1. Two-Group Pretest-Posttest Design

1	X	2
<i>Pretest</i>	Video	<i>Posttest</i>
<i>Pretest</i>	<i>Leaflet</i>	<i>Posttest</i>

This study was conducted at SMK Kimia PGRI Serang City in 2024. The population in this study consisted of tenth-grade students, with the sampling technique being total population sampling, involving 60 students—30 in the video group and 30 in the leaflet group. The independent variable in this study is occupational safety and health (OSH) knowledge, while the dependent variable is the intervention using chemical laboratory safety rules through videos and leaflets.

A questionnaire was used consisting of a pretest and a posttest, in the form of multiple-choice questions with 24 items. Scoring was based on 1 point for each correct answer and 0 for incorrect ones. The questionnaire underwent content validation by three experts (an occupational safety lecturer, a chemistry teacher, and a laboratory practitioner), followed by a pilot test on 20 students outside the study sample. Data collection was conducted by first administering a pretest to assess initial knowledge. Participants were then randomly assigned into two groups: the video group (n=30) and the leaflet group (n=30). The video group was shown a 15 minute educational video on chemical laboratory safety, while the leaflet group was provided with printed materials containing the same content in a concise and illustrated format. After the treatment, a posttest was administered to measure the impact of the media used. The effectiveness of the two learning media—video and leaflet—was then compared.

To determine the difference in effect between the use of video and leaflet, a dependent two-mean test was used. If the data were normally distributed, the Paired Samples Test was applied. If not, the Mann-Whitney Test was used. An effectiveness percentage test was also employed to compare which media—video or leaflet—was more effective in improving students' knowledge of chemical laboratory safety rules. The percentage was calculated by dividing the total score by the ideal score and then multiplying by 100. The ideal score was calculated by multiplying the maximum score per question with the number of respondents and the total number of questions. These tests were used to assess whether there was a statistically significant improvement in students knowledge within each group and to evaluate the comparative effectiveness between video and leaflet media in line with the research hypotheses (H_0 and H_1). H_0 means there is no significant difference in the effectiveness of video and leaflet media in improving chemical laboratory safety knowledge among students of SMK Kimia PGRI Serang. While H_1 means there is a significant difference in the effectiveness of video and leaflet media in improving chemical laboratory safety knowledge among students of SMK Kimia PGRI Serang.

In additional, an effectiveness percentage test was conducted to compare which mendium video or leaflet was more effective in improving students knowledge of chemical laboratory safety rules. The percentage effectiveness was categorized as follows[6] ,Very Ineffective: 25%–40%, Less Effective: 41%–55%, Moderately Effective: 56%–70%, Effective: 71%–85%, and Very Effective: 86%–100%. This study received ethical clearance from the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Faletahan, with certificate number: 182/KEPK.UF/VI/2024.

3 Results

Table 2. Distribution of Pretest Scores on Knowledge of Chemical Laboratory Safety Rules (Video Group)

Category	Score Interval	Frequency	Percentage
Poor	25-40	3	10%
Fairly poor	41-55	13	43%

Moderate	56-70	10	33%
Good	71-85	4	13%
Very Good	86-100	0	0%
Total		30	100%
Average			54.59

Table 2 shows that the average score before the use of video in the video group was 54.59, which falls into the “fairly poor” category. Students with poor knowledge accounted for 10%, fairly poor 43%, moderate 33%, and good 13%.

Table 3. Distribution of Posttest Scores on Knowledge of Chemical Laboratory Safety Rules (Video Group)

Category	Score Interval	Frequency	Percentage
Poor	25-40	0	0%
Fairly Poor	41-55	5	16%
Moderate	56-70	6	20%
Good	71-85	11	37%
Very Good	86-100	8	27%
Total		30	100%
Average			74.17

Table 3 shows that after the use of video, the average score increased to 74.17, which falls into the “good” category. Students were distributed as follows: fairly poor 16%, moderate 20%, good 37%, and very good 27%.

Table 4. Distribution of Pretest Scores on Knowledge of Chemical Laboratory Safety Rules (Leaflet Group)

Category	Score Interval	Frequency	Percentage
Poor	25-40	0	0%
Fairly poor	41-55	4	13%
Moderate	56-70	20	67%
Good	71-85	6	20%
Very Good	86-100	0	0%
Total		30	100%
Average			63.61

Table 4 shows that the average score before the use of leaflets was 63.61, which falls into the “moderate” category. Students with fairly poor knowledge accounted for 13%, moderate 67%, and good 20%.

Table 5. Distribution of Posttest Scores on Knowledge of Chemical Laboratory Safety Rules (Leaflet Group)

Category	Score Interval	Frequency	Percentage
Poor	25-40	0	0%
Fairly poor	41-55	0	0%
Moderate	56-70	0	0%
Good	71-85	9	30%
Very Good	86-100	21	70%
Total		30	100%
Average			89.31

Table 5 shows that after the use of leaflets, the average score increased to 89.31, which falls into the “very good” category. The distribution includes 30% good and 70% very good knowledge.

Table 6. Paired Samples Test Before and After Video Use

Knowledge	Mean	SD	SE	P value	N
Before Video	54.59	11.354	2.073	0,000	30
After Video	74.17	14.696	2.683		30

Table 6 shows that the mean knowledge score before using video was 54.59 with a standard deviation (SD) of 11.354, while after using video it increased to 74.17 (SD = 14.696), yielding a mean difference of 19.58. The result of the Paired Samples Test yielded a p-value of 0.000, indicating a statistically significant difference before and after using video, with an effect size of Cohen’s d = 1.49 (large effect).

Table 7. Paired Samples Test Before and After Leaflet Use

Knowledge	Mean	SD	SE	P value	N
Before <i>Leaflet</i>	63.62	8.551	1.561	0,000	30
After <i>Leaflet</i>	89.31	7.149	1.305		30

Table 7 shows that the mean knowledge score before using leaflet was 63.62 (SD = 8.551), increasing to 89.31 (SD = 7.149) after the intervention. The mean increase was 25.69, and the p-value of 0.000 indicates a significant improvement in knowledge after using leaflets, with effect size of Cohen’s d = 3.24 (very large effect).

Table 8. Percentage Effectiveness Test of Video and Leaflet

Media	N	Total Score	Ideal Score	Percentage	Category
Video	30	534	720	74%	Effective
Leaflet	30	643	720	89%	Highly Effective

Based on table 8, the video group achieved a total score of 534, which corresponds to an effectiveness percentage of 74%, categorized as Effective. The leaflet group achieved a higher total score of 643, with an effectiveness of 89%, categorized as Very Effective. The total score was obtained by summing all students posttest scores in each group, while the ideal score was calculated by multiplying the maximum possible score per item (1 point) by the number of items (24 items) and the number of respondents (30 respondents), resulting in an ideal score of 720 for each group.

4 Discussion

4.1 Before and After Using Video

The results show an increase in average knowledge scores from 54.59 to 74.17 after using video, indicating a gain of **19.58 points**. The Paired Samples Test showed a significant difference ($p = 0.000$), supporting the finding that video use improves knowledge of laboratory safety, with a large effect size (Cohen's $d = 1.49$).

This aligns with [6], who found that the average score before using video was 69.86 and increased to 81.50 post-intervention. In this study, 28 out of 30 students improved their scores after watching the video. However, 2 students showed a decrease in their posttest results, likely due to inattention during video playback.

These findings suggest that while video is an effective medium for conveying laboratory safety information, its impact depends on students engagement and focus during viewing. According to the cognitive theory of multimedia learning, video can enhance understanding by combining visual and auditory channels, but if attention is divided, learning gains may be reduced. This interpretation is supported by [10] who also found significant learning improvements after video-based instruction, while [11] emphasized that animated videos are effective, easy to understand, and informative.

4.2 Before and After Using Leaflets

The average score increased from 63.62 to 89.31 after using leaflets—a gain of 25.69 points—with a significant p -value of 0.000. All 30 students improved in the posttest, confirming the effectiveness of the leaflet as a learning tool, with a very large effect size (Cohen's $d = 3.25$).

This finding supports [10], who observed an increase from 7.23 to 10.77 using leaflets. Leaflets allow students to review material multiple times at their own pace, enhancing understanding. [12] and [13] also support leaflets as accessible, low-cost, and effective learning aids. The strong impact of the leaflet intervention can be explained by its ability to provide self-paced learning, allowing students to repeatedly review information and focus on unclear points. This is in line with the cognitive load theory, which suggests that printed materials reduce extraneous load by letting learners control the pace of information intake.

4.3 Comparison of Video and Leaflet Use

Based on percentage effectiveness, the video group scored 74% (effective), while the leaflet group scored 89% (very effective). Leaflets were found to be more effective, possibly because learners can repeatedly read and review unclear points. In contrast, video content progresses on a fixed timeline, making it harder for students to pause and reflect during playback.

These findings are consistent with [14] who also found that leaflets are more effective for student health education than videos, as the information is clearly stated and can be read repeatedly. In contrast, students often get caught up in video narratives and miss key learning

points. Furthermore [13] emphasized that printed media like leaflets remain highly relevant in health promotion because of their practicality and adaptability to diverse learning contexts.

5 Conclusion

The use of leaflets is more effective in increasing students' knowledge of Chemical Laboratory Safety Rules at SMK Kimia PGRI Serang City. This finding highlights the practical value of printed materials as a low-cost and self-paced medium that allows students to repeatedly review safety information, making them especially suitable for covational school settings. It is recommended for future researchers to use different types of media, such as printed flyers, posters, bulletins, or electronic media like audio/radio, to explore their potential impact on learning outcomes.

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