AIDE IN IMPROVING COMPETENCIES ON POLARITY OF MOLECULES IN PHYSICAL SCIENCE AMONG GRADE 12 LEARNERS

IVY MISTICA A. VILLANUEVA

Special Science Teacher I, Researcher Casambalangan National High School

*Corresponding author: IVY MISTICA A. VILLANUEVA
Special Science Teacher I, Researcher Casambalangan National High School

Abstract

This study aimed to enhance the competencies of Grade 12 learners in Physical Science, specifically on the topic of Polarity of Molecules, at Casambalangan National High School during the 2020-2021 school year. The participants included 28 Grade 12 Humanities and Social Sciences (HUMSS) learners, consisting of 11 males and 17 females. Learners were grouped into control and experimental groups using simple random sampling. The two-group Pretest-Posttest Experimental Research Design was employed, utilizing a teacher-made Pretest and Posttest that were quality assured by the subject coordinator and school head. The study's results revealed no significant difference between the control group's pre-test and post-test scores, whereas a significant difference was observed for the experimental group. The intervention demonstrated a 'large effect size' on the academic scores of the learners, with a Cohen's d value of 1.51, favoring the experimental group. This indicates that the Accessible, Interactive, Developed E-learning module (AIDE) effectively improved the competencies of Grade 12 learners in Physical Science, particularly in understanding the Polarity of Molecules. It is recommended that teachers across various disciplines strategically utilize the AIDE module for remedial instruction or supplemental activities to enhance student competencies.

Keywords: *Accessible, Interactive, Developed E-learning module (AIDE), e-learning module, intervention, academic performance, Physical Science, Polarity of molecules*

Introduction

ChatGPT

In today's science-driven and technology-rich society, the importance of learning and mastering Science, a cornerstone of education, cannot be overstated. Science pervades every aspect of our lives, offering systematic means to make sense of the world. It equips students with scientific inquiry abilities and instills values like objectivity, curiosity, and honesty, which are essential for personal growth, future employment, and adapting to an increasingly complex world.

Science education in the Philippines has faced persistent challenges. The country consistently performs poorly in international assessments. For instance, the 2018 Program for International Student Assessment (PISA) by the Organization for Economic Cooperation and Development (OECD) ranked 79 participating economies based on students' performance in reading, science, and mathematics. The PISA 2018 Philippine National Report revealed that the Philippines scored an average of 357 points in Scientific Literacy, significantly below the OECD average of 489 points. Filipino students typically perform at Proficiency Level 1a, recognizing basic scientific phenomena with guidance, while their OECD counterparts at Level 3 can draw on moderately complex knowledge to explain familiar phenomena.

Furthermore, the 2018 National Achievement Test (NAT) results for Region 2, highlighted in a Regional Memorandum dated May 24, 2019, showed low mean percentage scores in Science across various grades. Grade 6 had a mean score of 28.42, Grade 10 had 36.91, and Grade 12 had 31.94. This consistent underperformance in Science indicates low mastery levels.

Ajaja (2013) identified the teaching methods used for science as a factor contributing to low student interest and achievement, emphasizing the need for alternative instructional strategies. Westera (2015) and Johnson & Golombek (2016) noted that technology as a pedagogical tool can enhance student engagement and participation. Storksdieck & Hunter (2017) further proved that technology-supported teaching can significantly expand students' learning by supporting instructional goals. Costley (2014) argued that integrating technology into daily science teaching is one of the best solutions for raising student achievement.

In the proponent's school, Physical Science topics on Polarity of Molecules have consistently been among the least mastered competencies, with mean percentage scores of 66.23, 70.18, and 69.09 from school years 2017-2018, 2018-2019, and 2019-2020, respectively. Mastery of this concept is crucial as it has many real-life applications, such as understanding why water and vinegar mix while water and oil do not, and why milk can counteract the effects of spicy food.

Challenged by these findings, the proponent introduced the Accessible, Interactive, Developed E-learning (AIDE) modules to improve competencies in Polarity of Molecules. This innovation aims to provide a more engaging, interactive, and supportive learning experience. The implementation of AIDE is expected to enhance the academic achievement of Grade 12 learners at CNHS in Physical Science, specifically in the area of Polarity of Molecules.

Innovation, Intervention and Strategy
This study "AIDE: Improving Competencies on Polarity of Molecules in Physical Science among Grade 12 learners of CNHS" is a technology-based learning innovation. It utilized the use of MS PowerPoint in transforming printed self-learning modules into developed and interactive offline e-learning modules. The researcher adopted the contents of the downloaded self-learning modules. Then, she designed and created the e-learning module. The teacher-researcher contextualized the content and activities from the downloaded self-learning modules to make it relevant, useful and meaningful to her learners.

The e-learning module catered modern learners who prefer bite-sized interactive learning material. The more attractive the content, the better the learners remember the information. If they enjoy learning, they can recall and apply concepts in their daily lives. Moreover, it also saved time and money in printing.
The researcher included the following as parts of the e-learning module:

1. Homepage - this section contained the main topic. It had three buttons: View references (on the left), Continue (on the center) and Exit button (on the right). At the bottom of this page is the legend of the different symbols used in the e-learning module.
2. Main Menu page - this feature included a brief description of the topic and the different sub-topics. An exit button is present in this page
3. Sub-topic page – this included:
3.1. discussion of a specific topic
3.2. video lessons/activities/games/interactive simulations

The Menu and Exit button was present in this page

4. Reference page- This contained the list of sources used in the e-learning module which the learners may access online.

As to the implementation of the intervention, AIDE was introduced in the Fourth Quarter (Week 3) of the School Year 2020-2021. Pretest was administered first. Afterwhich, the created and quality assured e-learning module was saved in slideshow format and was provided to the learners to be saved on their smart phones or laptops during the scheduled distribution of modules.

The learners answered the activities in the AIDE. Lastly, their answer sheets were retrieved for checking after two weeks followed by the conduct of Posttest. To monitor the finished task of the participants, an Activity Tracker Card was also given to them. A check mark along with the date was written on the activity tracker card for every finished activity.

The teacher-researcher closely monitored the conduct of the intervention through phone calls, group chats in messenger or any other social media platforms. This was done to ensure maximum participation of the participants thereby improving their learning competence in Physical Science specifically on Polarity of Molecules.

Research Questions
The study generally aimed to improve the competencies of the Grade 12 learners in Physical Science specifically on Polarity of Molecules in Casambalangan National High School for the School Year 2020 – 2021.

Specifically, it sought to answer the following questions:

1. What are the mean pretest and posttest scores of the two groups of Grade 12 learners on Polarity of Molecules?
1.1. Control group
1.2. Experimental group
2. Is there a significant difference between the pretest and posttest scores of the two groups of Grade 12 learners on Polarity of Molecules?
2.1. Control group
2.2. Experimental group

3. Which strategy is better in terms of improving the learning competency of Grade 12 learners in Polarity of molecules?
3.1. printed self-learning modules
3.2. AIDE
4. What activity plan should be done to sustain, improve the intervention?

Research Methods

This action research employed a two-group Pretest-Posttest Experimental Research Design to evaluate and compare the effectiveness of Accessible, Interactive, Developed E-learning (AIDE) modules and printed Self-Learning Modules in enhancing the learning competency of Grade 12 students in understanding the Polarity of Molecules.

The study participants were 28 Grade 12 Humanities and Social Sciences (HUMSS) learners at Casambalangan National High School during the 2020-2021 school year, comprising 11 males and 17 females. The learners were randomly assigned to control and experimental groups using a random generator app. Additional data were sourced from item analyses highlighting the least mastered competency in Physical Science over the past three years. A 40-item pretest and posttest, designed with 60% easy, 30% average, and 10% difficult questions, were administered to assess students' knowledge before and after the intervention.

With approval from the principal, the control group used printed self-learning modules, while the experimental group used teacher-developed AIDE modules with identical activities. Pretests were conducted at the students' homes following strict health protocols set by the DOH and IATF, including wearing face masks, face shields, and maintaining physical distancing. After the two-week intervention, posttests were similarly administered at home, adhering to health guidelines.

The collected scores were recorded, analyzed, compared, and interpreted using Excel spreadsheets and appropriate statistical tools. The study ensured confidentiality of the pretest and posttest scores and obtained necessary approvals from relevant authorities. Participants and their parents were informed of their involvement through a memorandum of agreement and parental consent forms. Proper acknowledgment and citation were given to all authors of books, journals, publications, and websites referenced in this research.

Results and Discussions

This part includes the discussion of results and reflection of the study. The data presented in this part follows the arrangement of the problems as set in the Action Research Questions.

A. Discussion of Results

Table 1. Mean Pretest and Posttest Results of the Participants

Groups	N	Mean	Standard Deviation
PRE-TEST			
Control Group	14	15.07	5.12
Experimental Group	14	17.29	5.99
POST-TEST			
Control Group	14	24.21	4.02
Experimental Group	14	29.5	2.98

Table 1 presents the result of the pretest and posttest scores of the two groups. Pre-test scores reveal that the control group has a mean score of 15.07 (SD=5.99) in the 40-item test while the experimental group reported a mean score of 17.29 (SD=5.12) which is a little higher. The standard deviation results of 5.12 and 5.99 respectively signify that most of the scores are close to the mean. This means that both groups are heterogeneous.

Moreover, it can also be gleaned from the table the posttest scores of the control and experimental group. The result showed that the posttest scores of the experimental groups taught with AIDE as an intervention is remarkably better having a mean score 29.5 (SD=2.98) as compared to the mean scores of 24.21 (SD=24.21) recorded by the control group who were taught using the printed Self-Learning Module. Results implied a significant difference from low to high mean scores in the pretest and posttest mean scores respectively.

The result is supported by Ming, Huang & Kuang (2017) on their study on the effects of Digital Learning on Learning Motivation and Learning Outcome. The test results show that digital learning appears notable differences in learning effect (3.95) and is higher than traditional teaching; and, digital learning shows significant differences in learning gain (4.27), and is higher than traditional teaching (3.38).

Table 2. Test of difference between the Pre-test and Post-test Scores of the Participants

Groups	Mean	Standard Deviation	p Value at 0.05 Level of Significance	Descriptive Value
PRE-TEST				
Control	15.07	5.12	0.15	Not significant
Experimental	17.29	5.99		
POST-TEST				

Control	24.21	4.02	0.0002	Significant
Experimental	29.5	2.98		

Table 2 reveals the significant difference between the Pretest and Posttest scores of the control group and experimental group using unpaired T-test. The data shows the Pre-test yielded a p-value of 0.15 which is greater than the set alpha level of 0.05. Therefore, it indicates that there is no significant difference. This explains that the level of learning outcomes between the two groups is at the same level without a significant difference.

On the other hand, looking at the Posttest scores of the control and experimental group, the generated p-value is 0.0002. The above findings stressed that the results of the Posttest of the control and experimental groups have significant differences. This explains that the levels of learning outcomes between the two groups have improved in the same direction and their achievement level.

The result is compatible with the study of Darmaji, Astalini, Kurniawan, Prasdila, Irdianti, Susbiyanto, Kuswanto, & Ikhlas (2019) which shows that there are significant differences in mastery of science process skills between physics education students who use Kvisoft-based-e-modules than those who do not.

Table 3. Test of Effect Size

Groups	Mean	Standard Deviation	Cohen's d value	Interpretation
PRE-TEST				
Control	15.07	5.12	0.40	Small effect size
Experimental	17.29	5.99		
POST-TEST				
Control	24.21	4.02	1.51	Large effect size
Experimental	29.5	2.98		

Table 3 shows the Cohen's d computed value to determine the effect size of the strategy. Data shows that in the Pretest, the Cohen's d value yielded 0.40 which signifies small effect size.

Meanwhile, in the Posttest, the generated Cohen's d value is 1.51. This shows that the intervention had a large effect size on the increase of academic scores of the learners favoring the experimental group. Hence, the results suggest that the AIDE intervention is effective in improving the competencies of the Grade 12 learners in Physical Science specifically on Polarity of Molecules

The finding is in line with the study of Serevina (2018) which revealed that E-module based on Problem Based Learning (PBL) on the subject of heat and temperature is feasible to improve students' science process skill for high school students. The calculation of the n-gain test shows that the magnitude of the increase before and after students' learning. The students who learn with the developed e-module get the ascension of 0.06 with a moderate category.

Table 4. Action Plan to sustain and maximize the utilization of the intervention

STRATEGIES	PROGRAMS	ACTIVITIES	TASKS	RESOURCES		FINANCIAL	TIMELINE
				HUMAN	MATERIAL		
To sustain, maximize the utilization of the AIDE intervention	Research and Development in Developing the Scientific literacy skills of Grade 12 learners using the AIDE intervention	Conduct of School, Monitoring, Evaluation and Adjustment (SMEA)	Invite monitoring team to evaluate the effectiveness of the AIDE intervention	Proponent	---	---	August 2-6, 2021
		Establish stronger partnership/linkages with stakeholders	Communicate the findings and results of the study through online, face-to-face, and flyers	Proponent, SH, PSDS, SDS, Municipal Officials, Barangay Officials, HPTA, GPTA, SGC	---	---	August 9-13, 2021

				Seek donations from stakeholders for the continuous implementation of the intervention	Proponent	Photocopy fee Travelling expense	Php 150 Php 500	SY 2021-2022
				Fund the reproduction of the intervention	Proponent, School Head and Teachers	Black Ink Cyan Ink Magenta Ink Yellow Ink Bond paper Folder Staple wire CD	Php 125 Php 125 Php 125 Php 125 Php 200 Php 30 Php 50 Php 50	SY 2021-2022
			Adopt and utilize the intervention in other learning areas where it is suited and applicable to improve learners' performance especially on the least mastered competencies.	Administer diagnostic test	Proponent Learners	Bond paper	Php 400	SY 2021-2022
				Do the test item analysis to identify the least mastered competencies	Proponent	---	---	SY 2021-2022
				Identify the competencies where the intervention is suited	Proponent	---	---	SY 2021-2022
				Craft and develop parallel intervention anchored on the competency	Proponent	---	---	SY 2021-2022
GRAND TOTAL							**Php 1,880.00**	

Conclusions

On the basis of the findings of the study, the following conclusions are drawn:

1. The pretest scores of the control and experimental group do not differ significantly.
2. The posttest scores of the groups significantly differ resulting to higher scores for the experimental group.
3. No significant difference exists in the pretest and posttest scores of the control group, but significant difference is noted for the experimental group.
4. There is an improvement in both control and experimental group in the posttest but significant improvement was shown with the experimental group taught with the AIDE intervention.
5. The use of AIDE intervention is effective in improving the competencies of the Grade 12 learners in Physical Science specifically on Polarity of Molecules considering the scores of the experimental group compared to the control group.

Recommendations

Based on the above findings and conclusions, the following recommendations are suggested.

Learners may be exposed to Accessible, Interactive, Developed, E-learning module (AIDE) to improve the competencies in Physical Science specifically on Polarity of Molecules. Also, Science teachers may design and develop interactive learning materials using technology to increase students' engagement and academic performance in the distance learning. Further, Science teachers may integrate the use of Accessible, Interactive, Developed, E-learning module (AIDE) in the learning plan aligned with the learning competencies and to the needs of the learners. Likewise, Science teachers may conduct Focused Group Discussion (FGD) to improve skills in designing interactive and technology-based learning materials. Lastly, teachers across disciplines or subject areas may strategically utilized Accessible, Interactive, Developed, E-learning module (AIDE) for remedial instruction or supplemental activities to enhance competencies.

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