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VIRTUAL LABORATORY ASSISTED INSTRUCTION ON GRADE 7 STUDENTS'PERFORMANCE AND INTEREST IN SCIENCE

Abstract

Science education often faces challenges in providing students with hands-on laboratory experiences due to limited resources and facilities. This study examined the effectiveness of Virtual Laboratory-Assisted Instruction (VLAI) as an alternative strategy to enhance Grade 7 students' learning in science. Specifically, it investigated the effects of VLAI on students' interest and performance. A quasi-experimental design was employed, utilizing survey questionnaires and a researcher-constructed performance test. Two matched groups from MSU–Baloi Community High School participated, with one group exposed to VLAI and the other receiving Traditional Lecture-Discussion Instruction (TLDI). Matching was based on students' prior average science grades. Findings revealed no significant differences between the two groups before the intervention. After the implementation of VLAI, significant improvements were observed in students' interest, while performance scores showed no statistically significant difference. These results suggest that virtual laboratories can serve as an effective instructional tool, particularly in schools with limited laboratory facilities. It is recommended that teachers integrate VLAI into science instruction as a supplementary approach to help students visualize abstract concepts, interact with scientific phenomena, and foster greater engagement and motivation in learning science.
Keywords:Virtual Laboratory-Assisted Instruction, Science Performance, Student Interest

INTRODUCTION

Science education plays a vital role in developing students' intellectual abilities, problem-solving skills, and higher-order thinking. Constructivist and student-centered approaches emphasize learning by doing, making laboratory experiences essential for meaningful understanding, curiosity, and engagement in science. However, national and international assessments such as TIMSS and the National Achievement Test consistently show that

Filipino students perform poorly in science. Research attributes this underperformance to several factors, including curriculum gaps, limited instructional materials, and especially the lack of functional science laboratories in many public schools. This lack of laboratory access restricts students' ability to conduct experiments and engage in hands-on inquiry, contradicting constructivist principles and limiting meaningful learning opportunities.

Given these challenges, alternative strategies are needed to support laboratory-based learning in resource-limited settings. Advances in educational technology offer promising solutions, particularly virtual laboratories and virtual reality tools that simulate real laboratory environments. These virtual platforms allow students to manipulate variables, conduct experiments, and explore scientific concepts interactively, even without physical laboratory equipment. International studies report positive outcomes on student performance, interest, and attitudes, yet research in the Philippine setting remains limited. This study therefore aims to determine the effects of Virtual Laboratory-Assisted Instruction (VLAI) on Grade 7 students' performance and interest in science. The findings may offer teachers an effective alternative for promoting experiential and meaningful science learning in schools that lack adequate laboratory facilities.

Statement of the Problem

This study aimed to examine the effectiveness of Virtual Laboratory-Assisted Instruction (VLAI) in enhancing students' performance in science, their interest in learning the subject, and their attitudes toward laboratory experiences. Specifically, it sought to determine whether the use of virtual laboratory activities offers measurable advantages over the traditional lecture-discussion method. To achieve this purpose, the study sought answers to the following questions:

1. Is there a significant difference between the performance test mean scores of students exposed to Virtual Laboratory-Assisted Instruction (VLAI) and those taught using Traditional Lecture-Discussion Instruction (TLDI) before and after the intervention?
2. Is there a significant difference in the interest in science between the experimental group (VLAI) and the control group (TLDI) before and after the intervention?

3. How does the interest in science of students in the experimental group change after exposure to VLAI?

Scope and Limitation

This study focused on examining the effects of virtual laboratory activities on students' performance in science, their interest in the subject, and their attitudes toward laboratory experiences. The participants consisted of 34 matched pairs of Grade 7 students from two intact sections enrolled at MSU–Baloi Community High School. The implementation of the study was confined to one grading period. The content coverage was limited to selected concepts under the topic of matter, specifically the states 1 of matter, properties of matter, classification of matter, and changes in matter. The data gathered were restricted to students' questionnaire responses, performance test results, interview data, and journal entries. Consequently, the findings of this study are non-conclusive and should not be generalized beyond the population and conditions in which the study was conducted.Furthermore, students in the control group were not exposed to any form of traditional laboratory activity. Instead, they received instruction through the conventional "chalk-talk" lecture-discussion method supplemented with visual aids. This instructional condition may have influenced their responses on the interest and attitude survey questionnaires, representing a limitation that should be considered in the interpretation of the study's results.

Conceptual Framework

This study examines the influence of a specific teaching strategy, treated as the independent variable, on several learning outcomes identified as dependent variables. The independent variable is the instructional method used, operationalized as Virtual Laboratory-Assisted Instruction (VLAI) and compared with the Traditional Lecture-Discussion Instruction (TLDI). The dependent variables include students' performance in science and their interest in learning the subject. The conceptual flow of the study is illustrated in the research paradigm, which demonstrates how the independent variable exerts an effect on the dependent variables. The arrows represent the directional relationship, indicating that the type of instructional strategy—whether VLAI or TLDI—may influence students' learning outcomes. Under VLAI, students engage in virtual laboratory experiments following the discussion of each topic, allowing them to manipulate variables, observe results, and reinforce their conceptual understanding through simulated hands-on activities. In contrast, students under TLDI receive instruction through a teacher-centered "chalk-talk" approach supplemented with visual aids, without the use of virtual laboratory tools. This contrast between experiential, technology-enhanced learning and traditional lecture-based instruction provides the basis for examining differences in student performance and interest.

Figure 1

Research Paradigm

Independent Variable Dependent Variables

METHOD

Research Design

This study employed both quantitative and qualitative research methods to investigate the effects of Virtual Laboratory-Assisted Instruction (VLAI) on students' performance and interest in science. The quantitative component utilized a quasi-experimental approach involving two intact groups. Specifically, the study adopted the Matching-Only

Pretest–Posttest Control Group Design, which is appropriate when random assignment is not feasible but matching can help control initial group differences.The qualitative aspect of the study explored students' interest in science. This was accomplished through interviews and classroom observations. Interviews were conducted with students in the experimental group to capture their perceptions, feelings, and experiences while performing virtual laboratory tasks.

Locale of the Study

This study was conducted at MSU–Baloi Community High School, a community-based secondary institution serving the municipality of Baloi and its neighboring towns and barangays. The school is committed to providing quality education to incoming high school students from the twenty-one (21) barangays of Baloi and nearby municipalities.Similar to other MSU external units, MSU–Baloi Community High School operates with limited laboratory facilities. It does not have a fully equipped science laboratory, and only a few pieces of laboratory equipment are available for conducting science activities.

Subject Participants

The participants of this study consisted of 34 matched pairs of Grade 7 students from two intact sections of MSU–Baloi Community High School. The students' average age was 13 years. Both sections were considered academically homogeneous based on their average grades from Grade 6 and their performance in the 2013 summer classes.Matching of participants for the experimental and control groups was carried out using the average science grade in Grade 6. These matched pairs were then distributed between the two groups to ensure comparable baseline characteristics. The assignment of each intact section to either the experimental group or the control group was determined through a simple random procedure.

RESULTS AND DISCUSSION

Students' Performance in Science

The performance of students in science in both the experimental group (VLAI) and the control group (TLDI) was assessed and compared 1 before and after the intervention.

Table 1 presents the t-test results and p-values for the comparison of the performance test mean scores of the two groups.

Table 1

t-test and p-values for the Comparison of Students' Performance Test Scores Before and After Intervention

Period	Group	N	Mean Score	t-value	Two-tailed Sig (p)
Before Intervention	Control	34	25.26	1.02	0.310 (ns)
	Experimental	34	26.38		
After Intervention	Control	34	38.53		

1.40

0.167 (ns)

Experimental

34

40.12

Note: s = significant at 0.05 level; ns = not significant at .05 level

As shown in Table 1, the pre-intervention comparison revealed a p-value of 0.310, indicating no significant difference between the two groups at the 0.05 level. This suggests that the students in the experimental and control groups were initially comparable in terms of science performance. It further implies that both groups had a similar level of content knowledge and understanding of the concepts and principles within the topic domain of the study. This result is expected, given that both groups were taught by the same teacher, in the same school, under the same learning environment, instructional strategies, duration, topics, learning outcomes, and learning materials. The findings are consistent with Tuysuz (2010), who reported no significant difference in pretest mean scores between control and experimental groups, and with Kennepohl (2001), who observed similar results in their study.

After the intervention, the performance test mean scores showed a p-value of 0.167, indicating that the two groups still did not differ significantly at the 0.05 level. This suggests that the VLAI intervention did not produce a statistically significant improvement in students' science performance compared to the TLDI group. Several factors may explain this outcome. First, the limited number of laptops during virtual laboratory activities meant that not all students had the opportunity to manipulate and operate the equipment directly. Students who were not handling the laptops were assigned to take notes, which may have limited their engagement and learning. Second, the allotted time for each virtual laboratory activity may have been insufficient for thorough completion. One-hour periods were not always enough, especially since many students were unfamiliar with computer operations, despite prior instructions. Third, the novelty of the virtual laboratory presented challenges for students, particularly those from remote areas with little prior exposure to technology. Many students struggled to follow instructions and maintain focus, which may have impeded their understanding of the scientific concepts being studied.

Supporting these observations, Kocijancic (2004) emphasized that virtual laboratories involve computer-based simulations that require students to navigate electronic programs, pictures, and drawings. Similarly, Dinevski et al. (2012) highlighted that virtual laboratories often rely on networked computer systems, allowing students to engage in laboratory activities either locally or remotely. Consequently, a basic level of computer literacy is necessary to maximize learning outcomes from virtual laboratory activities. In this study, students' limited computer skills appeared to be a key factor hindering the effectiveness of the VLAI intervention.

Students' Interest in Science

As shown in the table 2, comparison of the interest in science mean scores of the two groups before the intervention has a p-value of 0.715. This suggests that the two groups do not significantly differ at 0.05 level of significance. This further indicates that the two groups were initially comparable (the same) in their science interest because the method of instruction used is similar and that they both received uniform instructional activities.

Table 2

t-test and p-values on the Comparison of the Control and Experimental Group of Students' Interest in Science Before and After Intervention

Period

Group

No. of Cases (N)

Mean Score

t-value

Two-tailed Sig (p) values

Before

Intervention

Control

34

76.71

.366

.715(ns)

Experimental

34

77.41

After Intervention

Control

34

78.32

.510

0.000 (s)

Experimental

34

87.91

Note: s = significant at 0.05 level; ns = not significant at .05 level

After the intervention, a statistically significant difference was observed between the posttest mean scores of the two groups in terms of interest in science ($p < 0.05$) at the 0.05 level of significance. This finding indicates that students' interest in science was significantly enhanced through their exposure to virtual laboratory activities. The observed increase in interest among students in the experimental group may be attributed to their active and constructive engagement in the virtual laboratory experiences. These activities motivated students to attend science classes regularly, as the virtual simulations allowed them to visualize abstract scientific concepts and principles more concretely.

Moreover, although the laboratory experiences were conducted virtually, students were still provided with meaningful opportunities to interact with the activities. This interaction enabled them to construct and reconstruct their understanding of the topic domains covered in the study, reinforcing conceptual learning through repeated engagement with the simulations. Such interactive learning environments promote deeper cognitive processing and sustained interest in science.

Consistent with these findings, Tatli and Ayas (2012) reported that the integration of computers with animation, simulation, and sound positively contributes to the quality of instruction. Similarly, Robinson (2010) found that virtual laboratories effectively promote chemistry learning. Additionally, Collette and Chiappetta (1989) emphasized that the use of computer animations increases students' motivation and eagerness to participate in laboratory activities. Students' satisfaction and excitement, driven by their active involvement in the virtual laboratory tasks, may have contributed to their perception of science as enjoyable and engaging rather than boring.

Change of Students' Interest in Science in the Experimental Group

Changes of students' interest in science in the experimental group were investigated. Table 3 shows the percentage of students who responded positively (SA & A) and negatively (SD & D) before and after intervention.

Statements

Percentage of students who responded positively

(SA & A)

Percentage of students who responded negatively (SD & D)

Positive

1. My teachers think I can do more advanced science.

2. I could talk to my teachers about a career that uses science.

5. I am good at science.

6. My teachers have encouraged me to study more science.

7. I think I could do more difficult science work.

8. I like conducting science experiments.

9. I like finding answers to science problems.

12. I look forward to science lessons in school.

14. I like to understand the scientific explanationsfor things.

15. I would like to study science in more details than I do now.

16. I enjoy discussing science topics.

18. I'll need science for my future career / jobs.

19. Knowing science will help me earn a living.

20. My teachers think I can do well in science.

21. My science teachers have been interested in myprogress in science.

22. Science is useful in everyday life.

24. When I can't immediately solve a problem, I stick with it until I have the solution.

25. I will use science in many ways as an adult.

Negative

3. Science is hard for me, even when I study.

4. I don’t think I could do advance science.

10. I do not have much interest in science.

11. I think scientists typically discuss boring

topics.

13. I get very stresses when taking science

quizzes / exams

17. Answering science questions in class makes

me nervous.

23. I would rather have someone give me the answerto a difficult science problem than

have to work it out for myself.

26. The challenge of science problems does not

appeal to me.

Pre

Post

Change

(Post-Pre)

Pre

Post

Change

(Post-Pre)

38.24

44.12

58.82

44.12

32.35

47.06

32.25

35.29

41.18

44.12

32.35

47.06

52.94

35.29

38.24

47.06

52.94

44.12

73.53

70.59

50.00

52.94

67.65

67.65

67.65

76.47

6176

70.59

82.35

73.53

67.65

82.35

70.59

82.35

76.47

73.53

82.35

76.47

85.29

79.41

85.29

76.47

67.65

76.47

32.35

35.29

20.59

29.41

26.47

26.47

35.29

41.18

23.52 (Inc)

26.47 (Inc)

23.53 (Inc)

29.41 (Inc)

35.3 (Inc)

35.29 (Inc)

38.34 (Inc)

47.06 (Inc)

35.29 (Inc)

32. 35 (Inc)

50 (Inc)

29.41 (Inc)

32.35 (Inc)

44.12 (Inc)

47.05 (Inc)

29.41 (Inc)

14.71(Inc)

32.35 (Inc)

-41.18 (Dec)

-35.3 (Dec)

-29.41(Dec)

-23.53(Dec)

41.18(Dec)

-41.18(Dec)

-32.36(Dec)

-35.29(Dec)

61.6

55.88

41.18

55.88

67.65

52.94

67.6

64.71

58.82

55.88

67.65

52.94

47.06

64.71

61.67

52.94

47.06

55.88

26.47

29.41

50.00

47.06

32.35

32.35

32.35

23.35

38.24

29.41

17.65

26.47

32.35

17.65

29.41

17.65

23.53

26.47

17.65

23.53

14.71

20.59

14.71

23.53

32.35

23.53

67.65

64.71

79.41

70.59

73.53

73.53

64.71

58.82

-23.52(Dec)

-26.47(Dec)

-23.53(Dec)

-29.41(Dec)

-35.3(Dec)

-35.29(Dec)

-38.19(Dec)

-47.06(Dec)

-35.29(Dec)

-29.41(Dec)

-50(Dec)

-29.41(Dec)

-32.35(Dec)

-44.12(Dec)

-46.96(Dec)

-29.41(Dec)

-14.71(Dec)

-32.35(Dec)

41.18 (Inc)

35.3 (Inc)

29.41(Inc)

23.53(Inc)

41.18(Inc)

41.18(Inc)

32.36(Inc)

35.29(Inc)

Note. Inc. = Increased, gradual change = a change of 20 below

Dec. = Decreased sudden/abrupt change = a change of above 20

As shown in Table 3, analysis of the pretest–posttest changes in students' interest in science reveals that 1 the majority of the students (97.06%) demonstrated a marked change in their level of interest following the intervention. This change is reflected in the shift of responses toward agreement (Strongly Agree and Agree) and disagreement

(Strongly Disagree and Disagree) on the positively worded statements. For the negatively worded statements, all students (100%) exhibited a substantial shift, characterized by a pronounced decrease in unfavorable responses, indicating an improvement in their interest in science after the intervention.

These findings suggest that students developed a greater interest in learning science in a virtual laboratory (VL) environment compared with a traditional classroom setting that relied solely on lecture-based instruction. The interactive and engaging nature of the virtual laboratory activities appeared to foster students' enjoyment and motivation, thereby enhancing their overall interest in learning science.

CONCLUSION

Based on the findings of the study, it can be concluded that Virtual Laboratory–Assisted Instruction is an effective instructional approach for enhancing students' interest in science but not necessarily their immediate academic performance. The absence of a significant difference in science performance between the experimental and control groups suggests that factors such as limited access to technological resources, insufficient time for laboratory activities, students' unfamiliarity with computer operations, and low levels of computer literacy may have constrained the potential impact of the virtual laboratory intervention on learning outcomes.

However, the significant improvement in students' interest in science highlights the strength of VLAI in fostering positive attitudes toward science learning. The interactive features of virtual laboratories such as simulations, animations, and opportunities for active participation enabled students to visualize abstract concepts, engage meaningfully with learning tasks, and perceive science as enjoyable and relevant. These experiences contributed to increased motivation, curiosity, and sustained interest in science, as evidenced by the substantial positive changes in students' attitudinal responses.

In conclusion, while Virtual Laboratory–Assisted Instruction alone may not immediately translate into higher performance gains, it plays a crucial role in enhancing students' interest and engagement in science. As interest is a key affective factor that supports longterm learning and academic success, integrating virtual laboratories with adequate technological support, sufficient instructional time, and explicit development of students' computer skills may further strengthen their effectiveness in improving both students' interest and performance in science.

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