



# The Effectiveness of Using Virtual Laboratories Based on Integrated Science Process Skills Zoom Meeting to Increase Understanding of Students Physics Concepts During the Covid-19 Pandemic

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**Abstract:** This study aims to describe the improvement in students understanding of physics concepts after using a virtual laboratory based on integrated science process skills zoom cloud meeting in class XA SMAN 1 Ende which totals 36 students. This research is quantitative descriptive research. This type of research is quantitative descriptive research. Considering that the number of research groups is only one group, the research design used is one pretest-posttest design group. The research mechanism is carried out through four stages, namely pretest, providing treatment in the form of practicum using virtual laboratories based on integrated science process skills zoom meeting, and providing posttests to find out the increase in scores in solving kinematics concept problems. The data collected are pretest and posttest scores, effectiveness analysis techniques using the N-Gain test. The results showed that the increase in students understanding of concepts averaged 4.27. At the time of the pretest, the average score of students understanding of concepts was 4.47 while the posttest result was 8.75. while the N-Gain value is 0.77. The N-Gain value of 0.77 belongs to the high category. Meanwhile, if it is concentrated at 77 percent, it means that the use of virtual labs based on integrated science process skills zoom meetings is effective in increasing students understanding of concepts.

**Keywords:** Virtual Laboratory; Science Process Skills; Zoom Meeting; Concept Understanding

## Introduction

To achieve maximum physics learning outcomes requires a good understanding of concepts. Understanding the concept of physics is the ability to understand and understand the physics material studied. Understanding concepts includes the ability to restate a concept, classify objects according to certain properties, provide examples of concepts, present concepts in various forms of mathematical representation, develop the necessary conditions for a concept, be able to utilize, use and select certain operations, and apply problem-solving concepts (Satriawan & Rosmiati, 2017; Wijayanti, 2016). Low understanding of physics concepts has a major effect on

student learning outcomes (Saharsa et al, 2018). And vice versa. Physics is a subject that is directly related to the real life of students. Physics lessons discuss the symptoms of nature based on the results of experiments and observations made by humans. Physical science examines the interaction between energy and matter which is the basic foundation of natural science. Learning physics is not only to master concepts in theory but also to prove these physics concepts with practicum and scientific methods. Physics learning in class focuses on a process of observation and experimentation in order to connect initial knowledge with the material to be learned by students. In the teaching and learning process, it is expected to be able to develop student competencies through direct experience. Direct

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experience and finding out is very effective if learning through practicum.

Understanding physics concepts is a challenge for physics teachers in schools. This is because most of the students in the school do not like physics lessons (Shidik, 2020; Halim et al, 2017; Mubarrok & Mulyaningsih, 2013). Especially with the covid-19 that has hit the world. During the Covid-19 pandemic, almost all education unit systems are required to carry out online learning, including subjects that require practicum in the laboratory. One of them is the school of SMAN 1 Ende. To continue to carry out practicum in helping to prove physics theory in students, special methods are needed in the form of technological adaptation in learning. One of the learning technologies that is suitable for use during the Covid-19 pandemic is the use of virtual laboratories. A virtual laboratory is a form of laboratory with observations or experiments using software run by a computer, the equipment needed by a laboratory is contained in the software (Ekawati et al, 2015; Gunawan et al, 2013). A virtual laboratory can simulate activities in the laboratory as if the student is in an actual laboratory. Through a virtual laboratory, it can meet the needs of students by providing freedom to do practicum anytime and anywhere without having to be in the laboratory (Mirdayanti & Murni, 2017; Hermansyah et al, 2017; Abidin et al, 2020).

This virtual laboratory has never been used before as a learning medium at SMAN 1 Ende school. For this reason, as one of the missions of the University of Flores, namely organizing research in the field of science and technology with a focus on studies on the needs of regional development, industry, natural resources and environmental and cultural preservation, as well as developing a good, efficient, effective, transparent and accountable institutional governance system supported by information and communication technology. Researchers conducted research on the development of a virtual laboratory based on science process skills integrated with the zoom meeting application. This research is expected to be a reference for partners, namely SMAN 1 Ende schools in the future in using computer-based technology that can help in improving the quality of education at the school.

This research is also in line with the priority programs contained in the National Medium-Term Development Plan for 2020-2024 and the Strategic Plan of the Ministry of Education and Culture for 2020-2024, as well as the latest strategic issues in the field of Education and Culture regarding the Independent Learning Policy. The Merdeka Study policy can be realized optimally, one of which is through improving infrastructure and utilizing technology in all education units. The problem in this study is the effectiveness of using virtual laboratories based on integrated science process skills, zoom cloud meetings, which can increase

students understanding of physics concepts during the COVID-19 pandemic. While the purpose of this study is to find out and describe the improvement in students understanding of physics concepts after using a virtual laboratory based on integrated science process skills zoom cloud meeting in the classroom. Thus, this research is expected to provide benefits in supporting practicum activities in laboratories that are interactive and dynamic based on science process skills during the Covid-19 pandemic, increase understanding of physics concepts for class X students of SMAN 1 Ende, and provide an overview to research partners as a reference in further learning about virtual laboratories based on integrated science process skills, zoom application.

## Method

This type of research is quantitative descriptive research. This study describes the effectiveness of using virtual laboratories based on integrated science process skills, zoom meetings to improve students understanding of physics concepts during the COVID-19 pandemic. This research was conducted on a group of class XA students of SMAN 1 Ende totaling 36 students who have the same knowledge background. Considering that the number of research groups is only one group, the research design used is one pretest-posttest design group.

The mechanism of the study is carried out through four stages. The first stage is to give 36 students a pretest. The test given is a kinematics problem. The problem consists of four concepts, the concept of straight motion, the concept of free fall motion, the concept of parabolic motion, and the concept of rotational kinematics. The pre-test form totals 20 numbers of multiple-choice questions. After the test, an answer sheet is collected, then it is checked to determine the student's score and at the same time learn how they tried to complete it. The objectives are: (1) to find out why students have difficulty solving pretest problems, and (2) to plan teaching strategies in the classroom.

The second stage is to provide treatment in the form of practicum using virtual laboratories based on integrated science process skills zoom meeting. The practicum process is carried out 4 times virtually via zoom. The third stage is to give a posttest to find out the increase in scores in solving kinematics concept problems. The posttest given consists of the concept of straight motion, the concept of free fall motion, the concept of parabolic motion, and the concept of rotational kinematics. The data collected are pretest and posttest scores, effectiveness analysis techniques using the N-Gain test to see an increase in scores in the understanding of kinematics concepts after practicum using virtual laboratory skills-based integrated science process zoom meeting.

## Result and Discussion

The pretest and posttest answer sheet examinations resulted in a description of the use of virtual laboratory based on integrated science process skills. To find out the effectiveness of the use of virtual laboratories on mastery of concepts, it is done by providing evaluation questions, namely pretest questions at the beginning and posttest at the end. Pretests and posttests by 36 students are shown in Table 1.

**Table 1.** Pretest and posttest answer sheet examination results

Score		$\Delta x = (x_f - x_i)$
Pretest ( $x_i$ )	Posttest ( $x_f$ )	
4	8	4
5	8	3
5	10	5
6	9	3
6	10	4
6	8	2
3	10	7
4	9	5
4	8	4
6	10	4
5	8	3
3	8	5
5	9	4
4	8	4
5	9	4
5	10	5
5	10	5
4	9	5
5	9	4
4	8	4
2	9	7
2	9	7
1	7	6
5	7	2
5	8	3
3	8	5
4	9	5
3	8	5
5	9	4
5	9	4
5	9	4
5	8	3
6	10	4
6	10	4
6	9	3
4	8	4
4.47	8.75	4.27
		0.77

It can be seen from table 1 below that there is an increase in scores after practicum using virtual laboratory skills-based integrated science process zoom meeting. The average increase in score from pretest to posttest was 4.27. These results reinforce the belief that the use of virtual laboratory skills-based integrated

science process zoom meetings is one of the best practicum models used in improving students understanding of physics concepts.

From the Table 1 too, it appears that there is an increase in the value of students understanding of physics concepts after the use of virtual laboratory based on integrated science process skills. It was shown that the increase in students understanding of concepts averaged 4.27. At the time of the pretest, the average score of students understanding of concepts was 4.47 while the posttest result was 8.75. The increase in students understanding of concepts is influenced by the enthusiastic attitude of students when conducting science skills-based virtual lab experiments.

Based on the results of research that has been carried out, it was obtained that the learning process of kinematics material practicum using a virtual lab plays a role in stimulating students to be active in following the teaching and learning process. The classroom atmosphere via Zoom meeting is more lively, students are very excited about developing creativity and seem to actively ask if there is anything that is not understood during the learning process.

From the results of the study, it was also shown that the value of N-Gain was 0.77. The N-Gain value of 0.77 belongs to the high category. Meanwhile, if it is concentrated at 77 percent, it means that the use of virtual labs based on integrated science process skills zoom meetings is effective in increasing students understanding of concepts. This result is also in line with the results of previous research that virtual laboratories can improve student mastery of concepts (Kusdiastuti et al, 2017; Sugiharti & Sugandi, 2020; Sari et al, 2017; Hikmah et al, 2017). The use of virtual laboratories affects student learning outcomes (Iskandar, 2016).

Virtual laboratory in the form of computer-operated software is used to observe and carry out experimental activities or experiments (Nurhayati et al, 2014; Sugiana et al, 2017). Simulations on computer devices help students to learn physics dynamically and interactively. A virtual laboratory is a computer-operated simulation in the form of interactive computer software where students carry out experiments or practicums as if they were in a school laboratory. Experimental tools, materials, and equipment are available inside computer devices and students can conduct subjective experiments anytime and anywhere (Yoon et al, 2014; Widiarini et al, 2022; Gunawan et al, 2018).

Virtual labs are used to improve students knowledge of the learning process. Virtual labs are an alternative, and can help fix existing weaknesses. Especially during the Covid-19 pandemic, virtual labs have become the main choice for physics teachers. For a physics teacher to be successful in using a virtual laboratory the thing that needs to be done is to first

analyze the basic learning skills to ensure the correct and proper practicum activities. Both teachers should prepare student worksheets. This student worksheet serves as a guide for teachers and students in carrying out practical actions.

Virtual labs have many advantages such as being able to improve students ability to manipulate test variables correctly, improving concept learning, and being accessible anytime and anywhere. In addition, virtual laboratories do not use a lot of costs because they do not require laboratory buildings and other expensive equipment, learning efficiency can increase because it is virtual so that it can be easily done repeatedly so as to clarify the question of the concept of proof (Susilawati et al, 2022., Budiarmo et al, 2022., Zulkifli et al, 2022). However, this virtual laboratory also has weaknesses such as students and teachers must use the internet which requires data packages in order to be able to simulate practicum.

To interest students in the use of virtual labs, researchers design in the learning process virtual labs using a science process skills-based approach. The approach to the process of science is intended to emphasize the formation of skills in obtaining knowledge scientifically (Rahman et al, 2017., Gunawan et al, 2017). Students actively develop creativity in learning, motivation and student learning outcomes can improve, and students will be able to discover and develop the facts, attitudes and values demanded (Ongowo & Indoshi, 2013., Rauf et al, 2013., Rahardjo, 2019., Agustina & Saputra, 2016., Dewi & Hayat, 2016). The science process skills developed in this study are basic skills that include observation, classification, communication, measurement, prediction, and conclusion drawing.

## Conclusion

The conclusion of this study is that the use of virtual laboratories based on integrated science process skills zoom meetings is effective in increasing students understanding of concepts. Improved student understanding of concepts averaged 4.27. At the time of the pretest, the average score of students understanding of concepts was 4.47 while the posttest result was 8.75. While the N-Gain value is 0.77. The N-Gain value of 0.77 belongs to the high category. If the percentage reaches 77 percent, it means that the use of virtual labs based on integrated science process skills zoom meetings is effective in increasing students understanding of concepts.

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