The Need of Using Videos to Teach Distance Education Students in Chemistry Practicum

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Abstract:- Teaching chemistry practicum courses in distance education has its challenges. The diverse educational backgrounds, ages and teaching experiences of the student-teachers involved in this study determine how they view the use of videos in chemistry practicum courses in the distance education system. 39 Chemistry Education students at the Open University, in Indonesia and 8 Chemistry Education experts were involved in this survey research. The instrument used in the study was a video-equipped with a questionnaire. The study data were analyzed descriptively. The result showed that (1) The experts agree that videos are needed to equip students before doing practical works. The respondents who provided the most dominant responses have a degree in chemistry , are less than 40 years old, and have less than ten years of teaching experience. (2) The students' responses to the video given were rated as excellent and necessary. So, it is considered necessary to procure videos for distance learning of chemistry . However, practical activities in the laboratory are still needed.

***Keywords:-** Chemistry Practicum, Practicum Video, Distance Education.*

I. INTRODUCTION

Chemistry is an experimental science and is integral to laboratory work. For students to have a deep understanding of chemistry and learn it meaningfully, they must conduct experiments and have different laboratory skills (Talib et al., 2017). Laboratory literacy is part of science literacy. Chemistry learning is based on understanding concepts and requires having laboratory skills to test theories and know the benefits of learning chemicals in our everyday life (Zuhaida & Imaduddin, 2019). One of the courses that equip students with laboratory skills to identify, measure, analyze and communicate the results of their work in analytical and physical chemistry, organic, and inorganic biochemistry is chemistry practicum course (Permanasari et al., 2008). Moreover, as a form of initial education for laboratory users, namely students, it is necessary to teach them the course Introduction of Chemical experiments/laboratory equipment under chemistry practicum courses .

The introduction of laboratory tools is vital for occupational safety while conducting research. Laboratory equipment cannot be easily damaged or dangerous if used according to procedures. It is important to introduce laboratory tools for users to know how to use them correctly and adequately. It can help to reduce errors in the process of using them (Andriani, 2016). One has to be careful when using chemicals which could be very dangerous. Therefore, it is necessary to brief students about laboratory equipment before allowing them to work in the laboratory. In addition, describing the tools to be used in the laboratory can help the students to avoid obstacles in practice.

With the development of web and internet technology today, it is possible to provide materials for introducing chemical laboratory equipment through electronic learning. An example is video learning. In addition to preparing students for independent learning in this digital era, we need video-based learning to enhance digital literacy and students' critical thinking (Yuen et al., 2018). Video-based e-learning provides better learning outcomes because one of the fantastic benefits of the e-learning approach is that students can access video learning instruction anytime and anywhere (El-Ariss et al., 2021).

Video is a time-based medium consisting of visual elements that are often combined with other media elements to present content. Video has the characteristics of moving images, and visualizations with audio support are very suitable for application in learning activities (Yuen et al., 2018). Video can be interpreted as a medium that effectively engages an audience and provides a multi-sensory learning environment to present information interestingly (Preradović et al., 2020). To introduce active learning, video is often used as one of the strategies to make students actively involved in the learning process (Pulukuri & Abrams, 2020). Video serves as a learning and teaching resource in classroom learning and can also be integrated to support practicum activities (Tembrevilla & Milner-Bolotin, 2019). Students who participate in practicum activities agree that a video is an effective tool for material recognition. During the COVID-19 pandemic, video served as an effective visual pedagogy used to build initial understanding; it enabled perceptual learning and empowered students to cultivate material sense (Joseph & Johnson, 2020).

A video can be a powerful learning component if the content in it is explored more deeply. Therefore, video-based learning emphasizes the importance of lecturers' presence. A good video has narrative or story structure, a beginning, content, and conclusions which are presented clearly and in details. It can connect an audience to the learning content being discussed (Schulz & Iskru, 2021). The application of video in practicum activities provides a positive laboratory experience, integrating hands-on activities as part of the laboratory to overcome the shortcomings of "learning while

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doing" (Yeşİloğlu et al., 2021). The use of videos depicting instrumentation or experimental settings has also been found to be an effective pre-laboratory preparation strategy. In this work, a video was used to present information about the purpose of the experiment, clarify the details of procedures, explain calculations, and highlight safety considerations. It was found to significantly improve the quality of laboratory classes (Jolley et al., 2016).

The use of video in chemistry learning is based on several things, including the nature and characteristics of abstract matter that require visualization. Video application can also meet students' learning styles, increase their engagement, improve their communication, and allow students to collaborate with their peers, and reflect on what they learn (Yuen et al., 2018). Learning with video-based e-learning platforms can make students to have a deep understanding of complex materials (El-Ariss et al., 2021). Another positive effect of video is that it increases students' learning motivation. Using video can allow students to study independently and learn according to their learning styles (Schulz & Iskru, 2021). Previous studies have shown that active learning, the idea that learners interact with learning materials and resources, and interactive experiences can be achieved through video-based learning activities (Mirriahi et al., 2021). Video is considered as a major contributor to the changing educational landscape, acting as a powerful agent that adds value and improves the quality of the learning experience (Zaneldin et al., 2019). Video also positively influences the learning process, and students achieve excellent learning results when using video in their learning activities (Preradović et al., 2020).

Several studies have discussed the development and evaluation of virtual laboratory teaching materials, one of which explains that it is possible to carry out activities in the laboratory through online learning (Veljko et al., 2016). As the lack of laboratory equipment facilities can reduce learners' understanding (Gregory & Trapani, 2012), direct learning activities can be approached through online learning and face-to-face learning to achieve competencies.

The main challenge in providing chemistry lectures with remote systems is to offer students an authentic and meaningful laboratory experience that still provides the rigor necessary to further science (Brewer et al., 2013). As a college that uses an open and distance education system, the Open University certainly has its students' profiles. Students studying chemical education in the Open University have diverse educational backgrounds, ages, and teaching experiences. This provides a foundation for the need to study how students think about the use of video in chemistry practicum courses in the distance education system. This is because chemistry practicum lectures in the chemistry study program conducted so far have not specifically used videos to show students chemical experiments/laboratory equipment and examples of chemical experiments (distillation experiments). At the same time, the use of virtual laboratories built using video and involving students with various backgrounds produces positive feedback on chemicals delivered online (Malley et al., 2015). So, the purpose of this study is to illustrate students' views on the need to use videos in chemistry practicum courses. The videos contain chemical experiments/laboratory equipment and examples of chemical experiments (distillation experiments).

II. METHOD

The study used survey methods to obtain information about the student-teachers involved in distance learning. The respondents who participated in this study consisted of 39 (out of 125) student-teachers running Chemical Education Study program at the Open University, in Indomesia and eight chemical education experts . The student-teachers were teaching chemistry in high school. Instruments used in this study are videos that show chemical experiments/laboratory equipment and examples of chemical experiments (distillation experiments) in a chemistry practicum. The video showed results obtained from the Chemical Education study program's development. The data were obtained via questionnaires given to the students. The contents in the questionnaires were related to video needs in practicum courses and students' responses to video impressions given . Two media experts validated the instruments to assess their level of reliability . The data were analyzed based on the students' responses: 1) Respondents' views on video needs in chemistry practicum courses, 2) Respondents' responses to the videos aired. Data obtained were analyzed descriptively and presented in a table to see the percentage.

III. RESULTS AND DISCUSSION

➢ *Respondents' views on video needs in chemistry practicum courses*

Respondents' views on video needs in chemistry activities begin with analyzing needs. Through the opinions of the experts and students, we obtained a needs analysis. We used the experts' opinion as complementary data from the questionnaires given to the students. Media experts and materials experts validated the video instruments of chemical experiments/laboratory equipment and examples of chemical experiments (distillation experiments). The experts' validation assessment stated that the video was good enough to equip students doing practical work . To equip students to work in the laboratory, it is necessary to design a complete video of learning activities in our practicum courses.The experts suggested the followings.

- Provide more learning/video resources that illustrate the use of more concrete tools for students to understand them better.
- The experimental process must be presented step-by-step clearly so that students can easily follow it. The steps for each process must be stated, or the students must read the steps in the practicum module.
- The narrative in the video must guide and provide adequate information to the students.
- A narrative conversation must accompany the demonstration in the video to create a more communicative atmosphere.
- Attention must be paid to the video capturing process for it to be stable and interesting to watch.

- The material should be packaged in a lightweight application that students can access via mobile phone. A voice is needed to state the working procedure following the video.
- For the students doing the practicum to observe clearly, the background music must not be too loud.

As previously stated, all chemical education students involved in this research are in-service teachers. They have diverse educational backgrounds: most of them (48.7%) are high school graduates, some are doing Diploma programs such as Chemistry Education Natural Sciences (non-education) while others are Bachelor students of Pure Chemistry who transferred from Chemistry Education

Table 1. Students' responses based on their educational backgrounds

	Response	
	Agree	**Strongly Agree**
High school graduates	20.5%	28.2%
D3 Chemical Education students	2.6%	2.6%
Diploma students of natural sciences (non-educational)	25.6%	7.7%
Bachelor students of Pure Chemistry	0%	12.8%

Based on the students' responses, those that enormously agreed that the videos on chemical experiments/laboratory equipment and examples of chemical experiments (distillation experiments) create impression are the the pure chemistry students (Table 1). This is possible because the students still need to refresh the knowledge they had obtained before. They also know very well that tools and chemicals vary widely and caution needs to be taken when using them, especially chemicals that are generally very dangerous and require proper storage for them not to cause explosions. Considering that laboratory equipment has specific specifications and sizes according to their use, students, therefore, need to be taught introduction to laboratory equipment in order for them to understand them.

Table 2. Students' responses based on their ages

	Response	
	Agree	**Strongly Agree**
Under 30 years old	12.8%	17.9%
30 - 40 Years	33.3%	28.2%
41 - 50 Years	0%	5.1%
More than 50 years	2.6%	0%

Most of the student respondents are between 30 to 40 years old and under 30 years old, as shown in Table 2. These two decades of age are the productive age of one generation, and those who are still in their productive period generally have a high level of productivity in their performance. It is, therefore, very reasonable that they strongly agreed that the introduction of chemical experiments/laboratory equipment and examples of chemical experiments (distillation experiments) should be taught via video because they need it to develop their understanding of practicals in the laboratory.

Table 3. Students' responses based on their teaching experience

	Response	
	Agree	**Strongly Agree**
Less than 5 years	20.5%	15.4%
Between 5 to 10 years	12.8%	20.5%
Between 10 to 15 years	12.8%	12.8%
More than 15 years	2.6%	2.6%

Most of the student-teachers' teaching experience is generally less than ten years, and only 30.7% have more than ten years of teaching experience, as shown in Table 3. However, the students whose teaching experience is more than ten years agreed and strongly agreed that the introduction of chemical experiments/laboratory equipment and examples of chemical experiments (distillation experiments) should be taught via video. They considered it essential and did not judge themselves to be experts working in a chemical laboratory because of their long teaching experience only. Generally, a teacher with long teaching experience will perform better than when they started teaching. Foster (2001) explained that measuring the level of work experience of an employee can be seen from; 1) length of time/working period, 2) the level of knowledge and skills possessed, and 3) mastery of work and equipment. Furthermore, Eliyanto & Wibowo (2013) explained that teaching experience has a positive and significant effect on the professionalism of teachers.

➢ *Respondents' response to the video shown*

The students assessed the video by filling in the students' response questionnaire after listening to the video on introduction of laboratory tools and distillation experiments. Then, the students' responses to the video were collected using a closed ended questionnaire with a rating scale model scores between 1-4. A questionnaire was designed in the form of a checklist filled by the students. It consisted of 13 items. The score options in the questionnaire are: 1 for "strongly disagree" answer; 2 for "disagree" answer; 3 for "agree" answer, and 4 for "strongly agree" answer.

We analyzed the data by calculating the percentage of the total number of response scores to the ideal score. To determine the ideal score, we calculated from the results of multiplication between the maximum answer score value of 4 (four) multiplied by the number of research respondents and the number of statement items in the questionnaire. After that, the students' responses were compiled in a score table. The percentage obtained was converted into qualitative data of five categories, namely: 1) not good, 2) less good, 3) good enough, 4) good, and 5) excellent. Eligible responses are arranged in tables such as table 1 below.

Table 4. Students' eligible responses to introduction of laboratory tool video

No	Interval	Category
1	86% - 100%	Excellent
2	71% - 85%	Good
3	56% - 70%	Pretty Good
4	41% - 55%	Less Good
5	25% - 40%	Bad

(adapted from: Arikunto, Suharsimi, 2018)

The results of the percentage analysis of the students' response showed a percentage value of 75.74%. Table 5 below shows the percentage results.

Table 5. Categories of students' response to introduction of laboratory tool video

Number of respondents	Total score	Ideal score	Percentage %	Category
39	1536	2028	75.74%	Good

The students agreed generally with each statement given in the study . The highest percentage of responses to the statement, 'videos on introduction of laboratory tools can make students understand them before working in a laboratory' is 85% (table 6).

Table 6. Students' response to introduction of laboratory tools video

No	Interval	Percentage
1	The images of the video footage of the introduction of laboratory tools are clear and sharp .	79%
2	Video footage of the introduction of laboratory tools shows suitable illustrations	81%
3	Videos consisting of interesting caption/graphics of laboratory tools create impressions	77%
4	Video footage of introduction of laboratory tools can provide an initial understanding before working in a laboratory	85%
5	Videos consisting of a voice that presents the lab tools make it easy to understand them	79%
6	Video footage of introduction of lab tools shows presenter's voice too fast	63%
7	Video on introduction of laboratory tools creates memorable tool images	76%
8	Video footage of introduction of laboratory tools has good sound effect	72%
9	Video footage of introduction of laboratory tools shows interesting images	76%
10	Video footage of introduction of laboratory tools shows clear articulation	78%
11	Video of introduction of laboratory tools explains the functions of the tools well	73%
12	Video of laboratory tools describes the procedure for using the tools easily	72%
13	Video of introduction of laboratory tools explains the characteristics of the tools	73%

In addition to introducing laboratory tools, the researcher also gave the students examples of chemical experiments videos, and the students responded very well. The researcher thought that the students strongly agreed with the statements because, through the video footage of chemistry experiments, the students can recall the steps used in conducting previous experiments, either in the place where they are teaching or their previous school. After all, they have previously completed the program that is allied with chemistry or chemistry education at the diploma level.

According to the expert respondents and student-teachers, the introduction of laboratory tools video is considered excellent and necessary. They further explained that distance education can use video learning to develop its programs, including chemical education study programs . This is because learning via videos can help communicate the messages that are conveyed better and provide understanding to the recipient of the messages (Sherin, 2017). Some research works on the development of video learning media have also been done to show that video media can support the success of learning. Munir (2012) mentioned that video media is very suitable as a teaching material in the psychomotor realm (such as practicum) and can clearly show procedural steps (e.g., how to pour chemicals).

IV. CONCLUSION

The use of video for passing instruction in a learning environment has gained popularity on the Web as a medium of presenting material for e-learning (Chan, 2010). The use of media in the learning process primarily aims to improve understanding of the learning materials provided, especially for students participating in distance education (Geri, 2012). The effectiveness of its use depends on the level of conformity with the material taught (Monisha & Balakrishnan, 2020). Therefore, the selected learning medium must display objects or events that contain meaning.

The hope of using learning media in video programs is to display images of the objects students are studying (Santaga et al., 2021). Information obtained from performance activities can help students' initial understanding of further activities (Chan, 2010). Whatley (2007) states that video program impressions at the beginning of activities help generate interest or motivation and help students' readiness to work in the laboratory. If the videos are presented in a structured and gradual manner, students would understand the process of the practical experimentation. Also when videos are used appropriately, they can be a powerful teaching medium to attract students and motivate them to learn. The use of video impressions, in general, can help to train the cognitive abilities of students. However, they have not been able to train the affective and psychomotor abilities of students. Although there are videos showing activities, practical activities in the chemistry laboratory are still necessary to provide hands-on experience with the object students are studying.

Some limitations of this study include the followings:

1. The number of the study respondents is not enough to describe the actual situation
2. The object of the study only focused on the need for the video to be shown with respondents of three variations in the input background with different proportions of the number of videos.
3. In the data collection process, we are not too sure whether the information provided by the respondents through the questionnaires is real, that is, it might not be their actual opinions.

This is because sometimes the thoughts, assumptions, and understanding of the respondents might vary , and they might not be honest in answering the questionnaire. Therefore, caution needs to be taken in generalizing the results of this study.

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