

# Problem-Based Chemistry Learning Reviewed from the Ability to Use Virtual Laboratories to overcome Pandemic Era

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**Abstract:** Media is an instrument that can be utilized to pass data on to understudies, one of them is a virtual laboratory. Currently an instructor should invigorate so understudies become more dynamic. Illustrations are conveyed by instructors who are hypothetically would get not exactly the most extreme outcomes. Accomplishing lab work is one perspective abilities of understudies in acquiring science. Understudies can take care of the issue of science by associating the perceptions in the lab results with hypothetical develops that have been held so it can fabricate structures with great idea. Apparatuses, materials and synthetic substances as well as an extraordinary peril is a deficiency of perception in the lab, so it requires the virtual research facilities that don't have such incredible risk. The sort of examination utilized is research with writing concentrate on approach. The outcomes acquired from this writing study is a science study directed by practicum utilizing a virtual research facility gives more solace to understudies during the lab with the goal that understudies all the more effectively comprehend the material and have a more profound impression.

**Keywords:** Virtual Laboratories, Media, Problem Based Learning, Pandemic

## 1. INTRODUCTION

Facing increasingly complex future challenges, the government continues to strive to improve the quality of human resources in Indonesia. One way is to improve the quality of education in Indonesia. Improvements in the quality of education that have been done include curriculum improvement, procurement of package books and improvement of the quality of teaching staff.

Chemical learning is currently in general already underway, but it is very necessary to improve again because based on the fact that the chemical value is still less than optimal. In general, chemical learning today still tends to focus on teachers, so we need to change little by little learning that focuses on students. Therefore, in the process of transferring science and chemical knowledge in schools need to be improved effectiveness so that the quality of learning is always maintained and the expected results can meet the learning goals set. In order for the teaching and learning process to succeed properly, teachers should be able to provide a stimulus so that students can be active in following teaching and learning because the learning methods that every student does in taking lessons will affect learning achievement.

The process of science should be taught through practicum, but this is rarely done by teachers for several reasons, including no specific time for practicum, inadequate tools and practicum materials, and some do not master the workings in the laboratory. Practicum plays an important role in science learning. Laboratory activities or often known as practicums that have been carried out are still classified as verification laboratories. Laboratory verification activities are laboratory activities where the practice only performs its activities based on the instructions or ways of working in the practicum manual. Overly detailed practicum instructions result in less encouraging students to be creative in organizing their ability

to plan and solve problems they face. Such activities can cause students to not become active and make the ability to think creatively students are not well honed

At this time educators have begun to get access to use various technologies to improve the effectiveness of the learning and teaching process. Computers as one of the technological products are considered appropriate to be used as teaching aids. Various instructional approaches packaged in the form of computer-aided teaching programs or CAI (Computer-Assisted Instruction) such as: drill and practice, simulation, tutorials and games can be obtained through a computer. Simulations of the real environment (virtual reality) created by the computer, and users can interact with results that show the content of the reality of the environment called virtual reality

Tools are everything that can be used in order to achieve teaching goals. As everything that can be used in achieving teaching goals, tools have a function that is tools as equipment, tools as assistants make it easier to achieve goals and tools

Media are graphical, photographic or electronic tools for capturing, processing and recasting visual or verbal information. Educational media has a nonphysical understanding known as software (software), which is the content of messages contained in the hardware that is the content that wants to be conveyed to students. Educational technology is the study and practice of ethics to facilitate learning and improve performance by creating, using and managing the processes and sources of technology that are in order. The tool or medium has practical values in the form of abilities such as:

- 1) make concrete abstract concepts,

- 2) bring objects that are difficult to obtain into the student's learning environment,
- 3) display objects that are too large,
- 4) display objects that cannot be observed with the naked eye,
- 5) observe movements that are too fast,
- 6) allow uniformity of observation and perception for the student's learning experience,
- 7) generate learning motivation and
- 8) present learning information consistently and can be repeated or stored as needed

## 2. LITERATURE REVIEW

### 2.1 Laboratory

Laboratories are usually defined as:<sup>1</sup> a place equipped for experimental studies in science or for testing and analysis; The place provides an opportunity to experiment, observe, or practice in the field of study, or<sup>2</sup> an academic period set aside for laboratory work.<sup>3</sup>

The existence of laboratories in schools is very important in supporting the activities of teaching and learning chemistry because there are some materials that in understanding it needs to make observations or experiments in the laboratory. In addition, in Government Regulation No. 32 of 2013 it is explained that every unit of education must have infrastructure that can support an orderly and sustainable learning process, one of which is a laboratory room.

In essence, theoretical and practicum learning in the laboratory is inseparable activities in the teaching and learning process. Chemistry as part of science has a characteristic that is built by putting forward experiments as a medium or way to acquire knowledge, then developed on the stage of observation, search, and proof. Practicum activities carried out in the laboratory is a method that affects the success of students in learning chemistry, students can study chemistry by observing directly the symptoms or chemical processes, can practice scientific thinking skills, can instill and develop scientific attitudes, can find and solve various problems that exist through the scientific method and so on. The level of effectiveness in the utilization of chemical laboratories greatly impacts the success of chemical learning and the effectiveness of the use of these chemical laboratories is determined by the extent of the intensity of use, the organization of both the organizational structure of laboratory organizer personnel and the organization of practicum participants

The effectiveness of laboratory use is very small. This is due to the magnitude of the negative impact that can be caused by practicum. Therefore, chemical learning is done using

media. From the diverse learning styles of students, the most appropriate media used is learning with virtual reality media because it integrates various dimensions in the learning process. The development and use of visual learning media (images), audio and video (multimedia) in learning continues to be researched and developed, it aims for effectiveness, efficiency and motivation in student learning. Virtual reality is a part of multimedia computers that will become a teaching trend in the future and is a new learning strategy in the field of engineering to learn a system

The Virtual Laboratory originated from a project called "Essays and Resources on the Experimentalization of Life (1830-1930) located at the Max Planck Institute for the History of Science. The project aims to examine the history of the experimentalization of life. The term experimentalization describes the interaction between life sciences, art, architecture, media and technology in the experimental paradigm

"Virtual environments, named virtual labs, vary from static web pages with video and text to dynamic pages with sophisticated environments, collaborative authoring, video on demand, virtual meetings, and many other features. These virtual laboratories can also allow remote access to measurement instruments, video cameras, microphones, electrical and mechanical circuits, chemical reactions, biological experiments, and so on. The diversity of models and structures for virtual laboratories is vast and varies according to the nature of the projects studied, the objectives, and the technologies involved". Motivation for the implementation of virtual laboratories, but not limited to:

- a. Limitations on resources and space in real-world laboratories. These types of limitations can cause delays in students' learning activities that may face situations where they have to compete or wait for the availability of resources provided. In addition to the fact that one's experiments can be disrupted before concluding due to divided resource needs.
- b. The possibility of sharing equipment is usually expensive.
- c. Stimulus for research collaboration or working in independent groups of their physical distance.
- d. The existence of a learning environment outside of school, which allows students to participate or develop their own projects together with other students in their spare time.
- e. The possibility of developing various experiments in different locations. Remote surveillance and intervention in dangerous experiments, thus helping to prevent accidents

Through virtual laboratories, simulation of a complex, too expensive or dangerous condition, which sometimes cannot be done at real convention, becomes possible. Financially, building a virtual laboratory is also relatively affordable. This computer-based laboratory allows students to perform practicums or experiments as if facing a phenomenon or set of real laboratory equipment

### 3. RESEARCH METHODS

The type of research used is research with a literature study approach. The study was conducted by combining eleven journals and three textbooks to obtain comprehensive results. The steps taken include collecting library data, reading and recording, and comparing literature to be processed and come to conclusions. The data used is secondary data derived from textbooks, journals, scientific articles, literature reviews that contain the concepts studied. Start with research results that are sequentially observed from the most relevant, relevant, and relevant. Read the abstract of each study first to assess whether the problem discussed is in accordance with what is to be solved in the research. Note the sections, important and relevant to the research problem

### 4. RESULTS AND DISCUSSIONS

#### 4.1 Design

Some of the supporting learning theories are constructivism, Piaget, Vygotsky, and Ausubel. Constructivistic learning theory states that students should be able to build their own knowledge. Knowledge is a person's cognitive construction of objects, experiences and environments. Piaget argues that there are two processes that occur in the development and cognitive growth of children, among others:

- 1) the assimilation process; at this stage the child adjusts or matches the new information to what he knows by changing it when necessary;
- 2) the accommodation process; At this stage the child arranges and rebuilds or changes what has been known before so that new information can be better adapted. The essence of learning from Ausubel is meaningful learning, which is a process of associating new information on relevant concepts contained in a person's cognitive structure. Learning means that new information is assimilated into relevant sources that already exist in cognitive structures. Vygotsky's learning theory posits about Zone Proximal Development (ZPD) and Scaffolding. ZPD is the level of development slightly above one's current level of development. The concept of Scaffolding means giving students a large amount of help during the early stages of learning then reducing that assistance and giving the child the opportunity to take over responsibility

. A teacher in the learning process always gives material theoretically using lecture methods, discussion methods, question and answer methods and other methods. In fact, the learning process that takes place like this will get unsatisfactory results. Therefore, a teacher can utilize technology to stimulate the capture and understanding of students to the subject matter, especially chemistry. Chemical clumps cannot be carried out by mere theoretical learning. The number of chemistry lessons that are abstract so that fieldwork or practicums are needed to hone students' thinking and as a way to make students more active. Practicum that will be done can make students think critically by combining their new knowledge with previous knowledge obtained from teachers in the learning process

In addition to having advantages that can make students more active, practicum also has disadvantages. Where the lack of this practicum is as follows:

- 1) equipment and materials that are so expensive,
- 2) limited space and place, and
- 3) the impact of accidents is quite high.

Avoiding these things, practicum is done virtually by utilizing technology. A virtual laboratory is a system that can be used to support a conventional practicum system. This virtual laboratory is commonly called the Virtual Laboratory or V-Lab. It is hoped that this virtual laboratory can provide opportunities for students in particular to perform practicum either through or without internet access so that students do not need to attend to follow the practicum in the laboratory room. This becomes effective learning because students can learn on their own actively without the help of instructors or assistants such as the system that runs. With a web-based display format enough to help students to be able to follow the practicum independently

- 1) Products developed using LabView are powered by macromedia flash for simulations that support practicums. The result of virtual laboratory development is in the form of computer programs and system design. For planning, the following steps are needed: Determining productive subjects. The subjects chosen are subjects that are abstract, difficult for students to understand so they need this medium.
- 2) Determine the type of visual multimedia application.
- 3) Determine the structure and navigation map to be used.
- 4) Create an interface design that is a storyboard multimedia application.

- 5) Creation of the elements to be used in the application (the elements used in the practicum and adjusting to the selected subject) a. Creating elements using the appropriate software b. Merging elements that have been created using authoring tools 6. Implementation and analysis of the application (the media is analyzed first before it is done) The design can also be described with flowcharts. The following flowcharts for system planning are as follows:

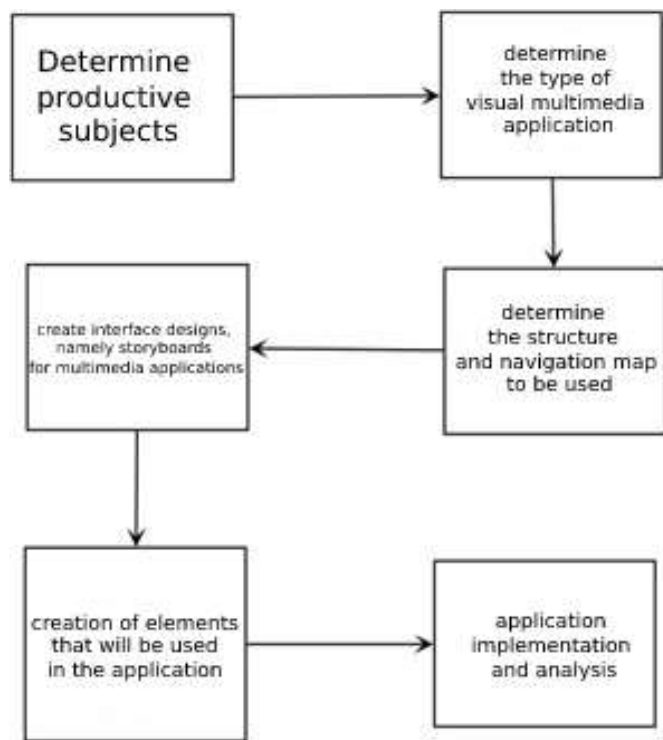


Fig1. Steps to System Design

In Virtual Practicum, virtual environments are sometimes used visually to investigate anything that happens to the physical world event under observation, even more so if the flow of an electric current that is not visible to the eye then needs to be simulated. One of the senses that is widely used to get information from the environment is vision. The sense of sight is used more than any other sense in processing information. Some psychological research suggests that more information is understandable when presented in visual form, than presentation in non-visual form.[3]

4.2 Implementation

Here are some examples of media using virtual laboratories that can help teachers and students in the learning process

Tool Name	Description
<i>Crocodile Chemisty</i>	With this virtual laboratory can find out the types of tools,

	materials and chemicals complete with functions and examples of chemical reactions.
<i>Spectronic-20 Genesis</i>	With this virtual laboratory can find out the wavelength and calibration curve with the absorbance in the v-lab.
<i>Phet Colorado</i>	With this virtual laboratory can study various chapters with simple coverage
<i>GoLab</i>	In this virtual laboratory presents an interactive and eye catching practicum so that it attracts students.

Virtual laboratories are a very suitable medium for use if practicum cannot be carried out. This is because virtual laboratories have the exact same appearance as the original ones when we perform practicums. Students can combine new knowledge with prior knowledge while undertaking this virtual-based practicum. Through this virtually based practicum students will see for themselves the events that have been learned through theory, so that it will give a deeper impression in his mind. In virtual labs, students have a smaller fear of not coming into contact with the tools and materials they use directly. In addition, one of the advantages of practicum with virtual laboratories is that it saves time, then they have more opportunities to repeat the practicum if they do not really know. Thus practicum with virtual laboratories provides a sense of comfort to students during practicum so that students more easily understand the material and have a deeper impression

5. CONCLUSION

Virtual laboratories are a medium that can be used to assist teachers in introducing abstract material to students. Virtual laboratories can attract the attention of students because of the presentation of material in the form of animation which is new for students. Students can combine the knowledge gained in theory by conducting their experiments with such visual laboratories. This is because virtual labs have so much time that students can re-repeat if they don't already know or understand. In addition, virtual laboratories also do not have the impact of accidents that can make students afraid to experiment.

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