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EFFECTS OF AUGMENTED REALITY TOOLS AND WORKSHEETS ON LEARNERS' ACADEMIC ACHIEVEMENT IN PHYSICS

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ABSTRACT

This quasi-experimental study investigated the effects of Augmented Reality (AR) tools and worksheets on Grade 10 students' academic achievement in physics at Cabalagnan National High School. A researcher-developed 40-item test was administered to fifty-six (56) learners who were selected through random sampling technique. The learners were exposed to Augmented Reality tools and worksheets to determine their effects on their academic achievement in physics. The results showed that there was a significant improvement in learners' performance from "developing" to "approaching proficient" after exposure to both Augmented Reality tools and worksheets. Augmented Reality tools outperformed worksheets in terms of mean scores and post-test results. The Mann-Whitney U-Test confirmed a significant difference in post-test scores between the two groups. Overall, the study suggests that Augmented Reality tools can be an effective learning tool for improving academic achievement in physics.

Keywords: *Augmented Reality Tool, Worksheets, Learner's Academic Achievement in Physics*

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INTRODUCTION

As material living conditions improve, the secondary school students have a strong sense of self and develop cognitively quickly. The current typical classroom, however, has numerous downside, that includes a lack of regard for students' active participation in knowledge acquisition, a single teaching methodology, and a detachment from practical applications (Jinghang Hu. 2024).

To fulfill the scientific societal demands, science as a body of knowledge must advance. In Southeast Asia, science education is viewed as more crucial to modernization and national progress than any other topic. The adoption of new teaching methods and technological advancements is causing a significant shift in Philippine science education.

The rapid advancement of technology has resulted in a significant learning gap, primarily due to differences in exposure to it. Students benefit greatly from the abundance of learning resources available to them in the digital environment. Different learning resources that aid in the learning process must be made available to students.

Writing instructional materials is a crucial step in helping teachers apply effective teaching strategies. One of the most often utilized resources is a worksheet. Worksheets become a significant component of the Philippine curriculum these days. Worksheets are used by teachers to encourage active learning, and facilitate assessment. The created worksheet has a major impact on student reactions and motivation, including their ability to comprehend the content being taught (Whalen & Paez, 2021).

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Despite the positive impacts, worksheets also have a downside on the academic achievement of the learners. The worksheets don't correspond with developmental stages. Worksheets as an Educational aid often focus on short-term achievement rather than long-term comprehension.

According to some academics, technology-enhanced education promotes more creative and participatory teaching and learning methods, which raises student motivation (Bursali & Yilmaz, 2019).

Augmented reality (AR) technology is revolutionizing the way we learn, offering an immersive and engaging educational experience. By leveraging the camera feature on tablets or smartphones, AR tools seamlessly merge the physical and virtual worlds, enabling users to interact with digital objects in real-time (Al-Ansi, 2023).

The increasing popularity of augmented reality tools has sparked a surge of interest in learning theories that can inform the design of effective AR-based educational experiences. These theories provide educators with valuable guidance and insights as they consider integrating AR technologies into their teaching practices (Klopfer & Squire, 2019; Li,2020).

There is an inadequate research that empirically compares the educational impacts of augmented reality (AR) technologies with the traditional teaching method of using worksheets, even though the use of AR tools to support instruction is growing in popularity. It's unknown how using this technology during the teaching and learning process impacts learners' motivation and achievement.

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The study sought to establish a learner-focused educational setting that harnesses cutting-edge technology and innovative instructional approaches to address the diverse needs and interests of high school learners through examining the efficacy of Augmented Reality tools and worksheets on high school learners achievement in physics.

MATERIALS AND METHODS

Research Methodology

This research investigated the efficacy of utilizing Augmented Reality (AR) tools and worksheets on Grade 10 students' academic achievement in physics at Cabalagnan National High School during the second quarter of the 2024-2025 academic year.

Research Method

The research method utilized in the study was experimental research using test questionnaires.

The the research collected data from pre-test and post-test results of Grade 10 students who received physics instruction using AR tools and worksheets as the primary learning strategy.

Employing an experimental research design, this study utilized a quantitative-experimental approach and a researcher-developed test questionnaire. The research process

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commenced with a pilot test involving Grade 11 students, followed by pre-test and post-test assessments for Grade 10 students, to examine the efficacy of AR in physics.

Research Design

Employing quasi-experimental design within the framework of quantitative research, the study assessed the effect of Augmented Reality (AR) tools and worksheets on physics. The researcher administered a pre-test prior to the second quarter and a post-test after implementing the AR-based instructional strategy. The goal was to investigate the impact of AR tools and worksheets in augmenting the academic achievement of Grade 10 learners in physics.

Participants of the Study

The participants were the fifty-six (56) grade 10 students of Cabalagnan National High School, in the District of Nueva Valencia South, Division of Guimaras. These students belong to an average, homogeneous section.

Research Instrument

To determine the physics achievement of the students before and after treatment, the researcher used a researcher-made 40-item test. This was validated and trial-tested for reliability.

A table of specifications was prepared before the construction of the test to obtain the correct proportion of the number of items to be taken from each objective. A 40-item test was

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drafted to give allowance for good and bad items and was submitted to the research adviser and panel of experts for validation.

Reliability of the Research Instrument

Reliability, as noted by Bolarinwa (2015), refers to the consistency and stability of a measurement tool's results over time or across different evaluators. In other words, a reliable method produces similar results when repeated, ensuring that the findings are dependable and consistent.

After incorporating the suggestions of the adviser and validators, the 40-item test was administered to 30 Grade 11 Learners of Cabalagnan National High School for trial testing. The result of the trial test was through item analysis to determine which items were to be retained. The Cronbach's Alpha of 0.80 showed that all the 40-item tests should be retained.

Data Gathering Procedure

The research procedures were divided into 3 stages:

The pre-experimental stage. The researcher obtained the necessary permissions from the School Head of Cabalagnan National High School to conduct both the pilot testing and the main study within the school premises.

Having the necessary permissions, the researcher conducted the pilot-testing, had the items analyzed, and identified the 40 items to be included in the research instrument. Then the researcher chose 2 homogeneous sections (Section Diamond & Section Silver) that will

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serve as the respondents in the study. Using a toss coin the researcher chose which group would be exposed Augmented Reality Tool and Worksheets learning strategy. Each group was oriented on what was expected of them. Pre-Test was then administered.

Experimental Stage. Grade 10 learners of section Diamond were exposed to Augmented Reality Tool, and Grade 10 learners of section Silver were exposed to worksheets to the same learning content.

Post Experiment. Following the experiment, a post-test was given to both groups to assess their Physics performance and measure the impact of the intervention.

For analysis, to evaluate the learners' performance in Physics, the researcher employed a mean scale with corresponding interpretations, as adapted from Somo (2019), for both the pre-test and post-test assessments.

Data Analysis

Following the completion of the experiment, the researcher conducted the post-test to collect data. Data gathered were then systematically organized, compiled, and presented in tabular form using Microsoft Excel. To derive meaningful insights from the data. the Statistical Package for Social Science (SPSS) software.

Statistical Tools

Data collected were tallied, tabulated, and computed by the researcher. Gathered data underwent rigorous analysis and interpretation using pertinent statistical techniques suitable for this study, with the aim of extracting meaningful conclusions and insights.

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Mean. The mean (M) score was used to assess the Physics performance of Grade 10 learners at two different points: before and after implementing two distinct learning strategies.

Wilcoxon-Signed Rank (Z) test. To investigate the impact of the Augmented Reality Tool and Worksheets learning strategy on Physics performance, the Wilcoxon-Signed Rank (Z) test was used for the comparison of learners' pre- and post-intervention scores.

Mann-Whitney (U) test. It was used to evaluate the Physics performance of learners who utilized the Augmented Reality Tool and Worksheets learning strategy, and to identify whether statistically significant differences existed between the treatment and control groups.

RESULTS AND DISCUSSIONS

This study aimed at determining the effects of Augmented Reality tool and worksheets on learners' academic achievement in Physics in Cabalagnan National High School students' academic performance during the school year 2024-2025.

The research method utilized in the study was experimental using a questionnaire made by the researcher, under quasi-experimenta

The participants of the study were the 56 grade 10 learners of Cabalagnan National High School in the Schools Division of Guimaras.

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Pre-test results of grade 10 learners before they are taught physics using Augmented Reality tools and worksheets

Table 2 shows that the pre-test results of Grade 10 learners were similar before being taught physics using Augmented Reality (M = 13.21, SD = 2.64) and worksheets (M = 12.86, SD = 2.43). The performance of learners before they are taught physics using the augmented reality tool, which is described as "developing" (M = 13.21), implies that before the intervention, learners' knowledge of physics can be considered insufficient. On the other hand, the performance of learners before they are taught physics using worksheets was also described as "developing" (M=12.86). Both groups demonstrated comparable performance, with the AR group scoring slightly higher on average. Additionally, the standard deviations indicate that the AR group had a slightly wider spread in scores compared to the worksheets group, suggesting more variation in individual performances within the AR group.

The pre-test results of Grade 10 learners before being taught physics using Augmented Reality and worksheets indicate that both groups were at the "Developing" level of understanding before instruction began.

The Augmented Reality group (n = 28) achieved a mean score of 13.21, with a standard deviation of 2.64, whereas the Worksheets group (n = 28) obtained a mean score of 12.86, with a standard deviation of 2.43, indicating a slightly lower average performance.

The small difference in mean scores suggests that the initial understanding of Physics concepts among the two groups was relatively similar. Additionally, the standard deviation values indicate some variability in scores, but the spread is not significantly large. These

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results establish a baseline for assessing the impact of Augmented Reality an d Worksheets as instructional tools, allowing for meaningful comparisons after the intervention.

These findings imply that prior to the intervention, students in both groups had comparable levels of knowledge, making the study's conditions ideal for evaluating the effectiveness of these instructional methods.

This study aligns with the results of Chiou, Tseng, and Hwang (2020), who observed that students initially demonstrated limited conceptual understanding due to traditional teaching methods lacking immersive and interactive elements, highlighting the potential of Augmented Reality (AR) in enhancing student understanding.

Table 2

Pre-test results of grade 10 learners before they are taught Physics using Augmented Reality and Worksheets

Category	N	Mean	Standard Deviation	Description
Augmented Reality	28	13.21	2.64	Developing
Worksheets	28	12.86	2.43	Developing

Legend

Scale	*Description/Interpretation*
40.01 – 50.00	*Advanced*
30.01 - 40.00	*Proficient*
20.01 – 30.00	*Approaching Proficiency*
10.01 – 20.00	*Developing*

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0.00 – 10.00 *Beginning*

Difference in the Results of the Pretest of grade 10 learners when using Augmented Reality tools and worksheets

As presented in Table 3, the Wilcoxon-Signed Rank (Z) test revealed no statistically significant difference in the pre-test scores of Grade 10 learners utilizing Augmented Reality (AR) tools and worksheets. This finding was corroborated by the Mann-Whitney U-test, which yielded a significance value ($p = 0.541$) exceeding the predetermined alpha level ($\alpha = 0.05$), indicating that both groups demonstrated comparable performance prior to the intervention.

The difference in pre-test results for Grade 10 learners using Augmented Reality tools and Worksheets in Physics shows that No significant disparity was observed in their preliminary understanding of the subject before instruction. The mean rank for the Augmented Reality group is 29.82, while the Worksheet group has a slightly lower mean rank of 27.18. However, the U-value of 355.00 and the significance level (Sig = 0.541) indicate that this difference is not statistically significant. This means that any variations in pre-test scores between the two groups occurred by chance rather than due to any inherent advantage of one group over the other.

The "Not Significant" remark confirms that both groups started with relatively equal levels of knowledge before being exposed to their respective instructional methods. This establishes a fair baseline, ensuring that any differences in post-test results may be credited

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to the effectiveness of Augmented Reality or Worksheets rather than pre-existing disparities in knowledge.

This finding confirms Zhu et al.'s (2021) study on the impact of Augmented Reality (AR) in physics. Their research showed that students often start with relatively low pre-test scores, indicating a need for interactive learning tools like AR to enhance conceptual understanding and improve learning outcomes.

Table 3

Difference in Pre-Test Results for Grade 10 Learners Using Augmented Reality Tools and Worksheets in Physics

	Mean Rank	*U-Value*	*Sig*	*Remarks*
Augmented Reality	*29.82*			*Not Significant*
		355.00	*0.541*	
Worksheet	*27.18*			

Legend

Scale	Description/Interpretation
40.01 – 50.00	Advanced
30.01 - 40.00	Proficient
20.01 – 30.00	Approaching Proficiency
10.01 – 20.00	Developing
0.00 – 10.00	Beginning

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Post-test results of grade 10 learners after they were taught physics using Augmented Reality tools and worksheets

Table 4 highlights that the post-test results of Grade 10 learners were quite similar for both Augmented Reality (M = 28.79, SD = 3.49) and worksheets (M = 26.07, SD = 3.32). The AR group scored slightly higher on average, while the standard deviations suggest that the AR group had more variation in scores, pointing to a greater spread in individual performance compared to the worksheet group.

The post-test results of Grade 10 learners using Augmented Reality and Worksheets in Physics indicate that both groups improved their understanding of the subject, reaching the "Approaching Proficiency" level. The Augmented Reality group achieved a mean score of 28.79 with a standard deviation of 3.49, while the Worksheets group obtained a mean score of 26.07 with a standard deviation of 3.32.

The higher mean score of the Augmented Reality group suggests that students exposed to this method performed slightly better than those using Worksheets. Additionally, the standard deviation values indicate that while there was some variability in individual scores, the overall spread of results remained relatively consistent across both groups.

The enhancement in achievement from the pre-intervention test to the post-intervention test signifies an improvement in Physics comprehension, highlighting the effectiveness of both instructional strategies. However, the greater mean score for the Augmented Reality group suggests that this method may have provided a slight advantage in enhancing conceptual understanding and engagement with the subject matter.

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This result conforms the study done by Özçakır & Çakıroğlu (2021) and Çetin & Türkan (2021), which demonstrated that Augmented Reality (AR) Tools can enhance students' spatial thinking skills and facilitate faster achievement of learning goals by improving understanding and comprehension.

Table 4

Post-Test Results of Grade 10 Learners Using Augmented Reality and Worksheets in Physics

Category	M	SD	Description
Augmented Reality	28.79	3.49	Approaching Proficiency
Worksheets	26.07	3.32	Approaching Proficiency

Legend

Scale	*Description/Interpretation*
40.01 – 50.00	*Advanced*
30.01 - 40.00	*Proficient*
20.01 – 30.00	*Approaching Proficiency*
10.01 – 20.00	*Developing*
0.00 – 10.00	*Beginning*

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Differences in the Results of the Post Test of grade 10 learners using Augmented Reality Tools and worksheets

The Mann-Whitney U-test was used to compare the post-test scores of Grade 10 learners using Augmented Reality tools and worksheets. The result shown in Table 5 revealed a significant difference ($p = 0.004$). This means that students who used Augmented Reality tools performed better than those who used worksheets, suggesting that Augmented Reality had a positive impact on their learning.

The difference in post-test results for Grade 10 learners using Augmented Reality tools and Worksheets in Physics reveals a statistically significant improvement in favor of the Augmented Reality group. The mean rank for students who used Augmented Reality tools is 34.80, while the mean rank for those who used Worksheets is lower at 22.20. The U-value of 215.50 and the significance level (Sig. = 0.004) indicate that the observed difference is statistically significant at $P < 0.05$. This suggests that the higher post-test performance of the Augmented Reality group is unlikely due to chance and can be attributed to the effectiveness of the instructional method.

The "Significant" remark confirms that Augmented Reality had a meaningful impact on student learning, likely enhancing engagement, conceptual understanding, and retention of physics concepts more effectively than traditional Worksheet-based instruction. These findings underscores the potency of Augmented Reality as a strong teaching tool that can improve students' mastery of complex scientific concepts.

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The result is comparable to the study of research by Sánchez and Ramírez Diaz (2021). They highlighted that AR applications in physics teaching can improve students' understanding of complex concepts, leading to better performance. These findings align with the significant difference observed in your study, where students utilizing AR tools outperformed those relying solely on worksheets, suggesting that AR positively impacts physics learning.

Table 5

Difference in Post-Test Results for Grade 10 Learners Using Augmented Reality Tools and Worksheets in Physics

	Mean Rank	*U-value*	*Sig.*	*Remarks*
Augmented Reality	*34.80*			*Significant*
		215.50	*0.004*	
Worksheets	*22.20*			

P < 0.05, Significant

Difference in the Results of the pre-test and post-test using Augmented Reality Tools

To compare the pre-intervention and post-intervention results of students using Augmented Reality tools, a Wilcoxon signed-rank test was performed. In Table 6, the results show a notable improvement in students' performance from the pre-test to the post-test (p =

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0.000). This suggests that Augmented Reality tools effectively enhanced students' learning outcomes.

The data presented with the z-value of -4.630 shows a statistically significant gap between the two test scores, suggesting a notable improvement or change. The p-value (Sig.) of 0.000 is below the common significance threshold (typically 0.05), confirming that the observed difference is not due to random chance. The "Significant" remark further reinforces that AR tools had a measurable impact on student learning. This suggests that integrating AR in Physics education effectively enhances student understanding and performance by providing immersive and interactive learning experiences.

This result conforms with the research by Afnan et al. (2020), which revealed that Augmented Reality (AR) applications are more effective when students receive proper guidance on their use, enabling them to explore and learn independently.

Table 6

Difference in the Pre-test and Post –test Performance of Grade 10 learners using Augmented Reality Tools in Physics

	z-value	Sig.	Remarks
Pre-test vs Post Test	-4.630	0.000	Significant

P<.0.05, significant

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Difference in the results of pre-test and post-test using Worksheets

As presented in Table 7, the Wilcoxon signed-rank test demonstrated a substantial increase in students' Physics performance from pre-test to post-test (p = 0.000) when worksheets were utilized. This finding suggests that the incorporation of worksheets yielded enhanced learning outcomes. A comparison of pre-test and post-test scores of Grade 10 learners in Physics using worksheets as an instructional tool revealed a z-value of -4.635, indicating a substantial difference between the two test scores. The p-value (Sig.) of 0.000 confirms the statistical significance of this difference, implying that the observed improvement was not due to chance. The notable difference underscores the effectiveness of worksheets in augmenting student learning. This implies that structured worksheets offer a valuable learning approach, enabling students to reinforce concepts, practice problem-solving, and engage in self-paced learning, ultimately leading to improved achievement in Physics.

The finding of the study aligns with the findings of Whalen and Paez (2021), who discovered that a well-designed worksheet can have a significant impact on student motivation and responses, ultimately enhancing their ability to comprehend the taught material.

Table 7

Difference in the Pre-test and Post–test Performance of Grade 10 learners using Worksheets in Physics

	z-value	Sig.	Remarks
Pre-test vs Post-Test	-4.635	0.000	Significant

P<0.05, Significant

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Summary

This Chapter gives an outline of the investigation, the inferences drawn from the results, and the suggestions proposed by the investigator.

Summary

The research investigated the effects of Augmented Reality tool and worksheets on learners' academic achievement in physics on Cabalagnan National High School students' academic performance during the school year 2024-2025.

Using quasi-experimental design, the researcher utilized two groups of Grade 10 junior high school learners of the said school as participants in this study. Each group, with 28 learners, was randomly assigned to either of the two learning tools by a toss coin. The Grade 10 learners from section Diamond were taught physics using Augmented Reality Tool while learners from grade 10 Silver were taught the same learning content but with the use of worksheets.

To collect the necessary data, the researcher created a customized test to assess learners' performance before and after using two learning tools: Augmented Reality (AR) and worksheets. The test was validated by experts and pilot-tested to ensure reliability. Statistical analysis using mean, The results of the Wilcoxon-Signed Rank Test and Mann-Whitney U test indicated significant changes ($p < 0.05$) in scores between the pre-test and post-test assessments.

The study's findings indicate:

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Learners showed significant improvement in performance when using AR tools, with notable increases between the pre-intervention and post-intervention scores.

Worksheets also led to improved performance, with learners advancing from "developing" to "approaching proficiency" levels.

Both AR tools and worksheets yielded significant differences in learner performance before and after exposure.

Overall, learners demonstrated remarkable improvement in performance when using both AR tools and worksheets, achieving "approaching proficient" levels.

These suggested that AR tools and worksheets can efficaciously improve learner performance.

CONCLUSIONS

The study's findings yielded the following conclusions:

A significant improvement in learners' Physics achievement was observed when taught using Augmented Reality Tools, as well as with worksheets, compared to their pre-instructional levels.

These outcomes suggest that using Augmented Reality Tools and Worksheets greatly affects learners' academic. These differences are significant; thus, the Augmented Reality is more effective than worksheets when it comes to their effectiveness in the level of performance of learners in Physics.

On the other hand, learners who were exposed to Augmented Reality can have more confidence in class and can lead to a positive outlook in their Physics subject.

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RECOMMENDATIONS

In view of the research outcomes, the following suggestions are put forth:

Further research is needed in several areas. First preferred learning tools for secondary learners should be studied.

Second, the effects of various learning tools on other subjects areas should also be given focus and consideration.

Third, further studies should focus on why and what type of learning tools does successful students prefer than those of unsuccessful ones.

Fourth, new studies should focus on what really happens if different learning tools were applied as early as primary school.

Lastly, it is strongly recommended that respondents of this study and also the teachers, should integrate the Augmented Reality tools and worksheets into their studies and classes.

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