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Pre-Study: Innovation in Cheistry Learning Base Interactive Virtual Lab

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Abstract: *This study aims to identify the problems faced by students in implementing learning. This study used a quantitative approach with a survey method, involving 30 students from two high schools in Yogyakarta. Data were collected through questionnaires about students' learning difficulties, interests, and needs for learning media. The results showed that 96% of the students considered chemistry as a difficult subject to understand because of the abstract nature of the material. As many as 64% of the students felt bored due to the uninteresting presentation of the material, while 72% of the students indicated the need for varied learning methods and interactive learning media to facilitate understanding. The results of the study showed that an innovation was needed to support chemistry learning activities to make learning more active and enjoyable so that it does not lead to student boredom. The developed virtual laboratory media provides flexible, safe and economical simulation of chemical experiments. This application is designed to be accessible without an internet connection using an Android device, allowing students to learn anytime and anywhere. The use of this virtual lab is expected to increase students' motivation, understanding of concepts, and learning experience.*

Keywords: *Chemistry Learning, Innovation, Virtual Lab.*

1. INTRODUCTION

In the era of globalization, the development of information and communication technology provides a great opportunity to integrate digital media in learning (Sugiarto & Farid, 2023). This technology allows students to have a more flexible, interesting, and interactive learning experience, thus meeting the challenges of 21st century learning. In line with Sanaky (2009) statement, innovative learning media can increase students' interest in learning and understanding of the material, making the learning process more effective and efficient.

Chemistry is one of the subjects that plays an important role in high school education. The role of chemistry is important in providing an understanding of the elements of life. The concepts contained in chemistry are generally abstract concepts that require deep understanding from students. The main challenge in learning chemistry lies in the difficulties students face in understanding abstract concepts that are often not easily visualized or directly felt (Nakhleh, 1992). For this reason, the researcher wants to assess whether there are problems that occur in the process of learning chemistry in school.

Learning that can provide concepts and direct experience is very important in developing students' abilities (Arista & Kuswanto, 2018). Based on Edgar Dale's Cone of Experience theory, the most effective learning is learning that involves simulation or direct experience has a higher effectiveness than the lecture method. According to Puspitarini & Hanif (2019) utilizing interactive learning, like virtual labs, can be a solution. This medium

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offers flexibility because it can be accessed at any time through students' smart devices. In addition, this virtual lab allows students to simulate chemical experiments that are difficult to perform in a physical lab, such as hazardous chemical reactions or experiments that require expensive equipment. This medium provides a safe and affordable laboratory experience without compromising the essence of the hands-on experience. This is what makes the virtual lab very useful in learning (Domingues et al., 2010).

This research is important to identify the problems students face when learning chemistry in school. The wrong learning process can lead to a lack of motivation among students, resulting in a lack of understanding of the material. This research plays an important role in identifying solutions to reduce the barriers students face in the learning process.

2. LITERATURE REVIEW

Chemistry is one of the required subjects in the high school curriculum. The role of chemistry is important in providing an understanding of the elements of life. The concepts contained in chemistry are generally abstract concepts that require deep understanding from students. The main challenge in learning chemistry is that students have difficulty understanding abstract concepts that are often not easily visualized or directly felt. Therefore, an interactive learning approach is needed to help students connect knowledge of abstract concepts with real-world phenomena.

Learning is inextricably linked to two interrelated learning components the learning process and the teaching process. According to Slameto (2003) learning is a process of effort that a person makes to achieve changes in overall behavior as a result of his or her own experiences in interacting with the environment. According to Permendiknas No. 22 of 2006, the Chemistry subjects in SMA/MA aim to provide students with the following abilities

a. To form a positive attitude towards chemistry by recognizing the order and beauty of nature and glorifying the greatness of God Almighty.
b. To develop scientific attitudes that are honest, objective, open, resilient, critical, and able to cooperate with others.
c. To gain experience in applying the scientific method by designing experiments by setting up instruments, collecting, processing, and interpreting data, and presenting the results of experiments orally and in writing.
d. To increase awareness of applied chemistry, which can be both beneficial and detrimental to individuals, communities, and the environment, and to recognize the importance of managing and preserving the environment for the well-being of society.

e. Understand chemical concepts, principles, laws, and theories and their interrelationships and applications to solve problems in everyday life.

One of the most important functions in chemistry learning is to provide experiences that are interactions between students and the learning environment. Good chemistry learning is learning that can provide learning experiences for students. Learning experiences can be provided through learning activities that use a variety of learning media.

Knowledge gained in chemistry learning is mostly obtained through laboratory experiments and practicum (Ramnarain & Penn, 2019). Practicum is an important learning method because it provides students with direct experience. Chemistry practicum activities help students to connect theories with real applications, not abstractions, and to understand all the concepts they have learned. Chemistry laboratories are necessary for students to perform practicum activities (Seery et al., 2018).

Virtual lab is a computer-based medium that contains simulations of activities in a physics lab. Virtual labs are created to illustrate reactions that may not be visible in real life. A virtual lab is defined as an interactive multimedia object. Interactive multimedia objects consist of various heterogeneous formats, including text, hypertext, sound, images, animation, video, and graphics.

Virtual laboratory, or commonly referred to as virtual lab, is a set of laboratory equipment in the form of interactive multimedia-based computer software that is operated by a computer and can simulate laboratory activities as if the user is in the actual laboratory (Jasmadi, 2018: 20).

The virtual lab is a learning innovation in the form of learning media that allows students to digitally simulate experiments without the need for complete physical laboratory facilities (Woodfield at al., 2006). In the context of chemistry education, virtual labs offer practical solutions for schools with limited equipment, materials, and time. Virtual labs can strengthen students' understanding of concepts, and as a substitute or supplement to real labs, because students can interact directly with the material being studied or not understood (Tatenov et al., 2023). The use of virtual labs may require students to have a scientific mindset and scientific process skills in order to find concepts without working in a real lab. In addition, learners with visual skills can explore their knowledge based on virtual laboratory activities that are flexible according to their speed and needs (Maryuningsih et al., 2019). The main advantage of virtual labs is their flexibility. In terms of learning, virtual labs offer great advantages in helping learners understand abstract chemical concepts. With clear visualizations and interactions designed to mimic real laboratory conditions.

3. METHODS

This research uses a quantitative approach with survey data collection. The survey research method answers questions about a person's beliefs and behavior. This research was conducted in SMA Kolombo and SMA UII Yogyakarta in class XI with a sample of 30 students selected to represent the existing population.

The researcher asked several respondents about past or present beliefs, opinions, characteristics of an object, and behavior. Data collection is done by making a form-based questionnaire regarding students' opinions on the ongoing learning of chemistry. The things that are considered are aspects of attention, enjoyment, learning activities and students' interest in learning chemistry. From this aspect, questions were made about the level of complexity/difficulty of learning, the level of student motivation, and how the teacher teaches methods.

4. RESULTS & DISCUSSION

The data from the survey on students' problems in learning chemistry will be described in the following way:

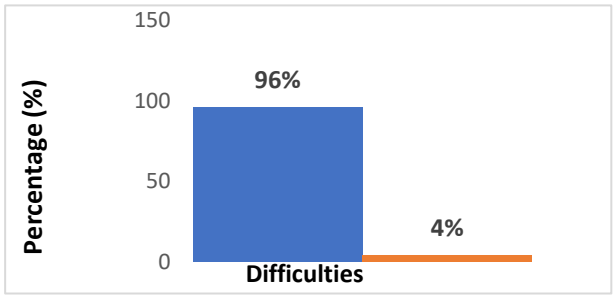

Figure 1. Students' opinions about chemistry difficulties

Figure 1 shows that as many as 96% of the students have difficulty in learning chemistry because the chemical material is too abstract and difficult to understand. Students indicated that buffer solution material is one of the class XI materials that is considered difficult to understand.

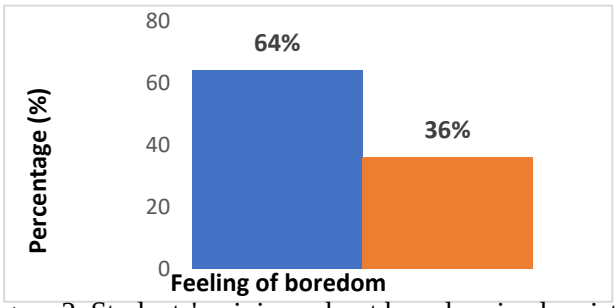

Figure 2. Students' opinions about boredom in chemistry

Figure 2 shows that 64% of students said they were bored while studying chemistry because the presentation of the material was less varied, so students were less motivated.

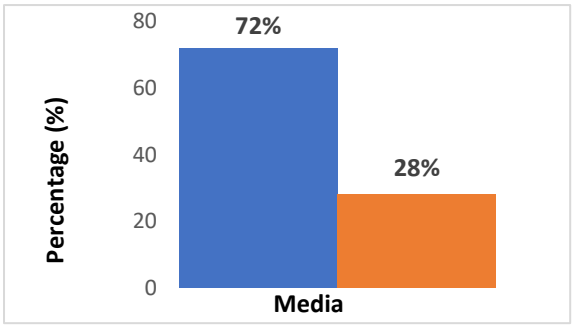

Figure 3. Students' opinions about the methods of instruction

Figure 3 shows that 72% of students stated that they need media that can help teachers implement the learning process, making it easier to understand difficult chemistry material. To address this desire, teachers can facilitate students by providing better and more meaningful chemistry learning than before using learning media (Puspitarini & Hanif, 2019)

The results of student observations are consistent with the results of interviews with chemistry teachers, where students often have difficulty understanding chemistry material. Especially in understanding material that is abstract and requires direct experience, such as practicum. However, practicum activities are often not carried out due to limited tools and materials in the school. Even if the practicum is done, it is often very short because a lot of time is used to prepare the equipment. As a result, students do not maximize their understanding of what is being practiced.

Based on the results of these interviews, it is clear that the limitation of hands-on tools and materials is a significant problem in the implementation of chemistry learning. This limitation results in students not getting the direct experience needed to understand chemical concepts, which are often abstract. Although the laboratory is available, the lack of tools and materials as well as the time wasted in preparing for the laboratory makes the learning process suboptimal (Ambarwati et al., 2018; Anggereni et al., 2021; Harling & Martono, 2021). Further observations also show that teachers still dominate learning activities (lectures) and still do not use interactive technology and information in learning. As a result, students are less engaged in the material and have difficulty connecting the theory learned to its application in the real world.

On the other hand, most of the knowledge gained in chemistry learning is gained through laboratory experiments and practicums. Based on Edgar Dale's cone of experience, the most effective learning is learning that is directly related to purposeful learning experiences. Hands-on learning is an important learning method because it provides learners with direct experiences. Hands-on learning requires students to recognize, become familiar with, and practice scientific steps and procedural knowledge. In addition to helping students understand concepts, hands-on learning also increases students' motivation and interest in learning

(Darmawan et al., 2021). This direct experience helps students deepen their understanding of abstract chemical concepts (Anderson & Krathwohl, 2010). In addition, through experiments or hands-on activities, the material presented is better understood by students.

Learning innovations need to be made in chemistry subjects so that the material can be understood by students. One solution that educators can provide is the development of technology-based learning media, such as virtual laboratories, especially for buffer solution chemistry materials that require activity. These media allow students to interactively simulate chemical experiments without the need for complete physical facilities. With a virtual lab, students can conduct experiments with tools and materials that are digitally represented so that they can still understand the scientific process and improve their science skills. This medium offers flexibility of time and place, where students can access hands-on simulations at any time, both at school and at home. Thus, the virtual lab can be a suitable learning medium to overcome the limitations of schools.

Based on the results of the literature, there are many virtual lab platforms that can be accessed online. Compared to the literature, the virtual lab created by the author is easily accessible by students and teachers via Android without the need for an Internet network. This is done so that students' smartphones can be useful in the learning process. In addition, teachers are also expected to develop other variations of chemistry learning media according to the material presented, as it has not been widely developed.

5. CONCLUSION

The survey results showed that 96% of the students said that chemistry learning tends to involve material that is difficult to understand. As many as 64% of the students stated that the chemistry learning process tends to be boring, and 72% of the students stated that they need media that can support the learning process so that it is easier to understand difficult chemistry material. Based on the results of the study, an innovation is needed to support chemistry learning activities to be more active and fun so as not to cause boredom among students. Researchers suggest the use of media in learning, namely a virtual laboratory. The use of virtual laboratories can provide students with an understanding of concepts and experiences related to the material presented.

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