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ONLINE SCIENCE LABORATORY-BASED ACTIVITIES ON STUDENT's METACOGNITION AND PERFORMANCE AMIDST PANDEMIC

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Abstract

This study determined the effects of online science laboratory-based activities on student's metacognition and performance amidst pandemic of the respondents from Gov. Felicisimo T San Luis Integrated Senior High School. It aimed to answer the questions such as the level of online Science laboratory based activities in terms of manipulative online activities, online videos, and interactive simulations. Furthermore, this also sought to determine the mean level of the student's metacognition in terms of cognitive process, thinking process, self-regulations, self-reflection, and appropriate strategies utilization, and the mean level of the student's performance as to Pre-Test and Post-Test. Lastly to sought to answer the question about the significant effect of online science laboratory-based activities on the students' metacognition and performance.

The descriptive method was utilized in this study since it yields valid and reliable results for a manageable number of respondents and can be accomplished with limited resources. The research also used the survey questionnaire and Pre-test and Post-test to obtain data from the selected grade 7 students from different public junior high school in Sta Cruz Laguna specifically Gov. Felicisimo T. San Luis Integrated Senior High School and Pedro Guevara National High School. The process of descriptive survey research went beyond mere gathering and tabulation of data. It involved an element of interpretation of the meaning or significance of the result since the investigation is concerned with determining the effect of online science

laboratory-based activities on the students' metacognition and performance.

It presents the significant effect of the science laboratory-based activities on the level of students' metacognition. Specifically, it shows the effect of manipulative online activities, online videos, and interactive simulations on the cognitive process, thinking process, self-regulation, self-reflection, and appropriate strategies utilization. The researcher then came up that online science laboratory-based activities have no significant effect on the students' metacognition and performance" is rejected and calls for the acceptance of the alternative, which incites a significant effect.

Keywords: online laboratory actvities,manipulative activities, interactive simulation, metacognitive strategy, self-regulation, self-reflection, cognitive process

1. INTRODUCTION

The Pandemic is ravaging the globe and caused the most serious disruption to educational trends in at least a century according to the World Health Organization (2020). No doubt that the disruption in education will be a time of experimentation and productive collaborations between teachers and students in the teaching-learning process. As education drives to shift our culture and society, educators of today are challenged to modify teaching methods and strategies to meet the needs of the learners (Vermulen, 2017) At this time, teachers are much needed to guide learners on online education as an alternative teaching modality amidst pandemic. Schleicher (2020).

As part of the Philippines' short- and long-term 8strategies, the DepEd_ Secretary introduced the BE-LCP as a guideline for the department on how to deliver education in time of the COVID-19 pandemic while ensuring the health, safety, and welfare of all learners, teachers and personnel of DepEd.

As part of the guideline on online education, the use of emerging technologies can be used to provide opportunities to enhance and improve the learning and education process. As such, online science laboratory- based activities need to be brought into classrooms to enhance current learning methods especially in science classes. Kennepohl (2017).

As the application of online science laboratory-based activities during classes has resulted in a change in the educational process for students and

teachers, it is necessary to know and confirm its effectiveness for teaching complex science topics.

Thus, the researcher seeks to find out the effects of online science laboratory-based activities on student's metacognition and performance amidst pandemic.

The Department of Education (DepEd) in the implementation of Basic Education Learning Continuity Plan (BE-LCP) is to adopt various learning delivery and teaching modalities. with distance learning as major option. It emphasized that online learning is only one option from the menu of learning modalities. These modalities will be offered appropriately depending on the situation of the learners' households

In response to that, teachers implemented the guidelines in Basic Education Learning Continuity Plan (BE-LCP) to conduct different modalities such as synchronous and asynchronous classes of which is the online learning.

With that, laboratory-based activities in online classes were carried out to provide supplemental knowledge and promote learning as the activities in online laboratories can enhance the learning environment and make the lesson more constructive. The importance of using online laboratory in science education lies in the fact that they offer the best solution for conducting laboratory activities as the students can perform lab activities using computer, which is cheaper and more efficient.

Furthermore, online laboratory allows students to repeat an experiment many times without any risk of danger. In this part, the metacognition and performance of the students will be enhanced in this kind of modality, specifically in Science subjects.

Sadly, in Gov. Felicisimo T. San Luis Integrated Senior High School, students under the modular approach as a learning modality are not able to experience online laboratory-based activities. With that in mind, the researcher seeks to find out the effects of online science laboratory-based activities on student's metacognition and performance as a basis for intervention activities/ programs for students under online classes as a learning modality.

1.1 Objectives of the Study

This study is centered on the online Science laboratory-based activities and student's metacognition and performance amidst of pandemic.

Specifically, it aimed to:

1. What is the level of online Science laboratory based activities in terms of:
   - 1.1. Manipulative online activities;
   - 1.2. Online videos; and
   - 1.3. Interactive simulations?

2. What is the mean level of the student's metacognition in terms of;
   - 2.1 . Cognitive process;
   - 2.2 Thinking process;
   - 2.3 Self-regulations;
   - 2.4 Self-reflection; and
   - 2.5 Metacognitive strategy

3. What is the mean level of the student's performance as to ;
   - 3.1 Pre-Test; and
   - 3.2 Post-Test

4. Does online science laboratory-based activities significantly affect the students' metacognition and performance?

2. METHODOLOGY

2.1 Research Design

The descriptive survey method will be utilized in this study.

According to Sevilla (2008), descriptive survey research is concerned with conditions of relationship that exist, practices that prevail, beliefs and processes that are going on, effects that are being felt, or trends that are developing. The process of descriptive survey research goes beyond mere gathering and tabulation of data. It involves an element of interpretation of the meaning or significance of what is being described.

As stated by Wallen (2008), this method is intended for the researcher to gather information about the existing situation at the time of study and also to explore its particular phenomena.

In determining the effects of online science laboratory-based activities on student's metacognition and performance, the researcher integrated various indicators in the dependent and independent variables.

2.2 Respondents of the Study

This study involved eighty (80) students from Grade 7 of Gov. Felecisimo T. San Luis Integrated Senior High School enrolled during the school year 2021-2022. In the current situation, learners attending online classes were the respondents of the study. The researcher prepared the online science laboratory activities for the coverage of the lessons and the online teacher taught the lesson.

The questionnaire, Pretest and Posttest were given to the students to find out the Effect of Online Science Laboratory Based Activities on Students' Metacognition and Performance Amidst Pandemic.

2.3 Research Instrument

The instrument used in the study was a survey questionnaire checklist The questionnaire is a research-made instrument devised to determine the effects of online laboratory-based activities on grade 7 students' metacognition and performance.

In the questionnaire, a five-point rating scale indicated below

Scale	Numerical Value	Descriptive Value
5	4.21 – 5.0	Strongly Agree
4	3.41 – 4.20	Agree
3	2.61 – 3.40	Neutral
2	1.81 – 2.60	Strongly Disagree
1	1.00 – 1.80	Disagree

In the construction of questionnaire described above, an extensive review of various books, publications and internet sites was used. An initial draft of the research tool was prepared and presented to professors and panel members for comments and suggestions. Validation was done to assess the representation of the items with those of others dealing with same area of investigation. The assistance of the adviser relevant to the contents of the questionnaire was solicited.

The final form of the questionnaire was reproduced and administered to respective respondents.

2.4 Statistical Treatment

The responses were tabulated as basis for statistical treatment of the data.

In order to analyze and interpret the data gathered, the following statistical tools was utilized in the study. Weighted mean, standard deviation, and t-test in pre and post-analysis variance.

3. RESULTS AND DISCUSSION

This section presents the data gathered which were statistically treated, presented, analyzed in tables and interpreted in relation to the problems and hypotheses specified in the study. The results were presented in the same sequence with the research questions posed for the study.

Table 1 illustrates the level of online science laboratory based activities in terms of manipulative online activities.

"Manipulative online activities provide tasks. wherein the students can positively engage in" yielded the highest mean score (M=4.65, SD=0.59) and was remarked as Strongly Agree. This is followed by "Manipulative online activities allow the students to improve their self-efficacy and self-awareness" with a mean score (M=4.59, SD=0.62) and was also remarked as Strongly Agree. On the other hand, the statement "Manipulative online activities promote working collaboration within the students" received the lowest mean score of responses with (M=4.53, SD=0.72) yet was also remarked Strongly Agree.

Table 1. Level of Online Science Laboratory Based Activities in terms of Manipulative Online Activities

STATEMENT	MEAN	SD	REMARKS
1. Manipulative online activities provide tasks. wherein the students can positively engage.	4.65	0.59	Strongly Agree
2. Manipulative online activities promote working collaboration among the students.	4.53	0.72	Strongly Agree
3. Manipulative online activities allow the students to explore their own capabilities in manipulating objects and experiments.	4.54	0.72	Strongly Agree
4. Manipulative online activities allow the students to improve their self-efficacy and self-awareness.	4.59	0.62	Strongly Agree
5. Manipulative online activities enable the students to enhance their understanding of abstract concepts.	4.56	0.70	Strongly Agree
Overall Mean = 4.57 Standard Deviation = 0.67 Verbal Interpretation = Very High			

Legend: Range / Verbal Interpretation
4.21-5.0 / Strongly Agree *3.41-4.20 / Agree*
2.61-3.40 Neutral *1.81- 2.60 / Strongly Disagree*
1-1.80 Disagree

Table 2 illustrates the level of online science laboratory based activities in terms of online videos.

"Online videos are accessible for the students whenever they want to review and recall their lessons" yielded the highest mean score (M=4.64, SD=0.66) and was remarked as Strongly Agree. This is followed by "Online videos allow students to learn using audio-visual materials" with a mean score (M=4.62, SD=0.65) and was also remarked as Strongly Agree. On the other hand, the statement "Online videos present ideas that help build students' knowledge and comprehension" received the lowest mean score of responses with (M=4.60, SD=0.60) yet was also remarked Strongly Agree.

Table 2. Level of Online Science Laboratory Based Activities in terms of Online Videos

STATEMENT	MEAN	SD	REMARKS
1. Online videos serve as an effective educational supplement for students' learning.	4.61	0.67	Strongly Agree
2. Online videos present ideas that help build students' knowledge and comprehension.	4.60	0.60	Strongly Agree
3. Online videos allow students to learn using audio-visual materials.	4.62	0.65	Strongly Agree
4. Online videos are accessible for the students whenever they want to review and recall their lessons.	4.64	0.66	Strongly Agree
5. Online videos produce information that may serve as a tutorial for students' activities.	4.61	0.69	Strongly Agree
Overall Mean = 4.62 Standard Deviation = 0.65 Verbal Interpretation = Very High			

Legend: **Range / Verbal Interpretation**
4.21-5.0 / Strongly Agree *3.41-4.20 / Agree*
2.61-3.40 Neutral *1.81- 2.60 / Strongly Disagree*
1-1.80 Disagree

Table 3. Level of Online Science Laboratory Based Activities in terms of Interactive Simulation

"Interactive simulations enable students to learn and discover the concept on their own" yielded the highest mean score (M=4.65, SD=0.58) and was remarked as Strongly Agree. This is followed by "Interactive simulations allow students to take their role as learners while performing activities and/or experiments" with a mean score (M=4.62, SD=0.65) and was also remarked as Strongly Agree. On the other hand, the statement "Interactive simulations enhance students in necessary thinking skills and perform experiments that they are engaged and working in" received the lowest mean score of responses with (M=4.53, SD=0.73) yet was also remarked Strongly Agree.

STATEMENT	MEAN	SD	REMARKS
1. Interactive simulations enable students to learn and discover the concept on their own.	4.65	0.58	Strongly Agree
2. Interactive simulations enhance students d in' necessary thinking skills and perform experiments that they are totally engaged and working in.	4.53	0.73	Strongly Agree
3. Interactive simulations allow students to take their role as learners while performing activities and/or experiments.	4.62	0.65	Strongly Agree
4. Interactive simulations assist students in gaining information and skills by self-studying.	4.59	0.68	Strongly Agree
5. Interactive simulations challenge the students to compromise with deep learning based on what they are doing.	4.54	0.69	Strongly Agree
Overall Mean = 4.59 Standard Deviation = 0.67 Verbal Interpretation = Very High			

Legend: **Range / Verbal Interpretation**
4.21-5.0 / Strongly Agree *3.41-4.20 / Agree*
2.61-3.40 Neutral *1.81- 2.60 / Strongly Disagree*
1-1.80 Disagree

Table 4 illustrates the mean level of the students' metacognition in terms of cognitive process

Among the statements above, "I can stimulate my knowledge and be apply it in real-life situations" yielded the highest mean score (M=4.74, SD=0.54) and was remarked as Strongly Agree. This is followed by "I improve processing information from audio-visual materials" with a mean score (M=4.72, SD=0.55) and was also remarked as Strongly Agree. On the other hand, the statement "I enhance my working memory" received the lowest mean score of responses with (M=4.55, SD=0.72) yet was also remarked Strongly Agree.

Table 4. Mean Level of the Students' Metacognition in terms of Cognitive Process

STATEMENT	MEAN	SD	REMARKS
1. I develop multi-tasking in doing my activities.	4.69	0.60	Strongly Agree
2. I improve my productivity in doing my school projects and performance tasks.	4.68	0.58	Strongly Agree
3. I enhance my working memory.	4.55	0.72	Strongly Agree
4. I improve processing information from audio-visual materials	4.72	0.55	Strongly Agree
5. I can stimulate my knowledge and be apply it in real-life situations.	4.74	0.54	Strongly Agree
Overall Mean = 4.68 Standard Deviation = 0.60 Verbal Interpretation = Very High			

Legend: **Range / Verbal Interpretation**
4.21-5.0 / Strongly Agree *3.41-4.20 / Agree*
2.61-3.40 Neutral *1.81- 2.60 / Strongly Disagree*
1-1.80 Disagree

Table 5 illustrates the mean level of the students' metacognition in terms of thinking process.

"I can make inferences and explanations about our lessons" yielded the highest mean score (M=4.66, SD=0.61) and was remarked as Strongly Agree. This is followed by "I can easily analyze information from the lesson and experiment we have made" with a mean score (M=4.63, SD=0.65) and was also remarked as Strongly Agree. On the other hand, the statement "I can interpret information from what we have watched and/or read" received the lowest mean score of responses with (M=4.57, SD=0.66) yet was also remarked Strongly Agree.

Table 5. Mean Level of the Students' Metacognition in terms of Thinking Process

STATEMENT	MEAN	SD	REMARKS
1. I can easily analyze information from the lesson and experiment we have made.	4.63	0.65	Strongly Agree
2. I can construct knowledge and ability to share it within the class discussion	4.59	0.60	Strongly Agree
3. I can interpret information from what we have watched and/or read.	4.57	0.66	Strongly Agree
4. I can evaluate the concepts from our activities.	4.59	0.64	Strongly Agree
5. I can make inferences and explanations about our lessons.	4.66	0.61	Strongly Agree
Overall Mean = 4.61 Standard Deviation = 0.63 Verbal Interpretation = Very High			

Legend: **Range / Verbal Interpretation**
4.21-5.0 / Strongly Agree *3.41-4.20 / Agree*
2.61-3.40 Neutral *1.81- 2.60 / Strongly Disagree*
1-1.80 Disagree

Table 6 illustrates the mean level of the students' metacognition in terms of self-regulations**.**

Among the statements above, "I can set and achieve my own academic goals" yielded the highest mean score (M=4.64, SD=0.63) and was remarked as Strongly Agree. This is followed by "I am active in terms of participating in class discussion and group activities" with a mean score (M=4.61, SD=0.65) and was also remarked as Strongly Agree. On the other hand, the statement "I find time for watching and/or reading supplementary sources to increase my learnings" received the lowest mean score of responses with (M=4.51, SD=0.67) yet was also remarked Strongly Agree.

Table 6. Mean Level of the Students' Metacognition in terms of Self-Regulations

STATEMENT	MEAN	SD	REMARKS
1. I am active in terms of participating in class discussion and group activities.	4.61	0.65	Strongly Agree
2. I can respond to my own needs while doing school activities.	4.55	0.69	Strongly Agree
3. I find time for watching and/or reading supplementary sources to increase my learnings.	4.51	0.67	Strongly Agree
4. I can manage my time in doing my school activities.	4.58	0.64	Strongly Agree
5. I can set and achieve my own academic goals.	4.64	0.63	Strongly Agree
Overall Mean = 4.58 Standard Deviation = 0.65 Verbal Interpretation = Very High			

Legend: **Range / Verbal Interpretation**
4.21-5.0 / Strongly Agree *3.41-4.20 / Agree*
2.61-3.40 Neutral *1.81- 2.60 / Strongly Disagree*
1-1.80 Disagree

Table 7 illustrates the mean level of the students' metacognition in terms of self-reflection.

"I can regulate my attitude and behavior when doing school performance tasks and activities" yielded the highest mean score (M=4.63, SD=0.60) and was remarked as Strongly Agree. This is followed by "I can analyze my own strength and weaknesses" with a mean score (M=4.60, SD=0.60) and was also remarked as Strongly Agree. On the other hand, the statement "I can evaluate my own progress" received the lowest mean score of responses with (M=4.52, SD=0.66) yet was also remarked Strongly Agree.

Table 7. Mean Level of the Students' Metacognition in terms of Self- Reflection

STATEMENT	MEAN	SD	REMARKS
1. I can evaluate my own progress	4.52	0.66	Strongly Agree
2.I can deeply understand my own knowledge	4.54	0.67	Strongly Agree
3. I can use my learning experiences in real-life situations.	4.58	0.59	Strongly Agree
4. I can regulate my attitude and behavior when doing school performance tasks and activities.	4.63	0.60	Strongly Agree
5. I can analyze my own strength and weaknesses.	4.60	0.60	Strongly Agree
Overall Mean = 4.57 Standard Deviation = 0.62 Verbal Interpretation = Very High			

Legend: **Range / Verbal Interpretation**

4.21-5.0 / Strongly Agree *3.41-4.20 / Agree*
2.61-3.40 Neutral *1.81- 2.60 / Strongly Disagree*
1-1.80 Disagree

Table 8 presents the mean level of the students' metacognition in terms of metacognitive strategy.

"I can create a healthy environment for my online and offline classes" yielded the highest mean score (M=4.72, SD=0.55) and was remarked as Strongly Agree. This is followed by "I can monitor and assess the beneficial effects of doing school activities" and "I look for other resources that help me gain more information and ideas for my school activities" with a mean score (M=4.67, SD=0.59) and were also remarked as Strongly Agree. On the other hand, the statement "I can effectively collect and analyze data to improve my skills" received the lowest mean score of responses with (M=4.56, SD=0.69) yet was also remarked Strongly Agree.

Table 8. Mean Level of the Students' Metacognition in terms of Metacognitive Strategy

STATEMENT	MEAN	SD	REMARKS
1. I can create a healthy environment for my online and offline classes.	4.72	0.55	Strongly Agree
2. I can find appropriate resources that can help me empower my knowledge.	4.64	0.58	Strongly Agree
3. I can monitor and assess the beneficial effects of doing school activities.	4.67	0.59	Strongly Agree
4. I can effectively collect and analyze data t improve my skills.	4.56	0.69	Strongly Agree
5. I look for other resources that help me gain more information and ideas for my school activities.	4.67	0.59	Strongly Agree
Overall Mean = 4.65 Standard Deviation = 0.60 Verbal Interpretation = Very High			

Legend: **Range / Verbal Interpretation**

4.21-5.0 / Strongly Agree *3.41-4.20 / Agree*
2.61-3.40 Neutral *1.81- 2.60 / Strongly Disagree*
1-1.80 Disagree

Table 9 presents the mean level of students' performance as to pre-test and post-test.

Table 9. Mean Level of Students' Performance as to Pre-Test and Post-Test

RANGE	PRE TEST		POST TEST		REMARKS
	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE	
41 to 50	0	0.00	12	24.00	Outstanding
31 to 40	17	34.00	17	34.00	Very Satisfactory
21 to 30	6	12.00	13	26.00	Satisfactory
11 to 20	22	44.00	8	16.00	Fairly Satisfactory
0 to 10	5	10.00	0	0.00	Did Not Meet Expectations
Total	50	100.00	50	100.00	
Overall Mean	22.12		31.00		
Standard Deviation	11.639		10.043		
Verbal Interpretation	Satisfactory		Very Satisfactory		

As to pre-test, out of fifty (50) students, twenty-two (22) were able to score between 11 to 20 points which is fairly satisfactory. Seventeen (17) or 34% of the population were able to score between 31 to 40 points which was very satisfactory. On the other hand, five (5) students were only able to score between 0 to 10 points which did not meet the expectations.

As to the post-test, a majority of thirty-four (34) students were able to score between 21 to 30 points which was on a very satisfactory level. Thirteen (13) or 26% was able to score between 21 to 30 points and was on a satisfactory level. While a small number, around 16% of the respondents still scored on a fairly satisfactory level.

In terms of students' performance as to pre-test and post-test, the findings showed that the pre-test was satisfactory while the post-test was very satisfactory. This implies that online laboratory-based activities can contribute to the improvement of students' performance. Therefore, it is essential to utilize activities applying technology advancement to enhance learners' competencies amidst the pandemic.

Effect of Science Laboratory-Based Activities on Student's Metacognition and Performance Amidst Pandemic

Specifically, it shows the effect of manipulative online activities, online videos, and interactive simulations on the cognitive process, thinking process, self-regulation, self-reflection, and metacognitive strategy.

Table 10 presents the significant effect of manipulative online activities to students' metacognition. Among the indicator of metacognition, cognitive process, thinking process, self-reflection, and metacognitive strategy appeared to have no significant effect with the (p=0.95,1000,0.062,0.238) respectively

Table 10. Significant Effect of Manipulative Online Activities to Students' Metacognition

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Science Laboratory-Based Activities	Students' Metacognition	Beta Coefficient	F-value	p-value	Analysis
Manipulative Online Activities	Cognitive Process	0.388	4.656	0.095	Not Significant
	Thinking Process	0.000	0.000	1.000	Not Significant
	Self-Regulations	0.626	3.556	0.027	Significant
	Self-Reflection	0.483	4.691	0.062	Not Significant
	Metacognitive Strategy	0.311	2.186	0.238	Not Significant

Manipulative Online Activities are observed to have a significant positive effect to self-regulation (0.027) while it was shown to have no significant effect to the rest of the fields. Tests for the other variables incurred p-values greater than the significance alpha 0.05 hence the decision.

Table 11 presents the significant effect of online videos activities to students metacognition

Table 11. Significant Effect of Online Videos Activities to Students' Metacognition

Science Laboratory-Based Activities	Students' Metacognition	Beta Coefficient	F-Value	p-value	Analysis
Online Videos	Cognitive Process	0.686	4.656	0.019	Significant
	Thinking Process	1.000	0.000	0.000	Significant
	Self-Regulations	0.415	3.556	0.236	Not Significant
	Self- Reflection	0.683	4.691	0.036	Significant
	Metacognitive Strategy	0.504	2.186	0.127	Not Significant

Online Videos are observed to have a significant positive effect on the Cognitive Process (0.019), Thinking process (0.000), and Self-Reflection (0.036). These mentioned tests incurred p-values less than the significance alpha which explains the significance.

The result of online videos to students' metacognition infers that they can stimulate knowledge, enhance memory, and can improve the processing of information from audiovisual materials. In which can make an explanation about the lessons.

Table 12 presents the significant effect of interactive simulation activities to students metacognition

Table 12. Significant Effect of Interactive Simulation to Students' Metacognition

Science Laboratory-Based Activities	Students' Metacognition	Beta Coefficient	F-Value	p-value	Analysis
Interactive Simulations	Cognitive Process	-1.020	4.656	0.000	Significant
	Thinking Process	-0.000	0.000	0.000	Significant
	Self-Regulations	-1.031	3.556	0.003	Significant
	Self- Reflection	-1.157	4.691	0.000	Significant
	Metacognitive Strategy	-0.810	2.186	0.012	Significant

Interactive Simulations are observed to have a significant negative effect to Cognitive Process (0.000), Thinking Process (0.000), Self-Regulation (0.003), Self-Reflection (0.000), and Metacognitive Strategy (0.012). All of the tests incurred p-values less than that of 0.05. The study indicates that the use of interactive simulation can be beneficial for learning and understanding the concepts. It promotes the use of critical and evaluative thinking. Also, encourage students to contemplate the implications of a scenario and lead to more engaging interaction by learners

Table 13 presents the significant effect of the science laboratory-based activities on the students' performance. Specifically, it shows the effect of manipulative online activities, online videos, and interactive simulations on the scores of the students.

Table 13. Significant Effect of Science Laboratory-Based Activities on the Students' Performance in Post Test

Science Laboratory-Based Activities	Students' Performance	F-value	p-value	Analysis
Manipulative Online Activities				
Online Videos	Post Test	25.635	0.000	Significant
Interactive Simulations				

From the findings above, it can be stated that at 0.05, the null hypothesis
"Online science laboratory-based activities have no significant effect on the students' metacognition and performance" is rejected and calls for the acceptance of the alternative, which incites a significant effect This implies that through online laboratory-based activities can contribute to the improvement of students' performance. Therefore, it is essential to utilize activities applying technology advancement to enhance learners' competencies amidst the pandemic.

Another result determined as a result of the research is that virtual laboratory applications increase students' interest and motivation to science lesson. Studies in the literature show that similar to the results of this research, in learning environments organized with virtual laboratory applications, students are more interested, curious and excited in the learning process, and students have positive opinions against virtual laboratory applications (Arvind & Heard 2010; Bozkurt & Sarıkoç, 2008 Ceylan & Seçken, 2019; Duman & Avcı 2016; Mırçık & Saka, 2016; Aşıksoy & Islek, 2017; Sarı et al. 2019).

4. CONCLUSION AND RECOMMENDATION

On the basis of the foregoing findings, the following conclusion was drawn.

It presents that the significant effect of the science laboratory-based activities on the level of students' metacognition. Specifically, it shows the effect of manipulative online activities, online videos, and interactive simulations on the cognitive process, thinking process, self-regulation, self-reflection, and metacognitive strategy. The researcher then came up that online science laboratory-based activities have no significant effect on the students' metacognition and performance" is rejected and calls for the acceptance of the alternative, which incites a significant effect.

Based on the drawn conclusions resulted to the following recommendations:

1. It is suggested to further improve the online science-laboratory based activities to enhance more skills and knowledge of the learners. Providing differentiated instructional materials may also help in the improvement of students' metacognition.
2. It is recommended to use more activities that can help students regulate themselves. It is a good way to let them learn at their own pace and evaluate their own learnings regarding the subject matter.
3. Moreover, even though findings are very high it is still recommended to provide more self-reflective activities induce learners' capabilities. They can be more productive and skilled with their own strength.
4. Lastly, it is suggested to maintain the use of effective online science laboratory-based activities to also maintain the student's metacognition enhancement. The use of various instructional materials is beneficial for all the learners to further improve their skills and abilities.

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