



Students' academic performance and engagement in science in a web-based interactive learning environment

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Abstract

This study determined the students' academic performance and engagement in Science through a Web-based Interactive learning Environment via Nearpod in Grade 10 Science of Valencia National High School. A quasi-experimental research was used involving a pretest- posttest design. One group, exposed to the experimental class (WBILE), and the control group (non-WBILE). The instruments utilized both academic and non-academic assessments. Descriptive statistics, and analysis of covariance (ANCOVA), were used to determine the significant difference in the students' academic performance and engagement in Science. Findings of the study revealed that the academic performance of the students exposed to WBILE attained "satisfactory" results while the students exposed to the non-WBILE obtained "Did Not Meet Expectations." Students in the experimental group performed better than those in the control group. Both groups exhibited high engagement in Science in their order of preferences such as emotional, social, behavioral, and cognitive. The difference in students' academic performance revealed a highly significant result. The Web-based Interactive learning Environment enhanced the students' academic performance and showed a positive effect on students' learning. Further, there was a significant difference in the students' engagement between groups. Hence, WBILE enhanced the engagement of students.

Keywords: academic performance, web-based interactive learning environment, students' engagement

Introduction

The new science curriculum is an offshoot of the K-12 curriculum, which intends to prepare Filipino students for the challenges of the 21st century. Moreover, DOST-SEI envisions the learners to be more active, well-equipped with technical skills, vocational, scientifically and technologically literate, and productive members of society. However, despite this outstanding vision by DOST-SEI for science education, the quality of Science education has been a long-shot concern in the Philippines, as reflected on the international examinations. In the 2019 Trends in Mathematics and Science Study (TIMSS) of the International Assessments, the Philippines came in last out of 58 nations. Furthermore, nearly identical outcomes were obtained in Programme for International Student Assessment (PISA) 2018, which placed the nation close to last in science and Mathematics (Galarosa, 2021) [7]. According to Education Secretary Briones, the result mirrors Filipino learners' performance in the National Achievement Test (NAT), which gravitates toward low proficiency levels.

This low performance has been attributed to student engagement (Schleicher, 2018) [17] and failure to integrate Information Communication Technology into teaching and learning (Munje & Jita, 2020) [11]. Research on science education reveals that student engagement was positively connected with students' academic performance (Delfino, 2019) [4] and directly correlated with technology integration (Francis, 2017) [6]. However, keeping students engaged is becoming difficult due to the unprecedented situation caused by COVID-19. This affects their commitment to performing school tasks and how they perceive themselves as learners, contributing to low performance. This challenges educators to provide a learning environment that maximizes student engagement in the teaching-learning

process. Therefore, to address the poor performance of science, there should be the application of teaching approaches that stimulate engagement and the utilization of technology that can aid learning (Olila, 2021) [14].

Web-based interactive learning is one approach that integrates learning technology to stimulate student engagement in science. Web-based learning and Interactive learning are combined to develop a better teaching strategy. It carries out a variety of learning activities using the Internet as a tool for instructional delivery and utilizes web-based technologies with embedded interactive elements to foster interactive learning. It can be incorporated into a curriculum and expanded into a whole course (Rusly *et al.*, 2020) [16].

Nevertheless, there are few studies conducted on how to use Web-based Interactive learning and limited local studies on its effect on student's performance and engagement in science. Hence, this study examined the effectiveness of a Web-based interactive learning environment via Nearpod in enhancing students' performance and engagement in science.

Methodology

The study used a quasi-experimental design to determine student performance and engagement in Science. Two (2) sections of Grade 10 Science students officially enrolled in the school year 2022-2023 of Valencia National High School were the participants in the study. This study used two (2) intact classes to avoid interrupting the natural setting. One section utilized Web-based Interactive Learning via Nearpod (experimental group), while the other utilized the non-WBILE (control group). This study used academic assessment that consist of fifty (50) items multiple-choice exam and non-academic assessment that consisted of four (4) domains and has as total of 33 indicators, adapted from

Wang *et al.* (2016). Both instruments were content validated by three science experts, pilot tested, and showed reliability of 0.87 (academic assessment) and 0.81 (non-academic assessment). The researcher oriented the respondents and explained the purpose of the study, and were given a consent form to sign. Statistical tools that were used

Results and discussion

This presents the interpretation and analysis of the data gathered from the students' academic performance and engagement in a Web-Based Interactive Learning Environment. The groups of data presented in this section follow the order of the specified problems of this study.

Table 1: Comparison of students' mean scores in the pretest

Range	Non-WBILE		WBILE		Qualitative interpretation
	N	%	N	%	
90-100	0	0	0	0	Outstanding (O)
85-89	0	0	0	0	Very satisfactory (VS)
80-84	0	0	0	0	Satisfactory (S)
75-79	0	0	0	0	Fairly satisfactory (FS)
Below 75	30	100	30	100	Did Not Meet expectation (DNME)
Total	30	100	28	100	
Overall MPS	49.2 (DNME)		51.5 (DNME)		

The tables show that both groups obtained an MPS below 75, which indicates that they "Did Not Meet Expectations". The low pretest scores of the two groups implied that students seemed to have less prior understanding of earth science. The current result of the study is consistent with the study of Obregon (2021) [13], when he found that the students' pretest scores did not meet expectations.

Moreover, Pagtulon-an and Tan (2018), as cited from Coronel and Tan (2019) [2], stressed that the finding is expected since they need more information about the topics. Furthermore, the results also show that both groups were homogeneous in understanding the tested content. Thus, both groups are comparable.

Table 2: Comparison of students' mean scores in the posttest

Range	Non-WBILE		WBILE		Qualitative Interpretation
	N	%	N	%	
90-100	0	0	7	25.0	Outstanding (O)
85-89	0	0	5	17.9	Very satisfactory (VS)
80-84	0	0	9	32.1	Satisfactory (S)
75-79	5	16.7	2	7.1	Fairly satisfactory (FS)
Below 75	25	83.3	5	17.9	Did Not Meet expectation (DNME)
Total	30	100	28	100	
Overall MPS	63.1 (DNME)		82.8 (S)		

Table 2 shows the posttest scores of the students in both groups. The students in the non-WBILE group had a mean score of 63.1, which indicates "Did Not Meet Expectations," while in the class exposed to the WBILE, the MPS was 82.8 and obtained a "Satisfactory" result. As reflected in the table, there was an increase in the overall mean percentage scores under the implementation of a Web-based interactive learning environment. On the other hand, though there was also an increase in students' overall mean percentage scores under the non-WBILE group, it did not reach the minimum requirement of 75%. The results indicate that the students in a Web-based interactive learning environment have increased their content knowledge acquisition in Earth Science from did not meet the expectation to satisfactory performance, compared to the non-WBILE group, who remained "did not meet expectations". This result is in line with Lev Vygotsky's (1978) social interaction, where a web-based Interactive learning environment allows the students to interact, collaborate, exchange, and gain ideas from one another. Moreover, as the students were exposed to WBILE, it enhanced their knowledge acquisition thus, improved their academic performance in Science. The result is consistent

with Dagaang (2016) [3] that students who experienced technology integration in their instruction obtained better scores after the intervention was given than students who only underwent the traditional instruction. Furthermore, the academic performance of the students exposed to WBILE was enhanced for they were exposed to the Interactive Learning Environment. The avenue of interaction provided by the intervention may have resulted in increased understanding among students (Naibaho, 2019) [12]. Moreover, one of the primary factors linked to this result is the students' emotional engagement, shown in Table 3, where the WBILE group obtained the highest mean score among the dimensions. As cited by Mabascog (2021) [9], having positive attitudes towards school and school-related activities is essential for student engagement in learning activities and exhibiting more academic achievement. In addition, Swarat *et al.* (2017) [20] revealed that hands-on involvement and more technology interaction stimulate a higher level of interest in Science, hence, positively associated with improved student performance. This drove the students to a greater extent by their intention to learn and perform better in school.

Table 3: Summary of Students’ Engagement Pretest and Posttest per Dimension

Indicators	Pretest				Posttest			
	WBILE		Non-WBILE		WBILE		Non-WBILE	
	Mean	QI	Mean	QI	Mean	QI	Mean	QI
Emotional Engagement	4.04	HE	4.16	HE	4.28	HE	4.23	HE
Social Engagement	3.97	HE	3.99	HE	4.26	HE	4.11	HE
Behavioral Engagement	3.72	HE	4.04	HE	4.08	HE	4.10	HE
Cognitive Engagement	3.54	HE	3.58	HE	3.83	HE	3.74	HE
Overall Mean	3.83	HE	3.95	HE	4.12	HE	4.06	HE

As noted in the findings, both groups have the same level of engagement. However, it can be observed that the mean difference in the three domains is still in favor of the WBILE group. Therefore, it is evident that a Web-based Interactive learning Environment via Nearpod improved students' interest, participation, and motivation to do science activities. These findings are supported by the study of Mattar (2018) [10] that a Web-based Interactive learning Environment via Nearpod can engage students in class and actively support student learning activities in the classroom. It can heighten students' engagement in class and positively influenced their learning (Heba, 2020) [8].

Table 4: Analysis of Covariance (ANCOVA) of students' posttest scores

Group	N	Mean	SD
Non-WBILE	30	31.53	5.17
WBILE	28	41.39	4.48
Total	58	36.29	6.92

Source	SS	df	MS	F-value	Sig.
Corrected Model	1895.624 ^a	2	947.812	62.777	.000
Pre_Acad	487.752	1	487.752	32.306	.000
Group	1185.246	1	1185.246	78.503	.000
Error	830.393	55	15.098		
Total	79123.000	58			

These results show that students exposed to a Web-based Interactive Learning Environment performed better than those in non- Web-based Interactive Learning Environment. The current results were consistent with Dagaang (2016) [3] study that students exposed to the Web-based Interactive Learning Environment and experienced technology integration in their instruction obtained better scores after the intervention was given compared to students who only underwent the traditional way of instruction. Ahakiri (2022) [1] added that it has a significant relationship with students' academic performance and implies that interactive learning tools can facilitate and enhance teaching and learning. Thus, Web-based Interactive learning Environments such as Nearpod could direct students to more positive outcomes. Similar findings to the study of Su & Wang (2017) [19] that it could assist students in achieving a high level of learning performance. Furthermore, the academic performance of the students exposed to WBILE was enhanced for they were exposed to the Interactive Learning Environment. The avenue of interaction provided by the intervention may have caused the deepening of understanding among students (Naibaho, 2019) [12].

Table 5: Comparison of students’ engagement after intervention between classes exposed to WBILE and non-WBILE

Group	N	Mean	SD
Non-WBILE	30	4.06	0.359
WBILE	28	4.12	0.345
Total	58	4.09	0.351

Source	SS	df	MS	F-value	Sig.
Corrected Model	3.267 ^a	2	1.634	23.944	.000
Pre_Eng	3.216	1	3.216	47.138	.462
Group	0.330	1	0.330	4.834	.032
Error	3.753	55	0.068		
Total	975.043	58			

The result of this study indicates that the intervention effectively promotes an increase in the students' engagement with the intervention. The current results were consistent with Dequito (2019) [5] study that Web-based Interactive Learning Environment, or Web 2.0 technologies, could enhance teaching-learning activities and create a more engaging and innovative classroom experience. Mattar (2018) [10] added that using Nearpod can engage students in class and actively support student learning activities in the classroom. Corroborative to this is the study of Shehata *et al.* (2019) [18] that using Nearpod increased students' engagement in class and improved their learning. Results of the posttests for academic performance and students' engagement as exposed to WBILE showed that the increase in students' engagement also indicates an increase in academic performance. Similar results yielded is that of the study of Mabascog (2021) [9]. Again, results showed a significant relationship between student engagement and academic performance; as the engagement of the students increases, their academic achievement also rises. This supports the study of Taylor *et al.* (2016) [21] that engagement is strongly related to student performance on the assessment task.

Conclusions and recommendations

Based on the findings of the study, the following conclusions are drawn:

The academic performance of the students exposed to the Web-based Interactive Learning Environment (experimental) obtained "Satisfactory" results than students exposed to the non- Web-based Interactive Learning Environment (control), which indicates "Did Not Meet Expectations." Thus, students in the experimental groups perform better than the control group. Regarding the students' engagement, both the WBILE and non-WBILE groups exhibited "high engagement." The following levels of students' engagement in Science in their order of preferences are Emotional, Social, behavioral, and Cognitive. The two groups' academic performance differences significantly differed in favor of the posttest exposed to WBILE. The intervention positively affects students' performance, hence rejecting the null hypothesis. A significant difference existed in students' engagement between the two groups, thus rejecting the stated null hypothesis. Thus, WBILE via Nearpod actively supports student learning activities in the classroom and engages students in class.

Based on the findings of the study, it leads to the following recommendations:

1. Web-based Interactive Learning Environment via Nearpod has been found to increase students' academic performance. Hence, teachers could utilize it during discussions and/or activities to enable the understanding of complex scientific concepts and increase students' academic performance.
2. Because students' engagement significantly impacts academic performance, teachers and educators may consider other variables affecting classroom performance and aim to maintain interest in practicing students' engagement.
3. Science educators can use a web-based interactive learning environment as innovative teaching to improve students' science performance, enhance instructional materials, and meet students' needs for engaging in meaningful science learning.
4. School administrators and curriculum developers may conduct workshops and training for the teachers on how to use Nearpod, which would help learners in their learning process and increase their engagement towards Science.
5. Future researchers on WBILE may conduct additional research as other facets of this model may still need to be explored, which might provide more details on its uses and applications. Teachers can use this to offer students a new environment for the teaching-learning process.

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