

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

3
4 **Abstract**

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

21 *Keywords:* Virtual Laboratory-Assisted Instruction, Science Performance, Student Interest

22
23 **INTRODUCTION**

24 Science education plays a vital role in developing students' intellectual abilities, problem-
25 solving skills, and higher-order thinking. Constructivist and student-centered approaches
26 emphasize learning by doing, making laboratory experiences essential for meaningful
27 understanding, curiosity, and engagement in science. However, national and international
28 assessments such as TIMSS and the National Achievement Test consistently show that Filipino
29 students perform poorly in science. Research attributes this underperformance to several factors,
30 including curriculum gaps, limited instructional materials, and especially the lack of functional
31 science laboratories in many public schools. This lack of laboratory access restricts students'
32 ability to conduct experiments and engage in hands-on inquiry, contradicting constructivist
33 principles and limiting meaningful learning opportunities.

34 Given these challenges, alternative strategies are needed to support laboratory-based
35 learning in resource-limited settings. Advances in educational technology offer promising
36 solutions, particularly virtual laboratories and virtual reality tools that simulate real laboratory

37 environments. These virtual platforms allow students to manipulate variables, conduct
38 experiments, and explore scientific concepts interactively, even without physical laboratory
39 equipment. International studies report positive outcomes on student performance, interest, and
40 attitudes, yet research in the Philippine setting remains limited. This study therefore aims to
41 determine the effects of Virtual Laboratory-Assisted Instruction (VLAI) on Grade 7 students'
42 performance and interest in science. The findings may offer teachers an effective alternative for
43 promoting experiential and meaningful science learning in schools that lack adequate laboratory
44 facilities.

45 **Statement of the Problem**

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

- 51 1. Is there a significant difference between the performance test mean scores of students
52 exposed to Virtual Laboratory-Assisted Instruction (VLAI) and those taught using
53 Traditional Lecture-Discussion Instruction (TLDI) before and after the intervention?
- 54 2. Is there a significant difference in the interest in science between the experimental group
55 (VLAI) and the control group (TLDI) before and after the intervention?
- 56 3. How does the interest in science of students in the experimental group change after
57 exposure to VLAI?

58 **Scope and Limitation**

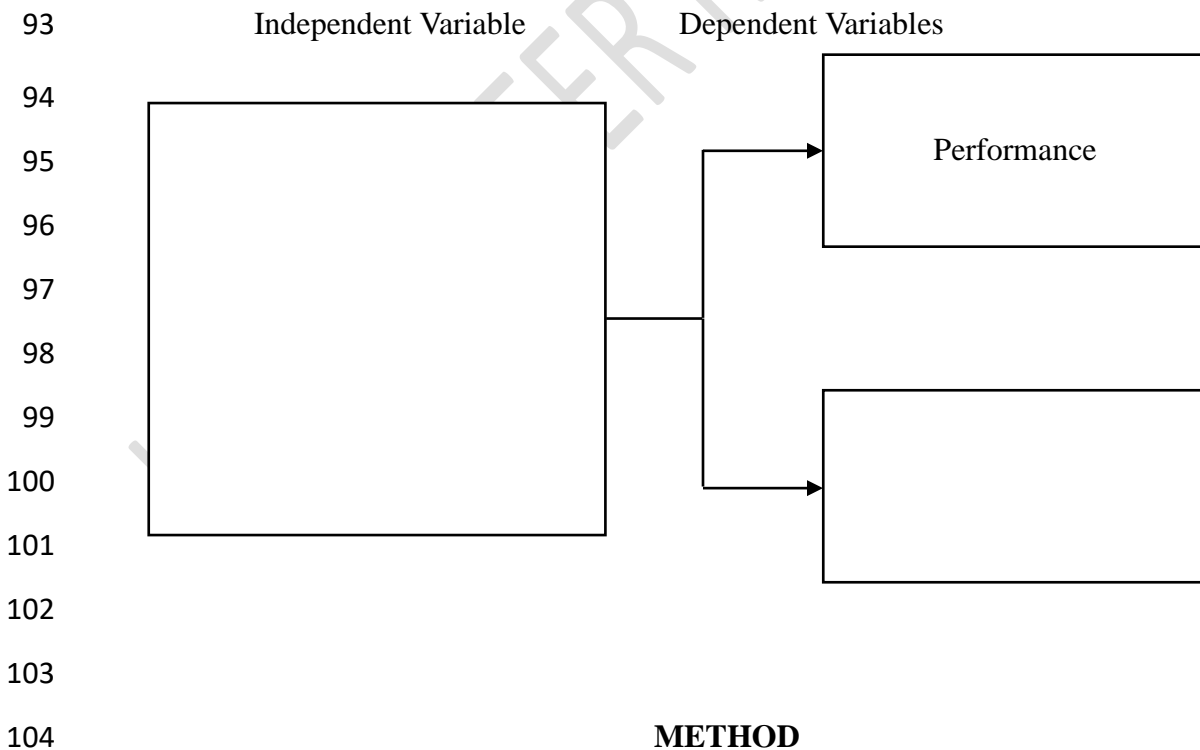
59 This study focused on examining the effects of virtual laboratory activities on students'
60 performance in science, their interest in the subject, and their attitudes toward laboratory
61 experiences. The participants consisted of 34 matched pairs of Grade 7 students from two intact
62 sections enrolled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

74 **Conceptual Framework**

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

91 **Figure 1**

92 *Research Paradigm*



105 **Research Design**

106 This study employed both quantitative and qualitative research methods to investigate the
107 effects of Virtual Laboratory-Assisted Instruction (VLAI) on students' performance and interest
108 in science. The quantitative component utilized a quasi-experimental approach involving two
109 intact groups. Specifically, the study adopted the Matching-Only Pretest–Posttest Control Group
110 Design, which is appropriate when random assignment is not feasible but matching can help
111 control initial group differences. The qualitative aspect of the study explored students' interest in
112 science. This was accomplished through interviews and classroom observations. Interviews were
113 conducted with students in the experimental group to capture their perceptions, feelings, and
114 experiences while performing virtual laboratory tasks.

115 **Locale of the Study**

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

123 **Subject Participants**

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

132 **RESULTS AND DISCUSSION**

133 **Students' Performance in Science**

134 The performance of students in science in both the experimental group (VLAI) and the
135 control group (TLDI) was assessed and compared before and after the intervention. Table 1
136 presents the t-test results and p-values for the comparison of the performance test mean scores of
137 the two groups.

138

139 **Table 1**

140 *t-test and p-values for the Comparison of Students' Performance Test Scores Before and After*
141 *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		

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

143 As shown in Table 1, the pre-intervention comparison revealed a p-value of 0.310,
144 indicating no significant difference between the two groups at the 0.05 level. This suggests that
145 the students in the experimental and control groups were initially comparable in terms of science
146 performance. It further implies that both groups had a similar level of content knowledge and
147 understanding of the concepts and principles within the topic domain of the study. This result is
148 expected, given that both groups were taught by the same teacher, in the same school, under the
149 same learning environment, instructional strategies, duration, topics, learning outcomes, and
150 learning materials. The findings are consistent with Tuysuz (2010), who reported no significant
151 difference in pretest mean scores between control and experimental groups, and with Kennepohl
152 (2001), who observed similar results in their study.

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

167 Supporting these observations, Kocijancic (2004) emphasized that virtual laboratories
168 involve computer-based simulations that require students to navigate electronic programs,
169 pictures, and drawings. Similarly, Dinevski et al. (2012) highlighted that virtual laboratories
170 often rely on networked computer systems, allowing students to engage in laboratory activities
171 either locally or remotely. Consequently, a basic level of computer literacy is necessary to

172 maximize learning outcomes from virtual laboratory activities. In this study, students' limited
173 computer skills appeared to be a key factor hindering the effectiveness of the VLAI intervention.

174 **Students' Interest in Science**

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

180 **Table 2**

181
182 *t-test and p-values on the Comparison of the Control and Experimental Group of Students'*
183 *Interest in Science Before and After Intervention*
184

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		

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

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

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

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

208 **Change of Students' Interest in Science in the Experimental Group**

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

Statements	Percentage of students who responded positively (SA & A)			Percentage of students who responded negatively (SD & D)		
	Pre	Post	Change (Post-Pre)	Pre	Post	Change (Post-Pre)
Positive						
1. My teachers think I can do more advanced science.	38.24	61.76	23.52 (Inc)	61.6	38.24	-23.52(Dec)
2. I could talk to my teachers about a career that uses science.	44.12	70.59	26.47 (Inc)	55.88	29.41	-26.47(Dec)
5. I am good at science.	58.82	82.35	23.53 (Inc)	41.18	17.65	-23.53(Dec)
6. My teachers have encouraged me to study more science.	44.12	73.53	29.41 (Inc)	55.88	26.47	-29.41(Dec)
7. I think I could do more difficult science work.	32.35	67.65	35.3 (Inc)	67.65	32.35	-35.3(Dec)
8. I like conducting science experiments.	47.06	82.35	35.29 (Inc)	52.94	17.65	-35.29(Dec)
9. I like finding answers to science problems.	32.25	70.59	38.34 (Inc)	67.6	29.41	-38.19(Dec)
12. I look forward to science lessons in school.	35.29	82.35	47.06 (Inc)	64.71	17.65	-47.06(Dec)
14. I like to understand the scientific explanations for things.	41.18	76.47	35.29 (Inc)	58.82	23.53	-35.29(Dec)
15. I would like to study science in more details than I do now.	44.12	73.53	32.35 (Inc)	55.88	26.47	-29.41(Dec)
16. I enjoy discussing science topics.	32.35	82.35	50 (Inc)	67.65	17.65	-50(Dec)
18. I'll need science for my future career / jobs.	47.06	76.47	29.41 (Inc)	52.94	23.53	-29.41(Dec)
19. Knowing science will help me earn a living.	52.94	85.29	32.35 (Inc)	47.06	14.71	-32.35(Dec)
20. My teachers think I can do well in science.	35.29	79.41	44.12 (Inc)	64.71	20.59	-44.12(Dec)
21. My science teachers have been interested in my progress in science.	38.24	85.29	47.05 (Inc)	61.67	14.71	-46.96(Dec)
22. Science is useful in everyday life.	47.06	76.47	29.41 (Inc)	52.94	23.53	-29.41(Dec)
24. When I can't immediately solve a problem, I stick with it until I have the solution.	52.94	67.65	14.71(Inc)	47.06	32.35	-14.71(Dec)
25. I will use science in many ways as an adult.	44.12	76.47	32.35 (Inc)	55.88	23.53	-32.35(Dec)
Negative						
3. Science is hard for me, even when I study.	73.53	32.35	-41.18 (Dec)	26.47	67.65	41.18 (Inc)
4. I don't think I could do advanced science.	70.59	35.29	-35.3 (Dec)	29.41	64.71	35.3 (Inc)
10. I do not have much interest in science.	50.00	20.59	-29.41(Dec)	50.00	79.41	29.41(Inc)
11. I think scientists typically discuss boring						

topics.	52.94	29.41	-23.53(Dec)	47.06	70.59	23.53(Inc)
13. I get very stresses when taking science quizzes / exams	67.65	26.47	41.18(Dec)	32.35	73.53	41.18(Inc)
17. Answering science questions in class makes me nervous.	67.65	26.47	-41.18(Dec)	32.35	73.53	41.18(Inc)
23. I would rather have someone give me the answer to a difficult science problem than have to work it out for myself.	67.65	35.29	-32.36(Dec)	32.35	64.71	32.36(Inc)
26. The challenge of science problems does not appeal to me.	76.47	41.18	-35.29(Dec)	23.35	58.82	35.29(Inc)

212 *Note.* Inc. = Increased, gradual change = a change of 20 below
213 Dec. = Decreased sudden/abrupt change = a change of above 20
214

215 As shown in Table 3, analysis of the pretest–posttest changes in students’ interest in
216 science reveals that the majority of the students (97.06%) demonstrated a marked change in their
217 level of interest following the intervention. This change is reflected in the shift of responses
218 toward agreement (Strongly Agree and Agree) and disagreement (Strongly Disagree and
219 Disagree) on the positively worded statements. For the negatively worded statements, all
220 students (100%) exhibited a substantial shift, characterized by a pronounced decrease in
221 unfavorable responses, indicating an improvement in their interest in science after the
222 intervention.

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

228 CONCLUSION

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

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

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

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