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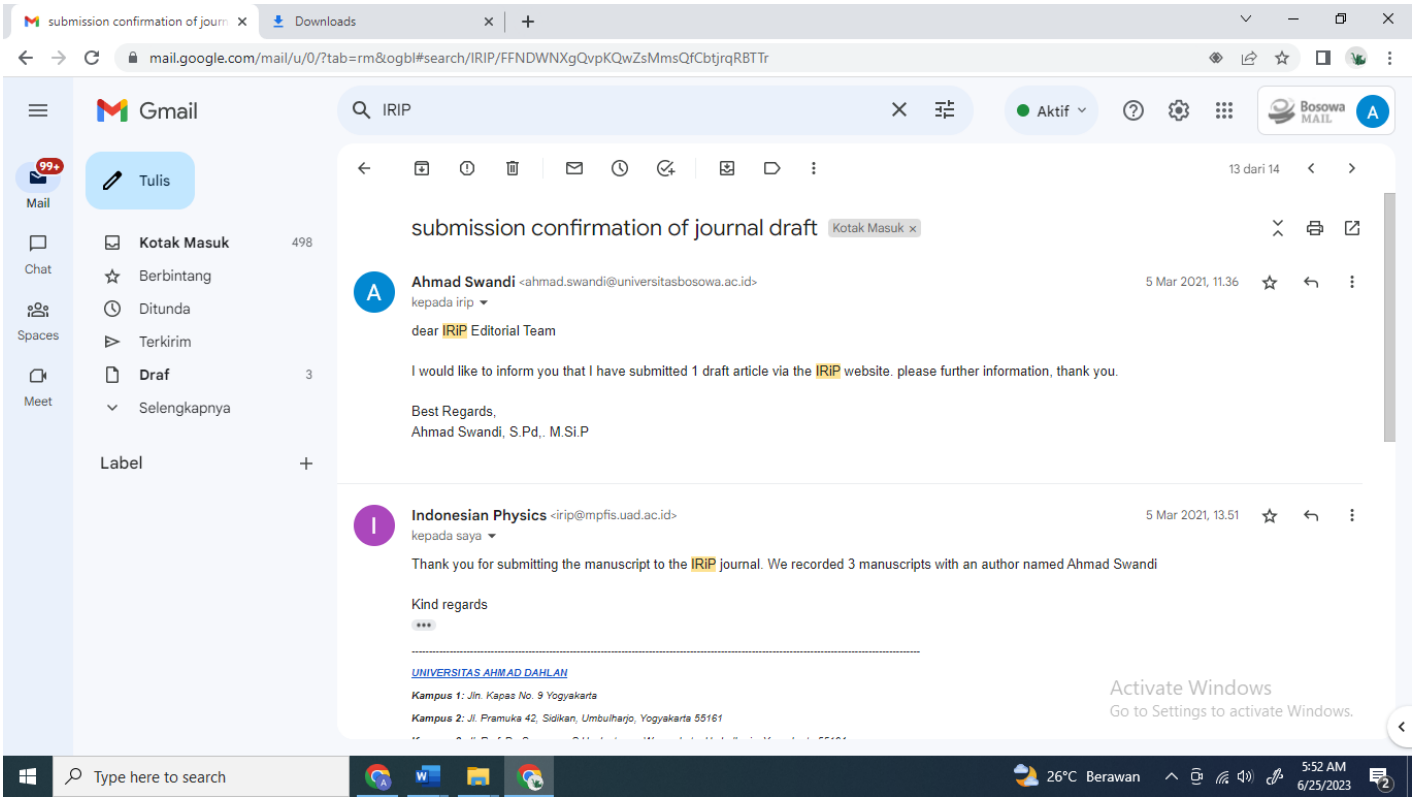

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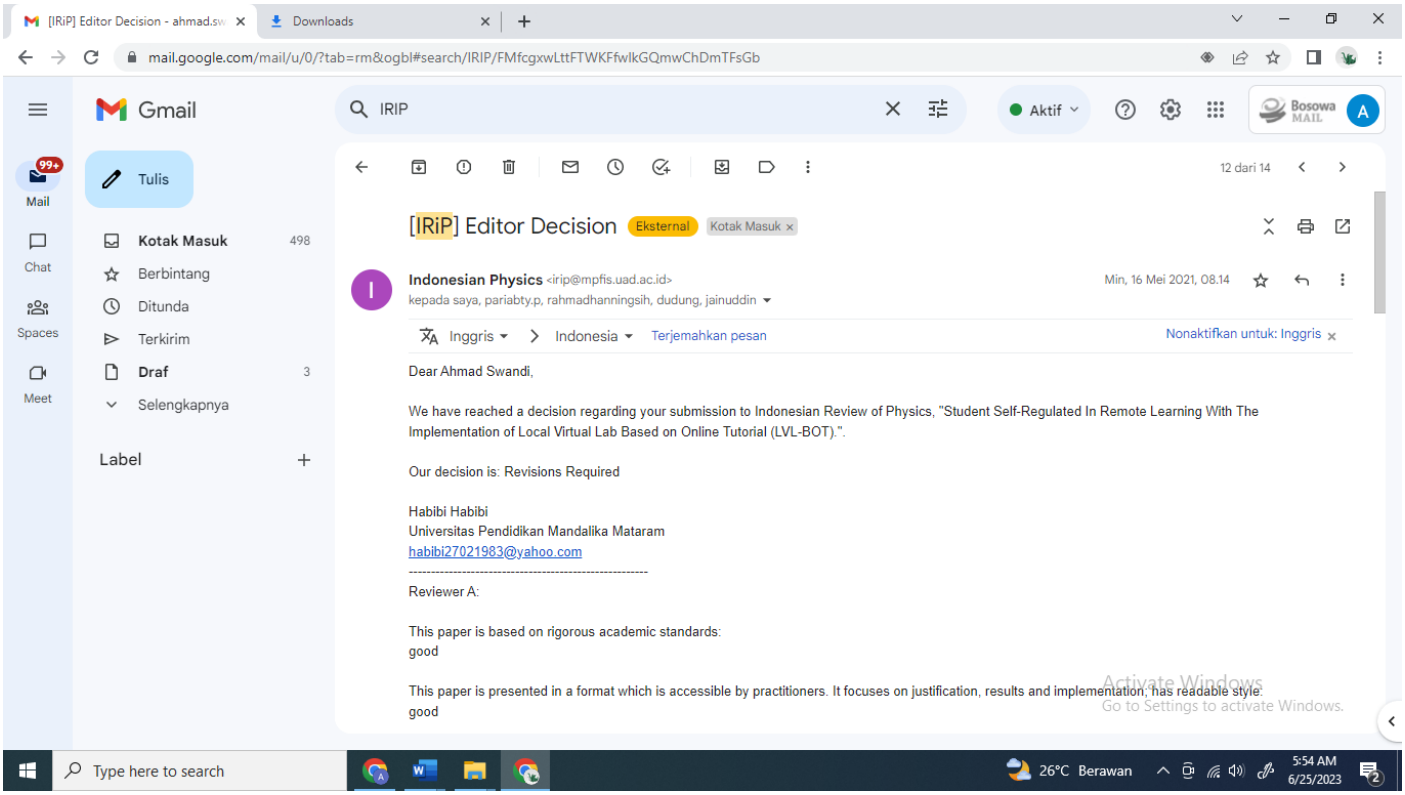

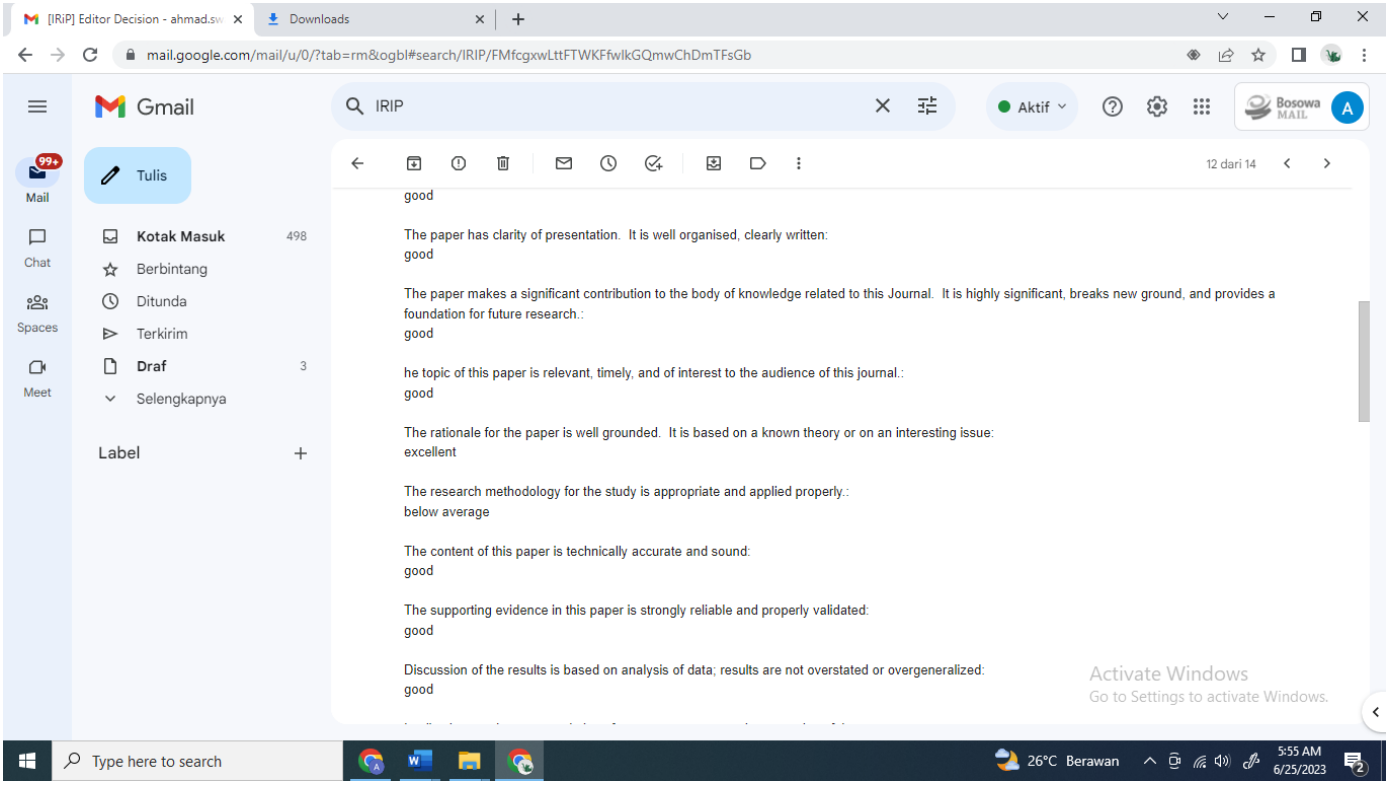

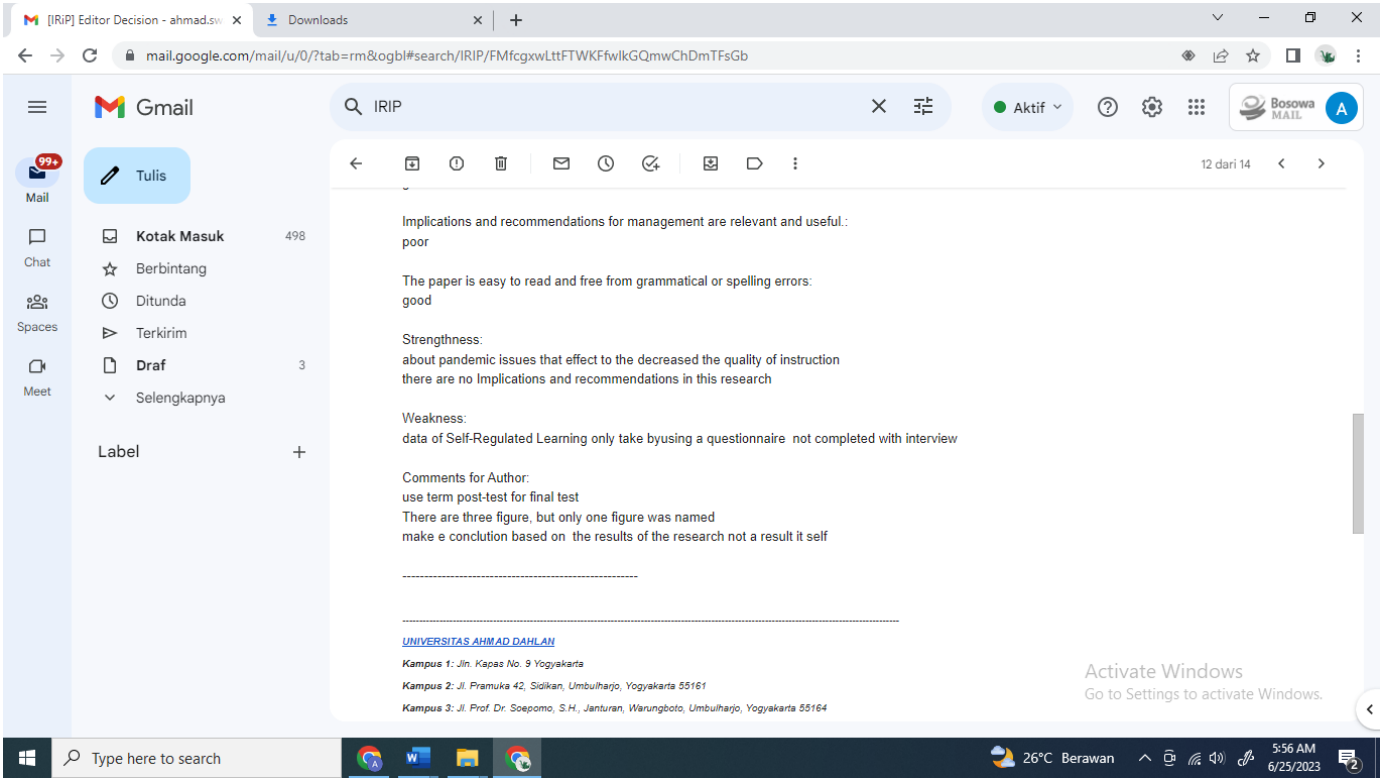

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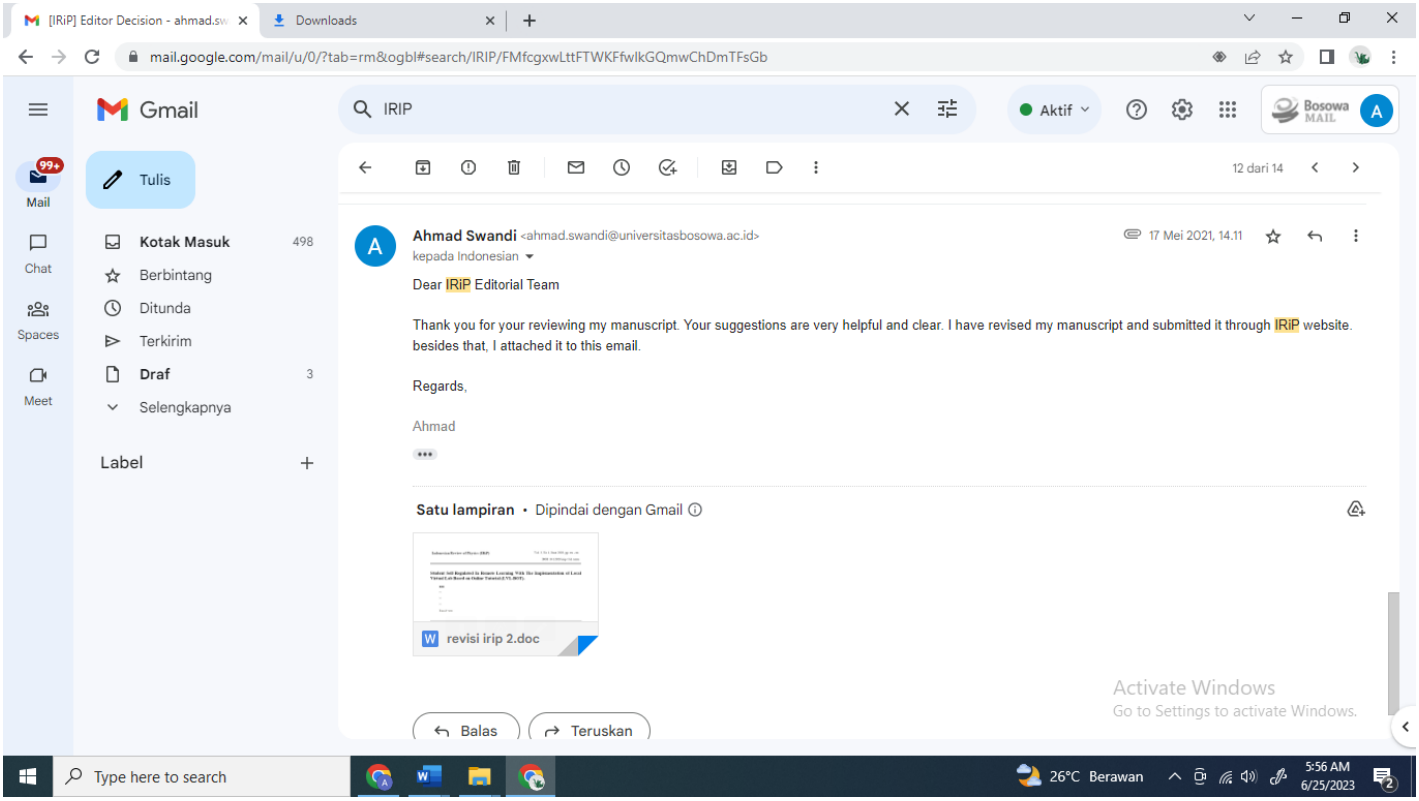

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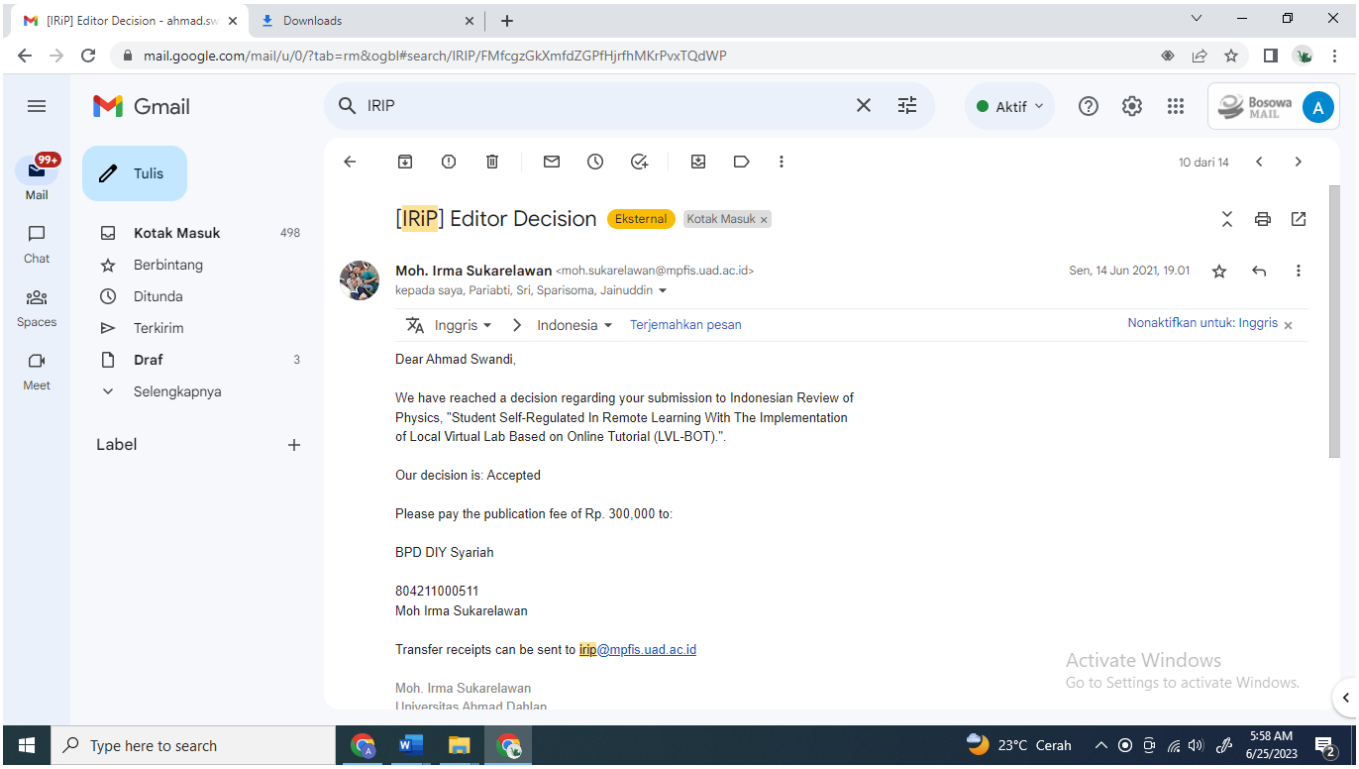

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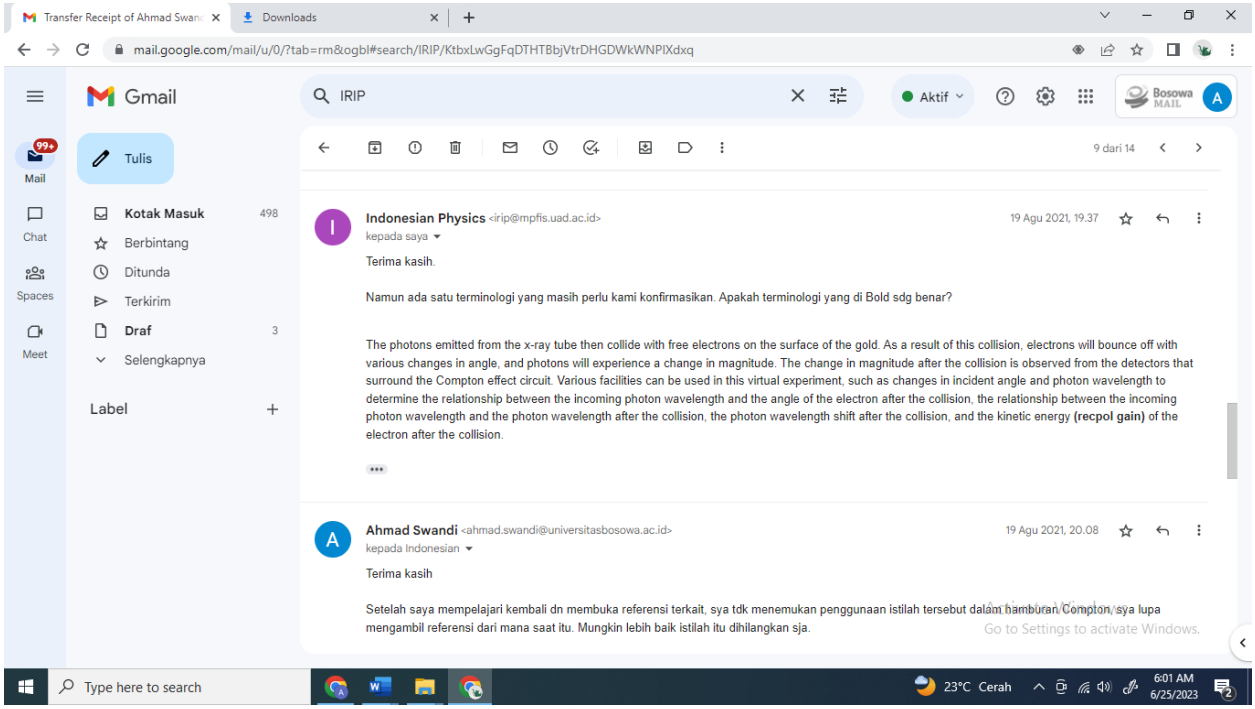

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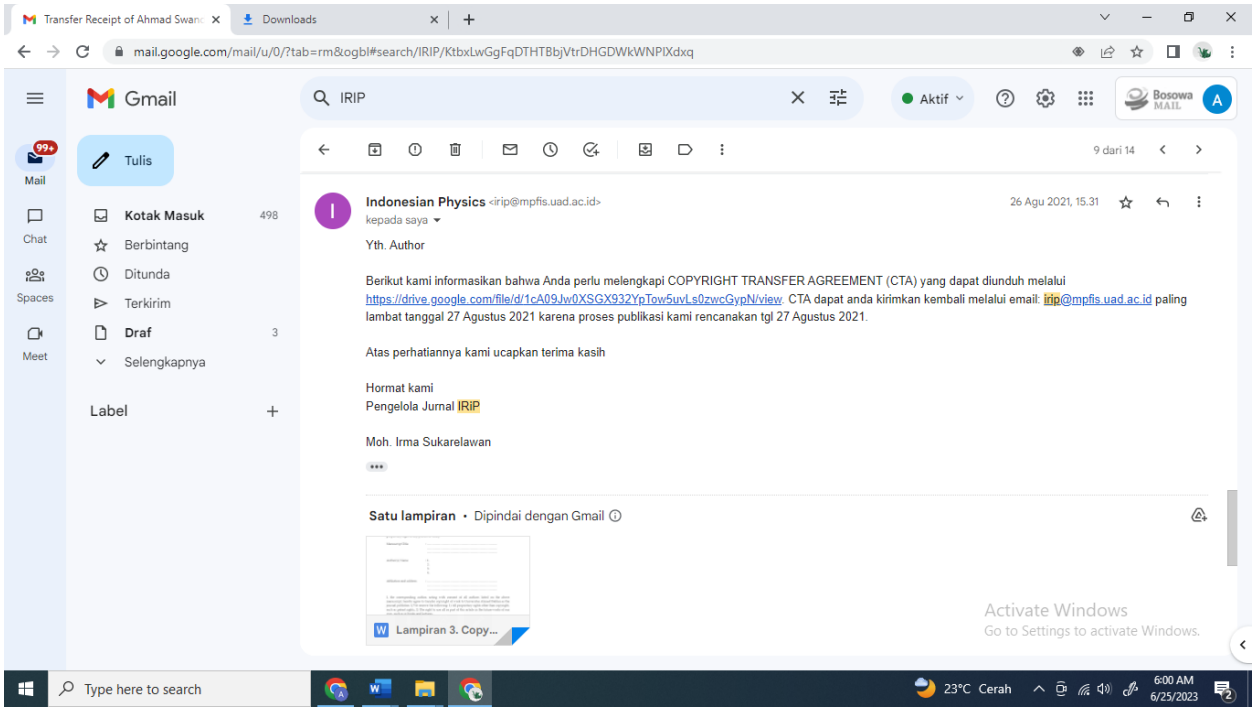

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Student Self-Regulated In Remote Learning With The Implementation of Local Virtual Lab Based on Online Tutorial (LVL-BOT).

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ABSTRACT

Changes in the learning system in higher education due to the spread of the corona virus have an impact on the quality of learning physics in universities. The implementation of laboratory activities in various subjects in the physics department cannot be carried out due to the learning system carried out in each house. As a result, physics learning is dominated by one-way theoretical learning by lecturers using online learning applications. Therefore, there is a need for a solution to solve this problem. This study aims to (1) measure the level of Self-Regulated Learning (SRL) in distance learning using a Local Virtual Laboratory Based on Online Tutorial (LVL-BOT), (2) identify the effect of utilization of LVL-BOT towards concept understanding. The type of this research was Pre-Experimental with a One-Group Pretest-Posttest Design. The level of Self-Regulated Learning of students was taken by using a questionnaire while understanding the concept used a test. Based on the results of the analysis, the percentage level of Self-Regulated Learning was at a value of 87, 7% which was included in the very high category. Meanwhile, based on the results of the pre-test and post-test for particle properties of electromagnetic waves concepts, there was a difference between the average score of the pre-test and the average score of the final test. This shows that there was an effect of utilization of LVL-BOT student's conceptual understanding.

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I. Introduction

The corona virus pandemic has had a significant impact on human life in all fields, especially in the field of education. Learning that was initially carried out face-to-face is now being carried out online in order to cut the spread of the corona virus. At present, all educational institutions are trying to find the right models and methods so that distance learning does not interfere with student learning and the concept remains easy to understand even though it is done online.

The separation of physics between students and lecturers is a characteristic of far-reaching education [1]. This has an impact on the lack of interaction between students and lecturers so that of course it has a negative effect on student learning outcomes. Lecturers cannot control student activities during the distance learning process. In fact, there are still many lecturers who do not carry out learning due to limited skills in operating computer technology, besides that, lecturers are also not used to developing online-based teaching materials. For this reason, it is necessary to use technology to support wider interactions and activities for students and lecturers [2], the use of this technology is also expected to be able to present interesting, easy, and meaningful learning. Along with the ongoing impact of the Covid 19 pandemic and advances in network-based Information and Communication Technology in the field of education. So the use of ICT in supporting distance learning is a must and the government, educational institutions, and lecturers need to develop appropriate models, methods, and media of technology.

In addition, one indicator in seeing the achievement of distance learning objectives is the level of understanding of students' concepts. Learning achievement has a relationship with the student's SRL level. Students with a low level of learning independence tend to have a low understanding of concepts, and vice versa [2], [3]. SRL is closely related to the planned thoughts, feelings, and actions of students, so that this greatly affects their learning process and motivation.

Distance learning in various majors or courses is certainly different. In social learning, the material presented in presentation slides or learning videos is sufficient. This is different from the science and mathematics majors, especially physics. Physical phenomena that can be understood by mastering mathematical concepts first become quite difficult, they must be trained how to solve problems with a good understanding of mathematics. In addition, physics students must be able to understand and observe directly existing physical phenomena and study these phenomena with correct mathematical concepts. Learning like this will be more interesting, not boring, and able to increase student activity, therefore physics learning should involve direct experimentation [4], [5]. However, not all physical phenomena can be observed by conducting experiments because some abstract material is impossible and invisible [6], [7]. In addition, the implementation of the experimental method is currently not possible due to several factors, such as (1) during the pandemic, which requires learning to be carried out in individual homes; (2) the availability of equipment in the laboratory that can be used by students in their homes is very limited [6], [8]; (3) the absence of practicum guidelines developed by lecturers that can direct students to make observations independently is also a big problem for physics learners during the pandemic [9].

Students who use distance learning are referred to as autonomous learners who have freedom of behavior and the learning system they will and do [2]. They have broad autonomy to determine when they learn, where and how to organize their learning process and what learning resources should be used. This is different from face-to-face learning where the lecturer has the freedom to regulate the course of the teaching and learning process in the classroom. In addition, because the characteristics of each student are different, in the distance learning process, their ability to manage the learning process both in distance classes and additional learning is of particular concern for the teaching staff. Choosing the right physics learning method during the distance learning class is expected to be able to increase student motivation and activity in learning. This will also greatly affect their independence in learning physics.

Self Regulated Learning (SRL) or what is also called independent learning for students in distance learning is very important. They must be able to control and regulate the learning process. They are also expected to be able to direct their learning in a positive direction [2], [10]. The use of communication technology is expected to be more widely used in accessing information and learning resources. Therefore, the role of lecturers in this matter is very much needed. The types of technology and teaching materials provided by the lecturers certainly affect their learning independence. Lecturers who do not understand the technology and are unable to use technology either in developing learning media or using it in the teaching and learning process will affect the course of distance learning. It is necessary to have technology-based teaching materials that are able to achieve learning objectives.

To overcome this, there needs to be learning techniques that is able to direct students to explore abstract concepts even though learning is carried out

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online, the use of this technology is also expected to increase students' understanding of these concepts, reduce misconceptions and improve skills in analyzing graphics, numbers or completion with mathematical concepts. This technology is able to replace the use of physics practicum tools, easy to use by students and has no risk even though it is used outside the supervision of a lecturer or tutor. In addition, with the right technology-based teaching materials, students' learning independence and conceptual mastery can be much better even though learning is done online. Therefore, online tutorial-based virtual laboratory media (VLBOT) is the right choice.

II. Theory

Local virtual lab is a developed application tool capable of describing a real laboratory environment. This application is stored in technology devices such as computers, laptops or smartphones that can be accessed offline by the user. Several studies on the use of virtual laboratories have been conducted. According to Yusuf and Widyaningsih, the use of virtual laboratories can improve critical thinking skills. In addition, students' activities and perceptions of learning physics with virtual laboratories are very good [11][11]. Swandi et al also stated that the use of virtual laboratories had a positive effect on problem-solving skills and student learning outcomes. In addition, the observation of student activity is in the very high category, which is above 80% when participating in learning with the experimental method using a virtual laboratory [6]. Most students also strongly agree with the use of virtual laboratories, because they feel that invisible phenomena become visible and visible even though in everyday life they will never be seen [7]. Students who use virtual media such as virtual laboratories as learning media have a higher ability to understand and present the material being studied [12][13]. A similar conclusion was also put forward by Magyar & Žáková in their research which stated that the motivation of students to be more active in participating in learning and to develop various skills can be increased by the use of virtual laboratories [14]. The following is an example of a virtual laboratory developed by Swandi et al [15]

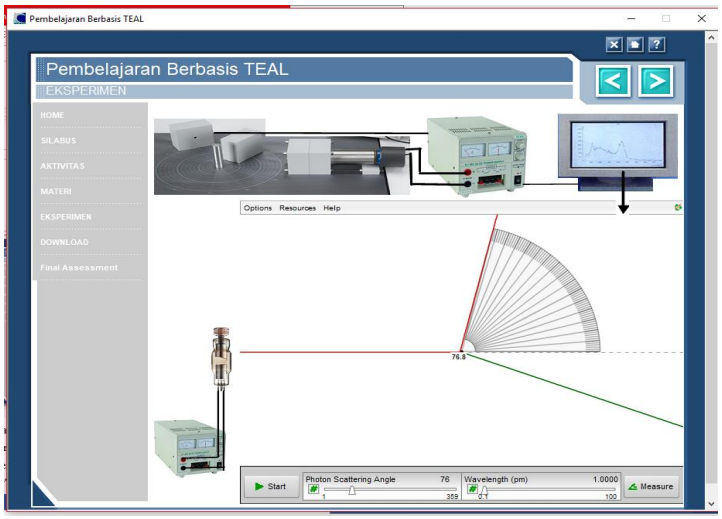

Figure 1. Local virtual laboratory equipment on the Compton effect concept.

The photons emitted from the x-ray tube then collide with free electrons on the surface of the gold metal. As a result of this collision, electrons will bounce off with various changes in angle as well as photons will experience a change in magnitude. The change in magnitude after the collision is observed from the detectors that surround the Compton effect circuit. Various facilities can be used in this virtual experiment, such as changes in incident angle and photon wavelength to determine the relationship between the incoming photon wavelength and the angle of the electron after the collision, the relationship between the incoming photon wavelength and the photon wavelength after the collision, the photon wavelength shift. after the collision, and the kinetic energy (recpol gain) of the electron after the collision.

Although virtual laboratories have been widely developed and used by previous researchers, however, all of these studies indicate that virtual laboratories are used in the classroom (face-to-face between lecturers and students) which means that there is still extensive and direct interaction between lecturers and students. This is certainly different if learning is carried out remotely where students cannot meet directly with the lecturer so that without prior explanation by the lecturer, virtual laboratory learning will be very difficult to do. Therefore, to overcome this, lecturers need to develop virtual laboratory teaching materials that can be downloaded by students equipped with online tutorials. This is important so that without direct instruction from lecturers or tutors, virtual laboratories can still be used. In addition, virtual laboratories are also supported by online learning platforms through applications such as websites or e-learning. So that even though lecturers and students are

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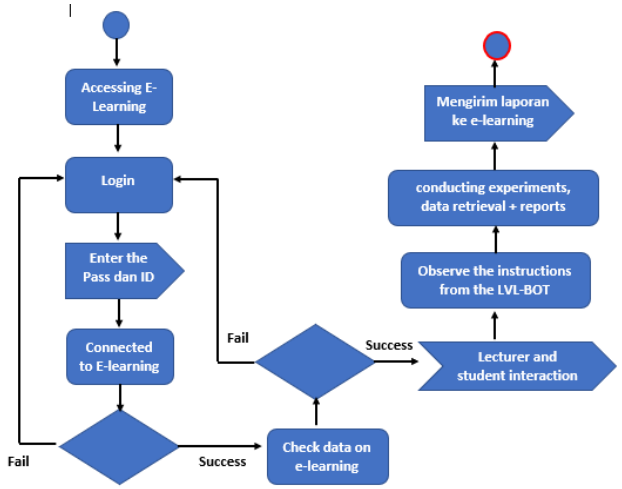
separated, they can still interact even through the application. The use of teaching materials and media like this will greatly assist students in learning, understanding concepts, and following the experimental process easily because there are instructions or video tutorials provided by lecturers and also through a distance learning platform so that when students find difficulties they can easily immediately asked the lecturer [16].



There are 2 things that distinguish LVL-BOT from virtual labs that have been widely used before. The first is the LVL-BOT supported by a video containing instructions from the lecturer. With this video students easily follow instructions so that they can make observations and collect data then analyze the results and draw conclusions. The second advantage is that LVL-BOT is accessed with an online learning platform, this makes learning more interactive, the interaction between teachers and students can still be done supported by e-learning facilities. In addition, teachers easily evaluate the learning process that has been taking place.

III. Method

This research is pre-experimental research where there are still external variables that influence the conceptual understanding and learning independence of students. This is due to the absence of control variables and the sample was not randomly selected. The sample in the study was 37 physics education students in 1 class. Students who program modern physics courses in the physics education department, Makassar State University. The research design is the One-Group Pretest-Postets Design which is described in the table as below [17].

Tabel 1. Desain Peneitian

Pattern	Information
O_1 X O_2	O_1 = Initial test scores before being given treatment O_2 = Final test scores after being given treatment

Before students are treated with the application of virtual laboratory teaching materials assisted by e-learning in distance learning, students are first given a preliminary test. Then, after being given treatment, students were again given the final test. Thus the results of the treatment can be known to be more accurate because it can compare with the previous situation.

The test instrument used to measure the understanding of the concept and the independent learning questionnaire was validated first, both expert validation and construct validation before use. The test instrument is in the form of essay questions with a total of 10 questions related to the concept of the photoelectric effect. Meanwhile, to promote independent learning consists of 40 questions with 5 indicators, namely (1) initiative in online learning; (2) responsibility for assigned tasks; (3) confidence in the results of work; (4) independence in working and making decisions; and (5) independence in using knowledge and experience in accordance with situations and conditions.

To determine the effect of using a video tutorial-based virtual laboratory and assisted with e-learning, the average final test score was reduced by the average initial test score. Meanwhile, the learning independence questionnaire data were obtained through coding the respondent's assessment, then analyzed descriptively quantitatively by calculating the percentage of responses, and then depicted the level of gradation of the analysis results based on the percentage scale. With correlation analysis, the researcher can see whether there is an effect of independent learning on students' conceptual understanding.

IV. Results and Discussion

At the end of the lesson with the application of a virtual laboratory based on online tutorials on black body radiation and photoelectric effects, students are asked to complete a self-study questionnaire according to their opinion of themselves during the lesson. The questionnaire was filled out online via google form and then analyzed using Ms. Eexcel in a quantitative descriptive manner to calculate the percentage of responses. The results of the independent learning

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questionnaire analysis for each indicator are presented in the data below.

Table 2 Indicators of Student Self-Regulated Learning

Aspect	**Percentage (%)**
Initiatives in online learning using LVL-BOT	92,4
Responsibility for assigned tasks	91,6
Kepercayaan diri terhadap hasil pekerjaan	80,4
Confidence in the results of work	91,8
Independence in using knowledge and experience in accordance with situations and conditions.	82,3
Average	**87,7**

Based on the results of the analysis, in general, the percentage of independent learning is at a value of 87.7% which falls into the very high category. The indicator of independent learning, namely student initiative in online learning, had the highest percentage, namely 92.4%. While the lowest is the indicator of self-confidence towards work results, namely 80.4%. For the other 3 indicators, the score is above 80%. In addition, it can be concluded that the percentage for all indicators of student independence is in the very high category.

The high percentage of student initiative in online learning is due to the availability of adequate online learning support facilities, such as all students have laptops and smart smartphones that can be used to access teaching materials and virtual laboratories based on online tutorials. However, some students complained about the availability of their internet data packages and their unstable network. Because to access and download all teaching materials and virtual laboratory applications, a large data package is required. Some students have also prepared learning materials before the lecturers provide virtual laboratory teaching materials. Most of the students had studied the material beforehand with books and references from the internet.

Almost all students do assignments and collect on time. The task given is in the form of conducting experiments with a virtual laboratory. Each student studies the teaching materials provided, makes observations, collects data, analyzes, discusses, and draws conclusions. Students are happy with assignments that are quite clear and systematic. So they no longer need to ask the lecturer about completing the assignment. They also strongly agree with the task collection system that uses e-learning. The assignments that were entered were quickly checked by the lecturer then students were asked to correct them if there were deficiencies. However, there are still a small proportion of students who are still indifferent and cannot complete assignments independently. They still need help from friends for the process.

With the existence of sufficiently complete teaching materials such as books and worksheets as well as virtual laboratory manuals. Students find it easy to work and study. Online tutorial-based virtual labs are very helpful for them. They argue that this is tantamount to face-to-face learning because they are guided by a lecturer to work on a project even though it is in the form of audio and not video. The learning material is also presented in audio form so that the explanation is very clear and can be repeated if there are things that are not understood. Some students who do not understand the explanation can also directly ask questions through the e-learning used. Some students also thought that their memory ability of the concepts they learned through virtual laboratories was better. This is in line with the results of Jagodzinski and Wolski's research that learning using virtual laboratories has a positive impact on improving teaching efficiency, students also experience an increase in remembering information and show greater resilience in remembering information (concepts) material [18], [19]. However, even though distance learning is becoming more interesting, there are still many students who lack confidence in their results.

Even in a pandemic situation, where students are asked to increase their activities at home, including studying. This is not a problem for some students. They argue that although face-to-face learning in class is different from distance learning they actually have great freedom [20]. Supported by online tutorial-based virtual laboratory teaching materials, they can download and access teaching materials easily, manage when and wherever they study, repeat lessons repeatedly, ask lecturers directly using e-learning without being noticed by other students. Therefore, it can be concluded that the application of online tutorial-based virtual laboratories is very suitable to be applied to support distance learning and increase student independence in learning. Several previous studies have shown that the application of laboratory-based teaching materials can increase student learning activities, attitudes, and motivation in learning physics [21]–[23]. Amin et al also stated that there is a positive relationship between the application of a virtual laboratory with problem-solving skills and science process skills for physics students [5], [11], [13]. There is also research by Pariabti & Swandi which states that the application of virtual simulations with active learning

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strategies can increase student activity in observing abstract concepts [24].

After the students filled out the independent learning questionnaire, they were then asked to take a final test related to black body radiation and the photoelectric effect. Concept understanding test scores were then analyzed to determine the average score on the pre-test and the final test and then the intervals were determined. The results of the comparison of the results of the students' concept understanding test results before and after being treated in the form of the application of online tutorial-based virtual laboratory teaching materials on the photoelectric effect material, and black body radiation are described as below:

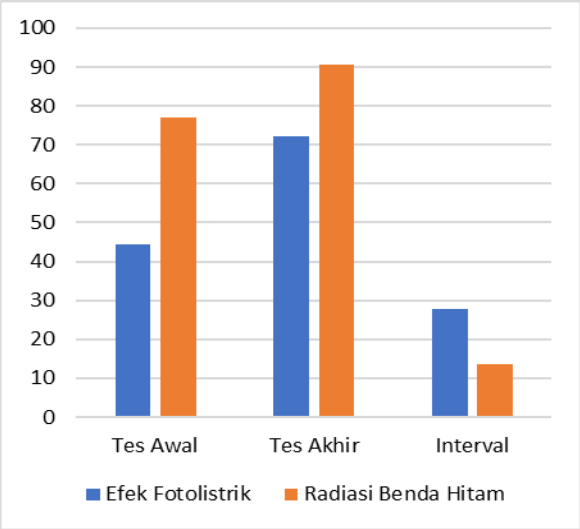

Figure 3 Comparison of Initial and Final Tests

From this graph, it can be seen that there is an increase in the average understanding of students' concepts before and after learning using virtual laboratories for photoelectric effect material and black body radiation. For the photoelectric effect material the difference between the final test and the pre-test is around the value of 27 while for the black body radiation material it is in the range of value 13. Although the difference between the final test and the pre-test is not too large, it can be concluded that there is an effect of using tutorial-based virtual laboratory teaching materials. online towards understanding student concepts.

These results are in line with several studies conducted by several researchers. Research conducted by Yusuf et al and Swandi et al shows that there has been an increase in student learning outcomes and science process skills after using virtual laboratories inside [7], [25]. According to Nurrokhmah and Sunarto, in their research results, learning with virtual laboratories makes learning activities more interesting, students 'interest in learning using this virtual laboratory can increase students' enthusiasm for learning and make students more active so that they can help understand the concepts being taught [26]. Athlah et al also stated that there was an increase in students' conceptual understanding which was marked by the N-Gain category in the experimental class and the control class for dynamic electricity material [27]. Likewise for chemistry learning, where there is an increase in conceptual understanding, especially in the realm of understanding, cognitive and application after learning using a Local Virtual Laboratory Based on Online Video Tutorial.

V. Conclusion

Based on the results of the study, it can be concluded that there is an effect of using local virtual laboratory based on online video tutorials on the self-regulated learning of physics students in remote learning. This is indicated by the average percentage value for all indicators of 87.7% in the very high category. In addition, the use of online tutorial-based virtual laboratories affects the conceptual understanding of physics students. This is indicated by an increase in the average score of the initial concept understanding test with the average score of the final test. Therefore, this teaching material is very suitable for use in distance learning in subjects..

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Student Self-Regulated In Remote Learning With The Implementation of Local Virtual Lab Based on Online Tutorial (LVL-BOT).

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ABSTRACT

Changes in the learning system in higher education due to the spread of the corona virus have an impact on the quality of learning physics in universities. The implementation of laboratory activities in various subjects in the physics department cannot be carried out due to the learning system carried out in each house. As a result, physics learning is dominated by one-way theoretical learning by lecturers using online learning applications. Therefore, there is a need for a solution to solve this problem. This study aims to (1) measure the level of Self-Regulated Learning (SRL) in distance learning using a Local Virtual Laboratory Based on Online Tutorial (LVL-BOT), (2) identify the effect of utilization of LVL-BOT towards concept understanding. The type of this research was Pre-Experimental with a One-Group Pretest-Posttest Design. The level of Self-Regulated Learning of students was taken by using a questionnaire while understanding the concept used a test. Based on the results of the analysis, the percentage level of Self-Regulated Learning was at a value of 87, 7% which was included in the very high category. Meanwhile, based on the results of the pre-test and post-test for particle properties of electromagnetic waves concepts, there was a difference between the average score of the pre-test and the average score of the final test. This shows that there was an effect of utilization of LVL-BOT student's conceptual understanding.

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I. Introduction

The corona virus pandemic has had a significant impact on human life in all fields, especially in the field of education. Learning that was initially carried out face-to-face is now being carried out online in order to cut the spread of the corona virus. At present, all educational institutions are trying to find the right models and methods so that distance learning does not interfere with student learning and the concept remains easy to understand even though it is done online.

The separation of physics between students and lecturers is a characteristic of far-reaching education [1]. This has an impact on the lack of interaction between students and lecturers so that of course it has a negative effect on student learning outcomes. Lecturers cannot control student activities during the distance learning process. In fact, there are still many lecturers who do not carry out learning due to limited skills in operating computer technology, besides that, lecturers are also not used to developing online-based teaching materials. For this reason, it is necessary to use technology to support wider interactions and activities for students and lecturers [2], the use of this technology is also expected to be able to present interesting, easy, and meaningful learning. Along with the ongoing impact of the Covid 19 pandemic and advances in network-based Information and Communication Technology in the field of education. So the use of ICT in supporting distance learning is a must and the government, educational institutions, and lecturers need to develop appropriate models, methods, and media of technology.

In addition, one indicator in seeing the achievement of distance learning objectives is the level of understanding of students' concepts. Learning achievement has a relationship with the student's SRL level. Students with a low level of learning independence tend to have a low understanding of concepts, and vice versa [2], [3]. SRL is closely related to the planned thoughts, feelings, and actions of students, so that this greatly affects their learning process and motivation.

Distance learning in various majors or courses is certainly different. In social learning, the material presented in presentation slides or learning videos is sufficient. This is different from the science and mathematics majors, especially physics. Physical phenomena that can be understood by mastering mathematical concepts first become quite difficult, they must be trained how to solve problems with a good understanding of mathematics. In addition, physics students must be able to understand and observe directly existing physical phenomena and study these phenomena with correct mathematical concepts. Learning like this will be more interesting, not boring, and able to increase student activity, therefore physics learning should involve direct experimentation [4], [5]. However, not all physical phenomena can be observed by conducting experiments because some abstract material is impossible and invisible [6], [7]. In addition, the implementation of the experimental method is currently not possible due to several factors, such as (1) during the pandemic, which requires learning to be carried out in individual homes; (2) the availability of equipment in the laboratory that can be used by students in their homes is very limited [6], [8]; (3) the absence of practicum guidelines developed by lecturers that can direct students to make observations independently is also a big problem for physics learners during the pandemic [9].

Students who use distance learning are referred to as autonomous learners who have freedom of behavior and the learning system they will and do [2]. They have broad autonomy to determine when they learn, where and how to organize their learning process and what learning resources should be used. This is different from face-to-face learning where the lecturer has the freedom to regulate the course of the teaching and learning process in the classroom. In addition, because the characteristics of each student are different, in the distance learning process, their ability to manage the learning process both in distance classes and additional learning is of particular concern for the teaching staff. Choosing the right physics learning method during the distance learning class is expected to be able to increase student motivation and activity in learning. This will also greatly affect their independence in learning physics.

Self Regulated Learning (SRL) or what is also called independent learning for students in distance learning is very important. They must be able to control and regulate the learning process. They are also expected to be able to direct their learning in a positive direction [2], [10]. The use of communication technology is expected to be more widely used in accessing information and learning resources. Therefore, the role of lecturers in this matter is very much needed. The types of technology and teaching materials provided by the lecturers certainly affect their learning independence. Lecturers who do not understand the technology and are unable to use technology either in developing learning media or using it in the teaching and learning process will affect the course of distance learning. It is necessary to have technology-based teaching materials that are able to achieve learning objectives.

To overcome this, there needs to be learning techniques that is able to direct students to explore abstract concepts even though learning is carried out

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online, the use of this technology is also expected to increase students' understanding of these concepts, reduce misconceptions and improve skills in analyzing graphics, numbers or completion with mathematical concepts. This technology is able to replace the use of physics practicum tools, easy to use by students and has no risk even though it is used outside the supervision of a lecturer or tutor. In addition, with the right technology-based teaching materials, students' learning independence and conceptual mastery can be much better even though learning is done online. Therefore, online tutorial-based virtual laboratory media (VLBOT) is the right choice.

II. Theory

Local virtual lab is a developed application tool capable of describing a real laboratory environment. This application is stored in technology devices such as computers, laptops or smartphones that can be accessed offline by the user. Several studies on the use of virtual laboratories have been conducted. According to Yusuf and Widyaningsih, the use of virtual laboratories can improve critical thinking skills. In addition, students' activities and perceptions of learning physics with virtual laboratories are very good [11][11]. Swandi et al also stated that the use of virtual laboratories had a positive effect on problem-solving skills and student learning outcomes. In addition, the observation of student activity is in the very high category, which is above 80% when participating in learning with the experimental method using a virtual laboratory [6]. Most students also strongly agree with the use of virtual laboratories, because they feel that invisible phenomena become visible and visible even though in everyday life they will never be seen [7]. Students who use virtual media such as virtual laboratories as learning media have a higher ability to understand and present the material being studied [12][13]. A similar conclusion was also put forward by Magyar & Žáková in their research which stated that the motivation of students to be more active in participating in learning and to develop various skills can be increased by the use of virtual laboratories [14]. The following is an example of a virtual laboratory developed by Swandi et al [15]

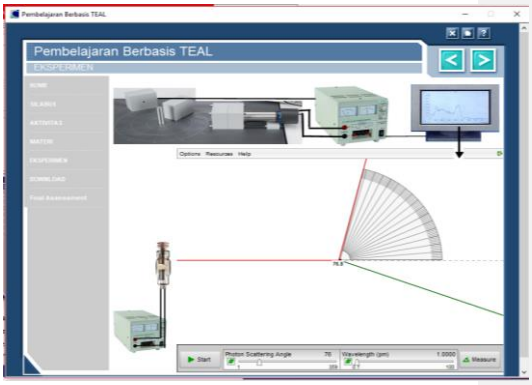

Figure 1. Local virtual laboratory equipment on the Compton effect concept.

The photons emitted from the x-ray tube then collide with free electrons on the surface of the gold metal. As a result of this collision, electrons will bounce off with various changes in angle as well as photons will experience a change in magnitude. The change in magnitude after the collision is observed from the detectors that surround the Compton effect circuit. Various facilities can be used in this virtual experiment, such as changes in incident angle and photon wavelength to determine the relationship between the incoming photon wavelength and the angle of the electron after the collision, the relationship between the incoming photon wavelength and the photon wavelength after the collision, the photon wavelength shift. after the collision, and the kinetic energy (recpol gain) of the electron after the collision.

Although virtual laboratories have been widely developed and used by previous researchers, however, all of these studies indicate that virtual laboratories are used in the classroom (face-to-face between lecturers and students) which means that there is still extensive and direct interaction between lecturers and students. This is certainly different if learning is carried out remotely where students cannot meet directly with the lecturer so that without prior explanation by the lecturer, virtual laboratory learning will be very difficult to do. Therefore, to overcome this, lecturers need to develop virtual laboratory teaching materials that can be downloaded by students equipped with online tutorials. This is important so that without direct instruction from lecturers or tutors, virtual laboratories can still be used. In addition, virtual laboratories are also supported by online learning platforms through applications such as websites or e-learning. So that even though lecturers and students are

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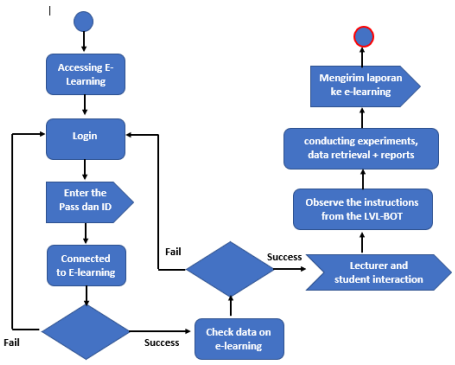
separated, they can still interact even through the application. The use of teaching materials and media like this will greatly assist students in learning, understanding concepts, and following the experimental process easily because there are instructions or video tutorials provided by lecturers and also through a distance learning platform so that when students find difficulties they can easily immediately asked the lecturer [16].



There are 2 things that distinguish LVL-BOT from virtual labs that have been widely used before. The first is the LVL-BOT supported by a video containing instructions from the lecturer. With this video students easily follow instructions so that they can make observations and collect data then analyze the results and draw conclusions. The second advantage is that LVL-BOT is accessed with an online learning platform, this makes learning more interactive, the interaction between teachers and students can still be done supported by e-learning facilities. In addition, teachers easily evaluate the learning process that has been taking place.

III. Method

This research is pre-experimental research where there are still external variables that influence the conceptual understanding and learning independence of students. This is due to the absence of control variables and the sample was not randomly selected. The sample in the study was 37 physics education students in 1 class. Students who program modern physics courses in the physics education department, Makassar State University. The research design is the One-Group Pretest-Postets Design which is described in the table as below [17].

Tabel 1. Desain Peneitian

Pattern	Information
O_1 X O_2	O_1 = Initial test scores before being given treatment O_2 = Final test scores after being given treatment

Before students are treated with the application of virtual laboratory teaching materials assisted by e-learning in distance learning, students are first given a preliminary test. Then, after being given treatment, students were again given the final test. Thus the results of the treatment can be known to be more accurate because it can compare with the previous situation.

The test instrument used to measure the understanding of the concept and the independent learning questionnaire was validated first, both expert validation and construct validation before use. The test instrument is in the form of essay questions with a total of 10 questions related to the concept of the photoelectric effect. Meanwhile, to promote independent learning consists of 40 questions with 5 indicators, namely (1) initiative in online learning; (2) responsibility for assigned tasks; (3) confidence in the results of work; (4) independence in working and making decisions; and (5) independence in using knowledge and experience in accordance with situations and conditions.

To determine the effect of using a video tutorial-based virtual laboratory and assisted with e-learning, the average final test score was reduced by the average initial test score. Meanwhile, the learning independence questionnaire data were obtained through coding the respondent's assessment, then analyzed descriptively quantitatively by calculating the percentage of responses, and then depicted the level of gradation of the analysis results based on the percentage scale. With correlation analysis, the researcher can see whether there is an effect of independent learning on students' conceptual understanding.

IV. Results and Discussion

At the end of the lesson with the application of a virtual laboratory based on online tutorials on black body radiation and photoelectric effects, students are asked to complete a self-study questionnaire according to their opinion of themselves during the lesson. The questionnaire was filled out online via google form and then analyzed using Ms. Eexcel in a quantitative descriptive manner to calculate the percentage of responses. The results of the independent learning

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questionnaire analysis for each indicator are presented in the data below.

Table 2 Indicators of Student Self-Regulated Learning

Aspect	**Percentage (%)**
Initiatives in online learning using LVL-BOT	92,4
Responsibility for assigned tasks	91,6
Kepercayaan diri terhadap hasil pekerjaan	80,4
Confidence in the results of work	91,8
Independence in using knowledge and experience in accordance with situations and conditions.	82,3
Average	**87,7**

Based on the results of the analysis, in general, the percentage of independent learning is at a value of 87.7% which falls into the very high category. The indicator of independent learning, namely student initiative in online learning, had the highest percentage, namely 92.4%. While the lowest is the indicator of self-confidence towards work results, namely 80.4%. For the other 3 indicators, the score is above 80%. In addition, it can be concluded that the percentage for all indicators of student independence is in the very high category.

The high percentage of student initiative in online learning is due to the availability of adequate online learning support facilities, such as all students have laptops and smart smartphones that can be used to access teaching materials and virtual laboratories based on online tutorials. However, some students complained about the availability of their internet data packages and their unstable network. Because to access and download all teaching materials and virtual laboratory applications, a large data package is required. Some students have also prepared learning materials before the lecturers provide virtual laboratory teaching materials. Most of the students had studied the material beforehand with books and references from the internet.

Almost all students do assignments and collect on time. The task given is in the form of conducting experiments with a virtual laboratory. Each student studies the teaching materials provided, makes observations, collects data, analyzes, discusses, and draws conclusions. Students are happy with assignments that are quite clear and systematic. So they no longer need to ask the lecturer about completing the assignment. They also strongly agree with the task collection system that uses e-learning. The assignments that were entered were quickly checked by the lecturer then students were asked to correct them if there were deficiencies. However, there are still a small proportion of students who are still indifferent and cannot complete assignments independently. They still need help from friends for the process.

With the existence of sufficiently complete teaching materials such as books and worksheets as well as virtual laboratory manuals. Students find it easy to work and study. Online tutorial-based virtual labs are very helpful for them. They argue that this is tantamount to face-to-face learning because they are guided by a lecturer to work on a project even though it is in the form of audio and not video. The learning material is also presented in audio form so that the explanation is very clear and can be repeated if there are things that are not understood. Some students who do not understand the explanation can also directly ask questions through the e-learning used. Some students also thought that their memory ability of the concepts they learned through virtual laboratories was better. This is in line with the results of Jagodzinski and Wolski's research that learning using virtual laboratories has a positive impact on improving teaching efficiency, students also experience an increase in remembering information and show greater resilience in remembering information (concepts) material [18], [19]. However, even though distance learning is becoming more interesting, there are still many students who lack confidence in their results.

Even in a pandemic situation, where students are asked to increase their activities at home, including studying. This is not a problem for some students. They argue that although face-to-face learning in class is different from distance learning they actually have great freedom [20]. Supported by online tutorial-based virtual laboratory teaching materials, they can download and access teaching materials easily, manage when and wherever they study, repeat lessons repeatedly, ask lecturers directly using e-learning without being noticed by other students. Therefore, it can be concluded that the application of online tutorial-based virtual laboratories is very suitable to be applied to support distance learning and increase student independence in learning. Several previous studies have shown that the application of laboratory-based teaching materials can increase student learning activities, attitudes, and motivation in learning physics [21]–[23]. Amin et al also stated that there is a positive relationship between the application of a virtual laboratory with problem-solving skills and science process skills for physics students [5], [11], [13]. There is also research by Pariabti & Swandi which states that the application of virtual simulations with active learning

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strategies can increase student activity in observing abstract concepts [24].

After the students filled out the independent learning questionnaire, they were then asked to take a final test related to black body radiation and the photoelectric effect. Concept understanding test scores were then analyzed to determine the average score on the pre-test and the final test and then the intervals were determined. The results of the comparison of the results of the students' concept understanding test results before and after being treated in the form of the application of online tutorial-based virtual laboratory teaching materials on the photoelectric effect material, and black body radiation are described as below:

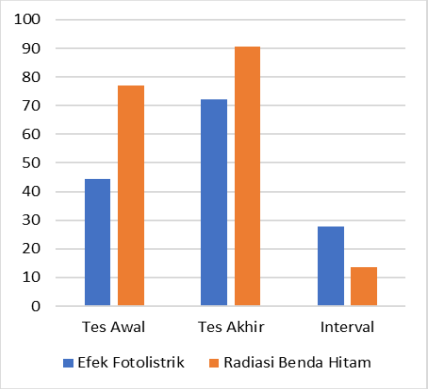

Figure 3 Comparison of Initial and Final Tests

From this graph, it can be seen that there is an increase in the average understanding of students' concepts before and after learning using virtual laboratories for photoelectric effect material and black body radiation. For the photoelectric effect material the difference between the final test and the pre-test is around the value of 27 while for the black body radiation material it is in the range of value 13. Although the difference between the final test and the pre-test is not too large, it can be concluded that there is an effect of using tutorial-based virtual laboratory teaching materials. online towards understanding student concepts.

These results are in line with several studies conducted by several researchers. Research conducted by Yusuf et al and Swandi et al shows that there has been an increase in student learning outcomes and science process skills after using virtual laboratories inside [7], [25]. According to Nurrokhmah and Sunarto, in their research results, learning with virtual laboratories makes learning activities more interesting, students 'interest in learning using this virtual laboratory can increase students' enthusiasm for learning and make students more active so that they can help understand the concepts being taught [26]. Athlah et al also stated that there was an increase in students' conceptual understanding which was marked by the N-Gain category in the experimental class and the control class for dynamic electricity material [27]. Likewise for chemistry learning, where there is an increase in conceptual understanding, especially in the realm of understanding, cognitive and application after learning using a Local Virtual Laboratory Based on Online Video Tutorial.

V. Conclusion

Based on the results of the study, it can be concluded that there is an effect of using local virtual laboratory based on online video tutorials on the self-regulated learning of physics students in remote learning. This is indicated by the average percentage value for all indicators of 87.7% in the very high category. In addition, the use of online tutorial-based virtual laboratories affects the conceptual understanding of physics students. This is indicated by an increase in the average score of the initial concept understanding test with the average score of the final test. Therefore, this teaching material is very suitable for use in distance learning in subjects..

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I. Introduction

The corona virus pandemic has had a significant impact on human life in all fields, especially in the field of education. Learning that was initially carried out face-to-face is now being carried out online in order to cut the spread of the corona virus. At present, all educational institutions are trying to find the right models and methods so that distance learning does not interfere with student learning and the concept remains easy to understand even though it is done online.

The separation of physics between students and lecturers is a characteristic of far-reaching education [1]. This has an impact on the lack of interaction between students and lecturers so that of course it has a negative effect on student learning outcomes. Lecturers cannot control student activities during the distance learning process. In fact, there are still many lecturers who do not carry out learning due to limited skills in operating computer technology, besides that, lecturers are also not used to developing online-based teaching materials. For this reason, it is necessary to use technology to support wider interactions and activities for students and lecturers [2], the use of this technology is also expected to be able to present interesting, easy, and meaningful learning. Along with the ongoing impact of the Covid 19 pandemic and advances in network-based Information and Communication Technology in the field of education. So the use of ICT in supporting distance learning is a must and the government, educational institutions, and lecturers need to develop appropriate models, methods, and media of technology.

In addition, one indicator in seeing the achievement of distance learning objectives is the level of understanding of students' concepts. Learning achievement has a relationship with the student's SRL level. Students with a low level of learning independence tend to have a low understanding of concepts, and vice versa [2], [3]. SRL is closely related to the planned thoughts, feelings, and actions of students, so that this greatly affects their learning process and motivation.

Distance learning in various majors or courses is certainly different. In social learning, the material presented in presentation slides or learning videos is sufficient. This is different from the science and mathematics majors, especially physics. Physical phenomena that can be understood by mastering mathematical concepts first become quite difficult, they must be trained how to solve problems with a good understanding of mathematics. In addition, physics students must be able to understand and observe directly existing physical phenomena and study these phenomena with correct mathematical concepts. Learning like this will be more interesting, not boring, and able to increase student activity, therefore physics learning should involve direct experimentation [4], [5]. However, not all physical phenomena can be observed by conducting experiments because some abstract material is impossible and invisible [6], [7]. In addition, the implementation of the experimental method is currently not possible due to several factors, such as (1) during the pandemic, which requires learning to be carried out in individual homes; (2) the availability of equipment in the laboratory that can be used by students in their homes is very limited [6], [8]; (3) the absence of practicum guidelines developed by lecturers that can direct students to make observations independently is also a big problem for physics learners during the pandemic [9].

Students who use distance learning are referred to as autonomous learners who have freedom of behavior and the learning system they will and do [2]. They have broad autonomy to determine when they learn, where and how to organize their learning process and what learning resources should be used. This is different from face-to-face learning where the lecturer has the freedom to regulate the course of the teaching and learning process in the classroom. In addition, because the characteristics of each student are different, in the distance learning process, their ability to manage the learning process both in distance classes and additional learning is of particular concern for the teaching staff. Choosing the right physics learning method during the distance learning class is expected to be able to increase student motivation and activity in learning. This will also greatly affect their independence in learning physics.

Self Regulated Learning (SRL) or what is also called independent learning for students in distance learning is very important. They must be able to control and regulate the learning process. They are also expected to be able to direct their learning in a positive direction [2], [10]. The use of communication technology is expected to be more widely used in accessing information and learning resources. Therefore, the role of lecturers in this matter is very much needed. The types of technology and teaching materials provided by the lecturers certainly affect their learning independence. Lecturers who do not understand the technology and are unable to use technology either in developing learning media or using it in the teaching and learning process will affect the course of distance learning. It is necessary to have technology-based teaching materials that are able to achieve learning objectives.

To overcome this, there needs to be learning techniques that is able to direct students to explore abstract concepts even though learning is carried out

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online, the use of this technology is also expected to increase students' understanding of these concepts, reduce misconceptions and improve skills in analyzing graphics, numbers or completion with mathematical concepts. This technology is able to replace the use of physics practicum tools, easy to use by students and has no risk even though it is used outside the supervision of a lecturer or tutor. In addition, with the right technology-based teaching materials, students' learning independence and conceptual mastery can be much better even though learning is done online. Therefore, online tutorial-based virtual laboratory media (VLBOT) is the right choice.

II. Theory

Local virtual lab is a developed application tool capable of describing a real laboratory environment. This application is stored in technology devices such as computers, laptops or smartphones that can be accessed offline by the user. Several studies on the use of virtual laboratories have been conducted. According to Yusuf and Widyaningsih, the use of virtual laboratories can improve critical thinking skills. In addition, students' activities and perceptions of learning physics with virtual laboratories are very good [11][11]. Swandi et al also stated that the use of virtual laboratories had a positive effect on problem-solving skills and student learning outcomes. In addition, the observation of student activity is in the very high category, which is above 80% when participating in learning with the experimental method using a virtual laboratory [6]. Most students also strongly agree with the use of virtual laboratories, because they feel that invisible phenomena become visible and visible even though in everyday life they will never be seen [7]. Students who use virtual media such as virtual laboratories as learning media have a higher ability to understand and present the material being studied [12][13]. A similar conclusion was also put forward by Magyar & Žáková in their research which stated that the motivation of students to be more active in participating in learning and to develop various skills can be increased by the use of virtual laboratories [14]. The following is an example of a virtual laboratory developed by Swandi et al [15]

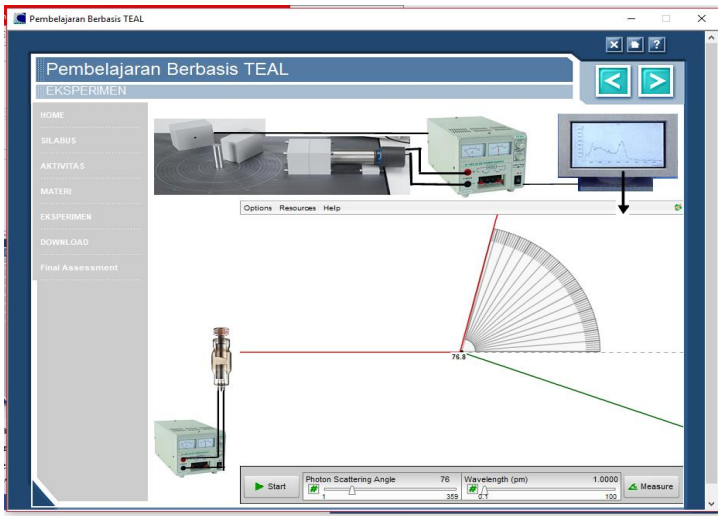

Figure 1. Local virtual laboratory equipment on the Compton effect concept.

The photons emitted from the x-ray tube then collide with free electrons on the surface of the gold metal. As a result of this collision, electrons will bounce off with various changes in angle as well as photons will experience a change in magnitude. The change in magnitude after the collision is observed from the detectors that surround the Compton effect circuit. Various facilities can be used in this virtual experiment, such as changes in incident angle and photon wavelength to determine the relationship between the incoming photon wavelength and the angle of the electron after the collision, the relationship between the incoming photon wavelength and the photon wavelength after the collision, the photon wavelength shift. after the collision, and the kinetic energy (recpol gain) of the electron after the collision.

Although virtual laboratories have been widely developed and used by previous researchers, however, all of these studies indicate that virtual laboratories are used in the classroom (face-to-face between lecturers and students) which means that there is still extensive and direct interaction between lecturers and students. This is certainly different if learning is carried out remotely where students cannot meet directly with the lecturer so that without prior explanation by the lecturer, virtual laboratory learning will be very difficult to do. Therefore, to overcome this, lecturers need to develop virtual laboratory teaching materials that can be downloaded by students equipped with online tutorials. This is important so that without direct instruction from lecturers or tutors, virtual laboratories can still be used. In addition, virtual laboratories are also supported by online learning platforms through applications such as websites or e-learning. So that even though lecturers and students are

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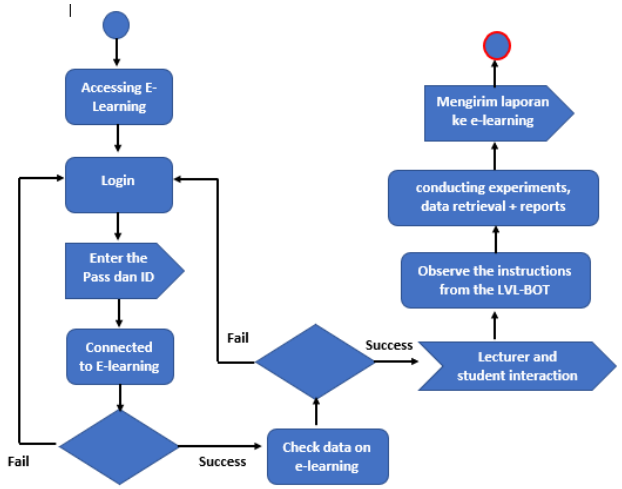
separated, they can still interact even through the application. The use of teaching materials and media like this will greatly assist students in learning, understanding concepts, and following the experimental process easily because there are instructions or video tutorials provided by lecturers and also through a distance learning platform so that when students find difficulties they can easily immediately asked the lecturer [16].



There are 2 things that distinguish LVL-BOT from virtual labs that have been widely used before. The first is the LVL-BOT supported by a video containing instructions from the lecturer. With this video students easily follow instructions so that they can make observations and collect data then analyze the results and draw conclusions. The second advantage is that LVL-BOT is accessed with an online learning platform, this makes learning more interactive, the interaction between teachers and students can still be done supported by e-learning facilities. In addition, teachers easily evaluate the learning process that has been taking place.

III. Method

This research is pre-experimental research where there are still external variables that influence the conceptual understanding and learning independence of students. This is due to the absence of control variables and the sample was not randomly selected. The sample in the study was 37 physics education students in 1 class. Students who program modern physics courses in the physics education department, Makassar State University. The research design is the One-Group Pretest-Postets Design which is described in the table as below [17].

Tabel 1. Desain Peneitian ??

Pattern	Information
O_1 X O_2	O_1 = Initial test scores before being given treatment O_2 = Final test scores after being given treatment

Before students are treated with the application of virtual laboratory teaching materials assisted by e-learning in distance learning, students are first given a preliminary test. Then, after being given treatment, students were again given the final test. Thus the results of the treatment can be known to be more accurate because it can compare with the previous situation.

The test instrument used to measure the understanding of the concept and the independent learning questionnaire was validated first, both expert validation and construct validation before use. The test instrument is in the form of essay questions with a total of 10 questions related to the concept of the photoelectric effect. Meanwhile, to promote independent learning consists of 40 questions with 5 indicators, namely (1) initiative in online learning; (2) responsibility for assigned tasks; (3) confidence in the results of work; (4) independence in working and making decisions; and (5) independence in using knowledge and experience in accordance with situations and conditions.

To determine the effect of using a video tutorial-based virtual laboratory and assisted with e-learning, the average final test score was reduced by the average initial test score. Meanwhile, the learning independence questionnaire data were obtained through coding the respondent's assessment, then analyzed descriptively quantitatively by calculating the percentage of responses, and then depicted the level of gradation of the analysis results based on the percentage scale. With correlation analysis, the researcher can see whether there is an effect of independent learning on students' conceptual understanding.

IV. Results and Discussion

At the end of the lesson with the application of a virtual laboratory based on online tutorials on black body radiation and photoelectric effects, students are asked to complete a self-study questionnaire according to their opinion of themselves during the lesson. The questionnaire was filled out online via google form and then analyzed using Ms. Eexcel in a quantitative descriptive manner to calculate the percentage of responses. The results of the independent learning

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questionnaire analysis for each indicator are presented in the data below.

Table 2 Indicators of Student Self-Regulated Learning

Aspect	**Percentage (%)**
Initiatives in online learning using LVL-BOT	92,4
Responsibility for assigned tasks	91,6
Kepercayaan diri terhadap hasil pekerjaan	80,4
Confidence in the results of work	91,8
Independence in using knowledge and experience in accordance with situations and conditions.	82,3
Average	**87,7**

Based on the results of the analysis, in general, the percentage of independent learning is at a value of 87.7% which falls into the very high category. The indicator of independent learning, namely student initiative in online learning, had the highest percentage, namely 92.4%. While the lowest is the indicator of self-confidence towards work results, namely 80.4%. For the other 3 indicators, the score is above 80%. In addition, it can be concluded that the percentage for all indicators of student independence is in the very high category.

The high percentage of student initiative in online learning is due to the availability of adequate online learning support facilities, such as all students have laptops and smart smartphones that can be used to access teaching materials and virtual laboratories based on online tutorials. However, some students complained about the availability of their internet data packages and their unstable network. Because to access and download all teaching materials and virtual laboratory applications, a large data package is required. Some students have also prepared learning materials before the lecturers provide virtual laboratory teaching materials. Most of the students had studied the material beforehand with books and references from the internet.

Almost all students do assignments and collect on time. The task given is in the form of conducting experiments with a virtual laboratory. Each student studies the teaching materials provided, makes observations, collects data, analyzes, discusses, and draws conclusions. Students are happy with assignments that are quite clear and systematic. So they no longer need to ask the lecturer about completing the assignment. They also strongly agree with the task collection system that uses e-learning. The assignments that were entered were quickly checked by the lecturer then students were asked to correct them if there were deficiencies. However, there are still a small proportion of students who are still indifferent and cannot complete assignments independently. They still need help from friends for the process.

With the existence of sufficiently complete teaching materials such as books and worksheets as well as virtual laboratory manuals. Students find it easy to work and study. Online tutorial-based virtual labs are very helpful for them. They argue that this is tantamount to face-to-face learning because they are guided by a lecturer to work on a project even though it is in the form of audio and not video. The learning material is also presented in audio form so that the explanation is very clear and can be repeated if there are things that are not understood. Some students who do not understand the explanation can also directly ask questions through the e-learning used. Some students also thought that their memory ability of the concepts they learned through virtual laboratories was better. This is in line with the results of Jagodzinski and Wolski's research that learning using virtual laboratories has a positive impact on improving teaching efficiency, students also experience an increase in remembering information and show greater resilience in remembering information (concepts) material [18], [19]. However, even though distance learning is becoming more interesting, there are still many students who lack confidence in their results.

Even in a pandemic situation, where students are asked to increase their activities at home, including studying. This is not a problem for some students. They argue that although face-to-face learning in class is different from distance learning they actually have great freedom [20]. Supported by online tutorial-based virtual laboratory teaching materials, they can download and access teaching materials easily, manage when and wherever they study, repeat lessons repeatedly, ask lecturers directly using e-learning without being noticed by other students. Therefore, it can be concluded that the application of online tutorial-based virtual laboratories is very suitable to be applied to support distance learning and increase student independence in learning. Several previous studies have shown that the application of laboratory-based teaching materials can increase student learning activities, attitudes, and motivation in learning physics [21]–[23]. Amin et al also stated that there is a positive relationship between the application of a virtual laboratory with problem-solving skills and science process skills for physics students [5], [11], [13]. There is also research by Pariabti & Swandi which states that the application of virtual simulations with active learning

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strategies can increase student activity in observing abstract concepts [24].

After the students filled out the independent learning questionnaire, they were then asked to take a final test related to black body radiation and the photoelectric effect. Concept understanding test scores were then analyzed to determine the average score on the pre-test and the final test and then the intervals were determined. The results of the comparison of the results of the students' concept understanding test results before and after being treated in the form of the application of online tutorial-based virtual laboratory teaching materials on the photoelectric effect material, and black body radiation are described as below:

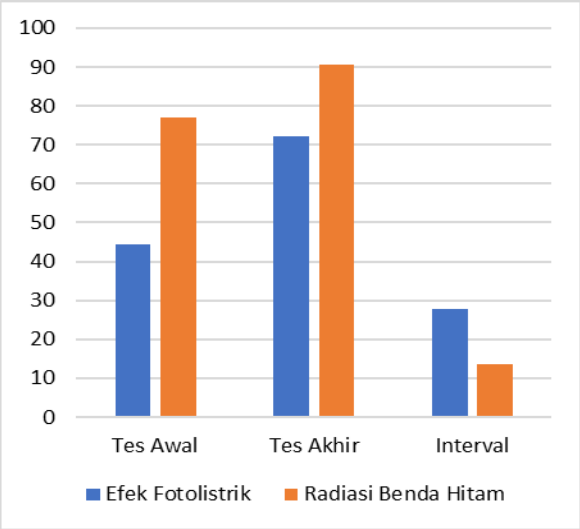

Figure 3 Comparison of Initial and Final Tests

From this graph, it can be seen that there is an increase in the average understanding of students' concepts before and after learning using virtual laboratories for photoelectric effect material and black body radiation. For the photoelectric effect material the difference between the final test and the pre-test is around the value of 27 while for the black body radiation material it is in the range of value 13. Although the difference between the final test and the pre-test is not too large, it can be concluded that there is an effect of using tutorial-based virtual laboratory teaching materials. online towards understanding student concepts.

These results are in line with several studies conducted by several researchers. Research conducted by Yusuf et al and Swandi et al shows that there has been an increase in student learning outcomes and science process skills after using virtual laboratories inside [7], [25]. According to Nurrokhmah and Sunarto, in their research results, learning with virtual laboratories makes learning activities more interesting, students 'interest in learning using this virtual laboratory can increase students' enthusiasm for learning and make students more active so that they can help understand the concepts being taught [26]. Athlah et al also stated that there was an increase in students' conceptual understanding which was marked by the N-Gain category in the experimental class and the control class for dynamic electricity material [27]. Likewise for chemistry learning, where there is an increase in conceptual understanding, especially in the realm of understanding, cognitive and application after learning using a Local Virtual Laboratory Based on Online Video Tutorial.

V. Conclusion

Based on the results of the study, it can be concluded that there is an effect of using local virtual laboratory based on online video tutorials on the self-regulated learning of physics students in remote learning. This is indicated by the average percentage value for all indicators of 87.7% in the very high category. In addition, the use of online tutorial-based virtual laboratories affects the conceptual understanding of physics students. This is indicated by an increase in the average score of the initial concept understanding test with the average score of the final test. Therefore, this teaching material is very suitable for use in distance learning in subjects..

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Hasil review:

1) Di pendahuluan, dasar pemilihan strategi pembelajaran SLR dan penggunaan virtual lab belum ada penjelasan yang memadai tentang hubungan kausal antara keduanya. Tiba-tiba muncul penggunaan vitual lab di akhir bagian pendahuluan.
2) Di pendahuluan hendaknya ditujunjukkan bahwa topik yang diteliti penting dan menarik dan diikuti tentang pembahasan penelitian-penelitian yang telah dilakukan oleh para peneliti dan apa yang masih kurang atau belum dilakukan. Kemudian kebaruan dari penelitian yang dilakukan untuk memperbaiki kekurangan penelitian sebelumnya, atau adanya inovasi dalam penelitian yang akan dilakukan
3) Di bagian teori dijelaskan bahwa topik pembelajaran tentang efek Compton. Belum ada penjelasan alasan pemilihan topik ini di pendahuluan.
4) Vitual Lab yang digunakan berbasis TEAL, sedangkan artikel ini menggunakan pembelajaran dengan konsep SLR. Bagaimana keterkaitan antara TEAL dan SLR belum ada penjelasan (……?)
5) Antara abstrak dan kesimpulan kurang sinkron. Di abstrak tidak disebutkan adanya video tutorial, tepai di kesimpulan disebutkan adanya pngaruh video tutorial. Di judul juga tidak tercermin adanya video tutorial. Penggunaan video tidak harus online.
6) Penulisan daftar Pustaka belum standar.

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Student Self-Regulated In Remote Learning With The Implementation of Local Virtual Lab Based on Online Tutorial (LVL-BOT).

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ABSTRACT

Changes in the learning system in higher education due to the spread of the corona virus have an negative impact on decrease of learning physics quality in universities. The implementation of laboratory activities in various subjects in the physics department cannot be carried out due to the learning system carried out in each house. As a result, physics learning is dominated by one-way theoretical learning by lecturers using online learning applications. Therefore, there is a need for a solution to solve this problem. This study aims to (1) measure the level of Self-Regulated Learning (SRL) and concep understanding in distance learning using a Local Virtual Laboratory Based on Online Tutorial (LVL-BOT), (2) identify the enhancement of concept understanding after using LVL-BOT towards. The type of this research was Pre-Experimental with a One-Group Pretest-Posttest Design. The level of Self-Regulated Learning of students was taken by using a questionnaire while understanding the concept used a test. Based on the results of the analysis, the percentage level of Self-Regulated Learning was at a value of 87, 7% which was included in the very high category. Meanwhile, based on the results of the pre-test and post-test for particle properties of electromagnetic waves concepts, there was a significant difference between the average score of the pre-test and the average score of the post-test. The N-Gain value of Photoelectric Effec and Black Body Radiation were 0.47 and 0,57 respectively. This shows that there was a “enough” enhancement of student's conceptual understanding after using LVL-BOT.

To cite this article:

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The corona virus pandemic has had a significant impact on human life in all fields, especially in the field of education. Learning that was initially carried out face-to-face is now being carried out online in order to cut the spread of the corona virus. At present, all educational institutions are trying to find the right models and methods so that distance learning does not interfere with student learning and the concept remains easy to understand even though it is done online.

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Distance learning in various majors or courses is certainly different. In social learning, the material presented in presentation slides or learning videos is sufficient. This is different from the science and mathematics majors, especially physics. Physical phenomena that can be understood by mastering mathematical concepts first become quite difficult, they must be trained how to solve problems with a good understanding of mathematics. In addition, physics students must be able to understand and observe directly existing physical phenomena and study these phenomena with correct mathematical concepts. Learning like this will be more interesting, not boring, and able to increase student activity, therefore physics learning should involve direct experimentation [4], [5]. However, not all physical phenomena can be observed by conducting experiments because some abstract material is impossible and invisible [6], [7]. In addition, the implementation of the experimental method is currently not possible due to several factors, such as (1) during the pandemic, which requires learning to be carried out in individual homes; (2) the availability of equipment in the laboratory that can be used by students in their homes is very limited [6], [8]; (3) the absence of practicum guidelines developed by lecturers that can direct students to make observations self regulatedly is also a big problem for physics learners during the pandemic [9].

Students who use distance learning are referred to as autonomous learners who have freedom of behavior and the learning system they will and do [2]. They have broad autonomy to determine when they learn, where and how to organize their learning process and what learning resources should be used. This is different from face-to-face learning where the lecturer has the freedom to regulate the course of the teaching and learning process in the classroom. In addition, because the characteristics of each student are different, in the distance learning process, their ability to manage the learning process both in distance classes and additional learning is of particular concern for the teaching staff. Choosing the right physics learning method during the distance learning class is expected to be able to increase student motivation and activity in learning. This will also greatly affect their independence in learning physics.

Self Regulated Learning (SRL) or what is also called self regulated learning for students in distance learning is very important. They must be able to control and regulate the learning process. They are also expected to be able to direct their learning in a positive direction [2], [10]. The use of communication technology is expected to be more widely used in accessing information and learning resources. Therefore, the role of lecturers in this matter is very much needed. The types of technology and teaching materials provided by the lecturers certainly affect their learning independence. Lecturers who do not understand the technology and are unable to use technology either in developing learning media or using it in the teaching and learning process will affect the course of distance learning. It is necessary to have technology-based teaching materials that are able to achieve learning objectives.

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To overcome this, there needs to be learning techniques that is able to direct students to explore abstract concepts even though learning is carried out online, the use of this technology is also expected to increase students' understanding of these concepts, reduce misconceptions and improve skills in analyzing graphics, numbers or completion with mathematical concepts. This technology is able to replace the use of physics practicum tools, easy to use by students and has no risk even though it is used outside the supervision of a lecturer or tutor. one of the right technologies to solve this problem is the implementation of Local Virtual Laboratory Based on Online Tutorial (LVL-BOT). Various previous studies have used virtual laboratories as a substitute for experimental activities in the classroom. However, in online learning there is still very little to do because the virtual laboratory needs to be developed so that it can be used easily by students wherever they are. So that with the additional application it is able to direct students in using teaching materials.

The formulation of the problem in this study is how (1) the level of learning independence of students and (2) increase understanding of concepts before and after using LVL-BOT.

II. Theory

Local virtual lab is a developed application tool capable of describing a real laboratory environment. This application is stored in technology devices such as computers, laptops or smartphones that can be accessed offline by the user. Several studies on the use of virtual laboratories have been conducted. According to Yusuf and Widyaningsih, the use of virtual laboratories can improve critical thinking skills. In addition, students' activities and perceptions of learning physics with virtual laboratories are very good [11][11]. Swandi et al also stated that the use of virtual laboratories had a positive effect on problem-solving skills and student learning outcomes. In addition, the observation of student activity is in the very high category, which is above 80% when participating in learning with the experimental method using a virtual laboratory [6]. Most students also strongly agree with the use of virtual laboratories, because they feel that invisible phenomena become visible and visible even though in everyday life they will never be seen [7]. Students who use virtual media such as virtual laboratories as learning media have a higher ability to understand and present the material being studied [12][13]. A similar conclusion was also put forward by Magyar & Žáková in their research which stated that the motivation of students to be more active in participating in learning and to develop various skills can be increased by the use of virtual laboratories [14]. The following is an example of a virtual laboratory developed by Swandi et al [15]

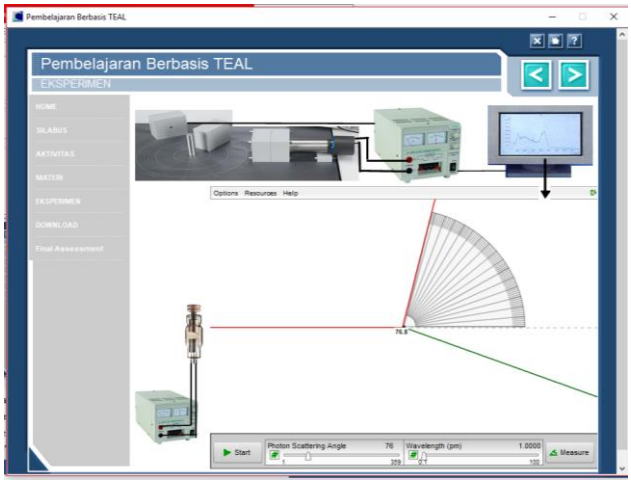

Figure 1. Local virtual laboratory equipment on the Compton effect concept.

The photons emitted from the x-ray tube then collide with free electrons on the surface of the gold metal. As a result of this collision, electrons will bounce off with various changes in angle as well as photons will experience a change in magnitude. The change in magnitude after the collision is observed from the detectors that surround the Compton effect circuit. Various facilities can be used in this virtual experiment, such as changes in incident angle and photon wavelength to determine the relationship between the incoming photon wavelength and the angle of the electron after the collision, the relationship between the incoming photon wavelength and the photon wavelength after the collision, the photon wavelength shift. after the collision, and the kinetic energy (recpol gain) of the electron after the collision.

Although virtual laboratories have been widely developed and used by previous researchers, however, all of these studies indicate that virtual laboratories are used in the classroom (face-to-face between lecturers and students) which means that there is still extensive and direct interaction between lecturers and students. This is certainly different if learning is carried out remotely where students cannot meet directly with the lecturer so that without prior explanation by the lecturer, virtual laboratory learning will be very difficult to do. Therefore, to overcome this, lecturers need to develop virtual laboratory teaching materials that can be downloaded by students equipped with online tutorials. This is important so that without direct instruction from lecturers or tutors,

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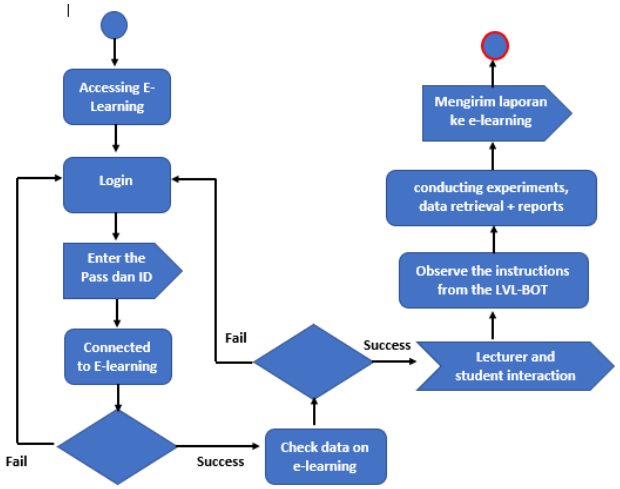
virtual laboratories can still be used. In addition, virtual laboratories are also supported by online learning platforms through applications such as websites or e-learning. So that even though lecturers and students are separated, they can still interact even through the application. The use of teaching materials and media like this will greatly assist students in learning, understanding concepts, and following the experimental process easily because there are instructions or video tutorials provided by lecturers and also through a distance learning platform so that when students find difficulties they can easily immediately asked the lecturer [16].



There are 2 things that distinguish LVL-BOT from virtual labs that have been widely used before. The first is the LVL-BOT supported by a video containing instructions from the lecturer. With this video students easily follow instructions so that they can make observations and collect data then analyze the results and draw conclusions. The second advantage is that LVL-BOT is accessed with an online learning platform, this makes learning more interactive, the interaction between teachers and students can still be done supported by e-learning facilities. In addition, teachers easily evaluate the learning process that has been taking place [17].

LVL-BOT which is rich in interactive simulations allows students to carry out experimental activities independently whenever and wherever they are [18], [19]. An interesting simulation is able to show physics concepts and phenomena through visualization. students can see how the influence or interaction of physical parameters on a concept or theory [20].

III. Method

This research is pre-experimental research where there are still external variables that influence the conceptual understanding and learning independence of students. This is due to the absence of control variables and the sample was not randomly selected. The sample in the study was 37 physics education students in 1 class. Students who program modern physics courses in the physics education department, Makassar State University. The research design is the One-Group Pretest-Postets Design which is described in the table as below [21].

Table 1. Research Design

Pattern	Information
O_1 X O_2	O_1 = Initial test scores before being given treatment O_2 = Final test scores after being given treatment

Before students are treated with the application of virtual laboratory teaching materials assisted by e-learning in distance learning, students are first given a preliminary test. Then, after being given treatment, students were again given the post-test. Thus the results of the treatment can be known to be more accurate because it can compare with the previous situation.

The test instrument used to measure the understanding of the concept and the self-regulated learning questionnaire that used to identify the level of each aspect of self-regulated learning, were validated first by expert to judge the test instrument and questionnaire (construct and content validity). The test instrument is in the form of essay questions with a total of 10 questions related to the concept of the photoelectric effect and blck body radiation concepts. Meanwhile, to promote self regulated learning consists of 40 questions with 5 indicators, namely (1) initiative in online learning; (2) responsibility for assigned tasks; (3) confidence in the results of work; (4) independence in working and making decisions; and (5) independence in using knowledge and experience in accordance with situations and conditions.

To determine the enhancement of concep understanding after using a video tutorial-based virtual laboratory and assisted with e-learning, the average final test score was reduced by the average initial test score. Categories of improvement in learning outcomes can be seen using the N-Gain equation. Meanwhile, the learning independence questionnaire data were obtained through coding the respondent's assessment, then analyzed descriptively quantitatively by calculating the percentage of responses, and then depicted the level of gradation of the analysis results based on the percentage scale.

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IV. Results and Discussion

At the end of the lesson with the application of a virtual laboratory based on online tutorials on black body radiation and photoelectric effects, students are asked to complete a self-study questionnaire according to their opinion of themselves during the lesson. The questionnaire was filled out online via google form and then analyzed using Ms. Eexcel in a quantitative descriptive manner to calculate the percentage of responses. The results of the self regulated learning questionnaire analysis for each indicator are presented in the data below.

Table 2 Indicators of Student Self-Regulated Learning

Aspect	**Percentage (%)**
Initiatives in online learning using LVL-BOT	92,4
Responsibility for assigned tasks	91,6
Confidence in the results of work	80,4
Behave in a disciplined manner	91,8
Independence in using knowledge and experience in accordance with situations and conditions.	82,3
Average	**87,7**

Based on the results of the analysis, in general, the percentage of self regulated learning is at a value of 87.7% which falls into the very high category. The indicator of self regulated learning, namely student initiative in online learning, had the highest percentage, namely 92.4%. While the lowest is the indicator of self-confidence towards work results, namely 80.4%. For the other 3 indicators, the score is above 80%. In addition, it can be concluded that the percentage for all indicators of Selef-Regulated Learning of students is in the very high category.

The high percentage of student initiative in online learning is due to the availability of adequate online learning support facilities, such as all students have laptops and smart smartphones that can be used to access teaching materials and virtual laboratories based on online tutorials. However, some students complained about the availability of their internet data packages and their unstable network. Because to access and download all teaching materials and virtual laboratory applications, a large data package is required. Some students have also prepared learning materials before the lecturers provide virtual laboratory teaching materials. Most of the students had studied the material beforehand with books and references from the internet.

Almost all students do assignments and collect on time. The task given is in the form of conducting experiments with a virtual laboratory. Each student studies the teaching materials provided, makes observations, collects data, analyzes, discusses, and draws conclusions. Students are happy with assignments that are quite clear and systematic. So they no longer need to ask the lecturer about completing the assignment. They also strongly agree with the task collection system that uses e-learning. The assignments that were entered were quickly checked by the lecturer then students were asked to correct them if there were deficiencies. However, there are still a small proportion of students who are still indifferent and cannot complete assignments self regulatedly. They still need help from friends for the process.

With the existence of sufficiently complete teaching materials such as books and worksheets as well as virtual laboratory manuals. Students find it easy to work and study. Online tutorial-based virtual labs are very helpful for them. They argue that this is tantamount to face-to-face learning because they are guided by a lecturer to work on a project even though it is in the form of audio and not video. The learning material is also presented in audio form so that the explanation is very clear and can be repeated if there are things that are not understood. Some students who do not understand the explanation can also directly ask questions through the e-learning used. Some students also thought that their memory ability of the concepts they learned through virtual laboratories was better. This is in line with the results of Jagodzinski and Wolski's research that learning using virtual laboratories has a positive impact on improving teaching efficiency, students also experience an increase in remembering information and show greater resilience in remembering information (concepts) material [22], [23]. However, even though distance learning is becoming more interesting, there are still many students who lack confidence in their results.

Even in a pandemic situation, where students are asked to increase their activities at home, including studying. This is not a problem for some students. They argue that although face-to-face learning in class is different from distance learning they actually have great freedom [24]. Supported by online tutorial-based virtual laboratory teaching materials, they can download and access teaching materials easily, manage when and wherever they study, repeat lessons repeatedly, ask lecturers directly using e-learning without being noticed by other students. Therefore, it can be concluded that the

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application of online tutorial-based virtual laboratories is very suitable to be applied to support distance learning and increase student independence in learning. Several previous studies have shown that the application of laboratory-based teaching materials can increase student learning activities, attitudes, and motivation in learning physics [25]–[27]. Amin et al also stated that there is a positive relationship between the application of a virtual laboratory with problem-solving skills and science process skills for physics students [5], [11], [13]. There is also research by Pariabti & Swandi which states that the application of virtual simulations with active learning strategies can increase student activity in observing abstract concepts [28].

After the students filled out the self regulated learning questionnaire, they were then asked to take a final test related to black body radiation and the photoelectric effect. Concept understanding test scores were then analyzed to determine the average score on the pre-test and the final test and then the intervals were determined. The results of the comparison of the results of the students' concept understanding test results before and after being treated in the form of the application of online tutorial-based virtual laboratory teaching materials on the photoelectric effect material, and black body radiation are described as below:

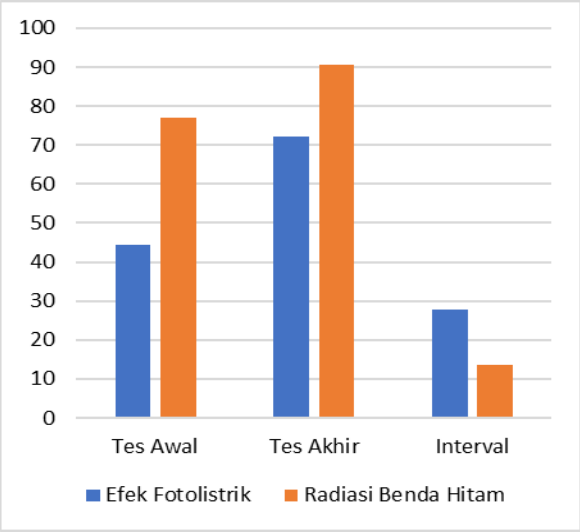

Figure 3 Comparison of Initial and Final Tests

From this graph, it can be seen that there is an increase in the average understanding of students' concepts before and after learning using virtual laboratories for photoelectric effect material and black body radiation. For the photoelectric effect material the difference between the final test and the pre-test is around the value of 27 while for the black body radiation material it is in the range of value 13. Although the difference between the final test and the pre-test is not too large, it can be concluded that there is an enhancement of student concepts understanding using LVL-BOT. To find out the categories for increasing students' conceptual understanding, an n-gain analysis was carried out as in the table below

Table 3. The Value and Category of Enhancement Concept understanding

Unit	N-Gain Value	Category
Photoelectric Effect	0.47	Average/enough
Black Body Radiation	0.57	Average/enough

From table 3 it can be seen that there is an increase in student learning outcomes after using the LVL-BOT both on the concept of the photoelectric effect and black body radiation. while the increase is in the ”enough” category.

These results are in line with several studies conducted by several researchers. Research conducted by Yusuf et al and Swandi et al shows that there has been an increase in student learning outcomes and science process skills after using virtual laboratories inside [7], [29]. According to Nurrokhmah and Sunarto, in their research results, learning with virtual laboratories makes learning activities more interesting, students 'interest in learning using this virtual laboratory can increase students' enthusiasm for learning and make students more active so that they can help understand the concepts being taught [30]. Athlah et al also stated that there was an increase in students' conceptual understanding which was marked by the N-Gain category in the experimental class and the control class for dynamic electricity material [31]. Likewise for chemistry learning, where there is an increase in conceptual understanding, especially in the realm of understanding, cognitive and application after learning using a Local Virtual Laboratory Based on Online Video Tutorial (LVL-BOT).

Although there is an increase in students' conceptual understanding after learning using LVL-BOT, it cannot be concluded that there is an effect of the application of the LVL-BOT on concept understanding. This is because the form of research used is only pre-experimental which does not limit other influencing variables.

V. Conclusion

Based on the results of the study, it can be concluded that the level of student self-regulated learning in distance learning physics after using the LVL-BOT learning device is at an average percentage of 87.7% which falls into the ”very high” category. In addition,

based on the results of the analysis before and after the use of LVL-BOT there was an increase in conceptual understanding of both the photoelectric effect material and black body radiation, each of which was in the "adequate/enough" category.

However, it cannot be said that there is an effect of using the LVL-BOT learning tool both on self-regulated learning and on concept understanding. This is because the research design used does not limit other variables that may have an effect. Therefore, there is a need for further research that can be carried out by other researchers using experimental research designs such as the use of pre-test and post-test in two classes, namely the experimental class and the control class. Further research can also be carried out to see whether there is an effect of the application of LVL-BOT on learning independence and conceptual understanding or learning independence on conceptual understanding. therefore, the use of research methodologies must be appropriate.

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