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Effectiveness of 5a's Instructional Module in Teaching Grade 12 Physics: An Experimental Study

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ABSTRACT

The study aimed to investigate the impact of the 5A's instructional module on students' Physics knowledge and application of knowledge in Physics. The research included understanding the pre-test and post-test profiles of the participants, comparing the students' levels of Physics knowledge and application of knowledge between the experimental and control groups, and assessing their perceptions of the 5A's instructional module. The study used a quasi-experimental design with a time-series design, employing mean, standard deviation, and paired-sample t-tests to examine the data statistically. The participants were Senior High School STEM students from Cagdianao National High School, Dinagat Islands Province. Four instruments were used: the 5A's instructional module, physics knowledge test, application of knowledge test, and Likert scale assessment on the 5A's instructional module. The results showed varied performance across physics topics under the conventional approach, with a mixed pattern of improvement observed in Newton's Law of Motion and Application, having a pre-test mean score of 21.27 and a post-test mean score of 23.47. The 5A's instructional approach demonstrated significant improvement patterns across the three topics, particularly notable in enhancing application of knowledge, with a mean pre-test score of around 10.13 and 18.63 in the posttest of topic B, Kinematics. The paired-sample t-tests revealed significant improvements in post-test scores across all topics with the experimental approach, indicating its efficacy in enhancing understanding and performance. Positive perceptions regarding content quality, instructional quality, and overall impact on learning were observed with the 5A's instructional module. Additionally, continuous refinement based on student feedback is crucial to achieving educational objectives and improving learning experiences.

Keywords: Physics knowledge, Application of knowledge, 5A's instructional module, likertscale assessment, conventional, experimental group

I. INTRODUCTION

Physics education serves as a cornerstone in the realm of science education and effective instructional approaches are essential for promoting student learning and achievement in science subjects, such as physics. In the context of education, physics is typically taught at the high school and college levels as a core subject in science curricula (Redish, 2003). Physics is a subject that often presents challenges to students due to its complex concepts and mathematical nature (Mazur, 2009). Despite the efforts of educators to provide engaging and effective instructional approaches, many students still struggle to develop the necessary problem-solving skills required for success in physics. The development of instructional approaches that promote active learning and engagement has therefore become a critical area of focus in the field of physics education (Wieman & Perkins, 2005; Mazur, 2009).

In the field of education, the need for effective and innovative pedagogical strategies has never been greater. The traditional approach to teaching physics often relies on lectures and passive learning, which has been shown to be less effective in promoting students' understanding and problem-solving skills (Meltzer & Thornton, 2012). To address this issue, many educators have turned to active learning methods, such as inquiry-based learning and flipped classrooms, which have been shown to improve student achievement and engagement (Freeman et al., 2014; Abeysekera & Dawson, 2015). However, there is still a need for novel and effective pedagogical approaches that can address the specific challenges of teaching physics. In recent years, there has been growing concern about the declining interest and knowledeg in physics among students in many parts of the world (Mickelson, 2018; Mujtaba, Rehman, & Iqbal, 2019). This has led to call for innovative pedagogical strategies and interventions that can enhance students' understanding, problem-solving skills, and motivation in this subject (Martin, Mullis, Foy, & Stanco, 2016; National Research Council, 2012). One promising approach is the use of local instructional modules that incorporate active learning, technology, and other innovative teaching methods (Freeman et al., 2014; Prince, 2004).

According to the American Physical Society (2021), physics education is a crucial component of STEM education that is vital in preparing students for future careers and addressing global challenges. However, the complex nature of physics concepts often poses challenges for students, resulting in poor academic performance and a lack of interest in the subject.

In recent years, there has been growing concern about the quality of education in the Philippines, particularly in the field of Science, Technology, Engineering, and Mathematics (STEM). The country has consistently performed poorly in international assessments of student achievement in these subjects, which has led to calls for reform in the way these subjects are taught. International assessments of student achievement in STEM subjects: "In international assessments of mathematics and science education such as the Programme for International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS) and the International Mathematics and Science Olympiad, the Philippines consistently ranked low among other countries" (Dizon, 2020).

Many studies have shown that instructional modules that incorporate innovative and effective teaching strategies can significantly improve students' knowledge, and application of this knowledge (Mendoza, 2017; Wang & Huang, 2019). Active learning approaches, in particular, have been shown to be effective in improving students' conceptual understanding and problem-solving skills in Physics (Braun et al., 2018).

Most of the public schools in the Philippines still use modules provided by the Department of Education Central Office, which do not necessarily fit the learning environment, culture, and pace of the students in their respective divisions (Cinco, 2019).

According to Velasco and Barcenal (2019), one of the major challenges faced by many divisions in the Philippines, including Dinagat Islands Division, is the lack of a standardized and locally developed instructional module for Physics. This situation has resulted in the division relying on weekly learning activity sheets sourced from other divisions, which may not fully align with the local needs and priorities. The use of learning activity sheets that are borrowed or adopted from other divisions is still common in public schools in the Philippines (Polo, 2018). This has led to a fragmented approach to teaching Physics, which may not adequately prepare students for higher-level studies in STEM.

In the Dinagat Islands Division of the Philippines, educators do not have access to local instructional modules for teaching, and instead rely on Weekly Learning Activity Sheets (WLAS) from other divisions. This scenario was observed at Cagdianao National High School, where teachers had to make use of WLAS because they do not have a locally developed instructional module. This has created a need for innovative instructional approaches that can be adapted to the unique needs of the local student population. To address this need, the researcher developed a new instructional approach based on the 5A's model, which stands for Advance Access, Anticipatory Set, Active learning, Articulate, and Assessment. The goal of this approach was to provide educators in Dinagat Islands with a locally owned and relevant instructional module that promotes active learning and engagement among students. By introducing this new approach, educators may be better able to meet the unique learning needs of students in Dinagat Islands, while also contributing to the advancement of research in the field of education. For physics, which aims to improve students' achievement, and problem-solving skills, the 5A's approach will serve as the framework for the module, which will be implemented in a senior high school physics course.

Moreover, this study had examined the impact of the 5A's instructional module on students' physics knowledge, and application of knowledge. Specifically, the study will focus on Physics 1 students and their responses to the 5A's instructional module. In addition, a quasi-experimental design was used to compare the effectiveness of the developed material and the conventional instructional approaches from the Department of Education (DepEd). By exploring the benefits and challenges of implementing the 5A's instructional module, this study seeks to provide insights into the development of more effective and engaging instructional approaches for physics education.

Through this study, it was hoped that the 5A's instructional module developed would continue contributes to the growing body of research on effective pedagogical approaches for physics education, and provide practical insights for educators seeking to improve student achievement and engagement in physics.

1.1 Review of Related Literature

Instructional Approach Module and Module Development

In education, instructional approach modules are essential for creating effective learning experiences. These modules provide structured frameworks to guide educators in delivering content, engaging students, and promoting achievement (Morrison, Ross, & Kemp, 2013). Their development involves aligning with educational objectives and standards to ensure relevance and meaningful contributions to broader educational goals (Briggs & Wager, 2010). This alignment fosters coherence and consistency, enhancing the learning experience across different contexts.

Developing instructional approach modules requires a deep understanding of pedagogical principles and best practices. Educators and curriculum developers use research-based strategies, instructional theories, and evidence-based methodologies to design modules that facilitate meaningful knowledge acquisition (Hamora et al., 2010). Incorporating active learning techniques, differentiated instruction, and formative assessment strategies further enhances these modules' effectiveness (Atmowardoyo, 2018).

A key consideration in module development is the integration of technology and digital resources to enrich the learning experience. Interactive multimedia, online simulations, and educational software create dynamic and engaging learning environments, fostering personalized learning and collaborative problem-solving (Hamweete, 2012). Additionally, flexibility and adaptability are crucial, allowing modules to be easily modified to accommodate evolving educational trends and student demographics (Souza & Al, 2021; Pentang, 2021).

Collaboration and stakeholder engagement are also vital in the development process. Educators, curriculum specialists, administrators, and students provide valuable insights and feedback, fostering ownership and shared responsibility (Pentang et al., 2022). Attention to cultural relevance and inclusivity ensures that modules resonate with students from diverse backgrounds, promoting representation and value in the learning process (Rajabalee & Santally, 2021).

Ongoing evaluation and improvement are emphasized, with developers employing formative and summative assessment strategies to gather feedback and optimize modules continuously (Ghazal et al., 2018). Sustainability and scalability are also considered, ensuring modules can be widely implemented and maintained with minimal resource requirements (Ambayon, 2020). Professional development initiatives for educators support the effective use of these modules, enhancing teaching and learning outcomes.

Instructional Approaches in Teaching Physics

Physics instruction aims to equip students with analytical abilities and subject-specific knowledge for scientific inquiry (Minishi et al., 2004). Various teaching methods and environments pique students' interest and enthusiasm for learning. Extensive research explores the impacts of different teaching interventions on students' conceptions (Jimoyiannis & Komis, 2001).

Despite the recognized significance of science education, many students struggle with it, particularly physics, which is considered challenging (OECD, 2021a; TIMSS & PIRLS International Study Center, 2021). Ineffective teaching methods can hinder comprehension of scientific concepts, exacerbated by students' preconceived notions from everyday experiences (Chi, Slotta, & de Leeuw, 2014). Developing advanced beliefs about science and critical thinking skills is crucial for better comprehension (Duschl & Grandy, 2012; Kuhn & Weinstock, 2002).

The debate on the best method for teaching physics continues, with discussions on whether students learn better through self-discovery and minimal guidance or through direct instructional guidance (Kirschner et al., 2006). Constructivist approaches, often used in science classes, encourage students to conduct experiments to learn scientific principles, though they may lack crucial instructional components like feedback (Van Joolingen et al., 2005; Zhang, 2018).

Instructional approaches such as inquiry-based learning (IBL) and active learning techniques have been employed to enhance students' comprehension and application of physics concepts (Li et al., 2016; Freeman et al., 2014). Technology integration in teaching physics, like virtual labs and computer simulations, has improved student understanding and motivation (Wei et al., 2020; Rizvi et al., 2019). Metacognitive strategies also positively impact student learning outcomes by enhancing problem-solving skills and academic performance (Schraw et al., 2013; Lehtinen et al., 2018).

Instructional Approaches in Science Education in the Philippines

In the Philippines, instructional approaches in physics and science education shape students' understanding and engagement with scientific concepts. Traditional methods like lecture-based teaching and rote memorization have been prevalent but often prioritize content delivery over student engagement (Stefaniak et al., 2015; Nuñez, 2010). Inquiry-based learning (IBL) encourages self-directed investigation and experimentation, promoting critical thinking and a deeper understanding of scientific concepts (Bautista, 2014).

The integration of technology in science education is gaining traction, with digital resources and interactive simulations enhancing teaching and learning experiences (Abella & Solis, 2018). This aligns with the Philippine government's efforts to modernize education through ICT-enabled learning environments (Department of Education, 2019).

Effectiveness and Weaknesses of Instructional Approaches in Science Education

The effectiveness and limitations of instructional strategies significantly impact students' learning processes and outcomes. Problem-Based Learning (PBL) engages students in real-world problems, fostering critical thinking and deeper understanding (Schroeder et al., 2017). Inquiry-Based Learning (IBL) promotes metacognitive awareness and ownership of learning, while the Flipped Classroom Model leverages technology for instructional content delivery and active learning (Jiang & McComas, 2021).

Project-Based Learning (PjBL) immerses students in interdisciplinary projects, enhancing understanding and collaboration skills (Joubert & Wishart, 2012). However, these approaches also present challenges, such as time management, the need for additional support, and potential inequities in access to technology (Partin et al., 2013; Hao & Han, 2017).

Despite these challenges, reflective practice and ongoing professional development can help educators navigate the complexities of instructional approaches, leveraging strengths and addressing weaknesses. By fostering a culture of collaboration and continuous improvement, educational institutions can create supportive environments where both students and teachers thrive (Singer et al., 2012).

1.2. Theoretical Framework

This research study was anchored on ADDIE Model, which is a systematic instructional design model used to develop effective and efficient instructional materials. The ADDIE model consists of five phases: Analysis, Design, Development, Implementation, and Evaluation (Dick, Carey, & Carey, 2009). Below are the phases of ADDIE Model and how it was being used to establish the 5A’s instructional module:

Analysis Phase. During the Analysis phase of the ADDIE Model, instructional designers identify learning needs, goals, and objectives. They also analyze the target audience and the context in which the instruction will occur. This phase sets the foundation for the entire instructional design process. The 5A's Instructional Approach Module begins with the "Advance Access" component, which aligns with this phase. Advance Access involves providing learners with access to preparatory materials or resources before the instructional session. This step corresponds to the analysis of learning needs and objectives, ensuring that learners have the necessary background knowledge or resources to engage effectively with the instruction. In this phase, the researcher will also review literature on the 5A's instructional approach and its effectiveness in improving Physics knowledge and its application (Guzey & Roehrig, 2009; Meltzer & Thornton, 2012)

Design Phase. Aside from developing a module using the 5A's instructional approach that aligns with the learning needs and goals as identified in the Philippine Professional Standards for Teachers (PPST), instructional designers develop the instructional strategy and create a detailed plan for achieving the learning objectives. This phase involves designing the structure of the instruction, selecting appropriate instructional methods, and developing materials and activities (Mayer, 2009). The "Anticipatory Set" component of the 5A's aligns with the Design phase of the ADDIE Model. Anticipatory Set refers to the introduction or warm-up activity designed to capture learners' attention and stimulate their interest in the upcoming instruction. This step corresponds to the design of engaging instructional strategies and activities to set the stage for effective learning.

Development Phase. The Development phase involves creating the instructional materials and resources according to the plan developed in the Design phase. This phase may include creating presentations, handouts, multimedia materials, and interactive activities (Reeves, 2006). The "Active Learning" component of the 5A's aligns with the Development phase of the ADDIE Model. Active Learning emphasizes learner engagement and participation through interactive activities, discussions, simulations, or hands-on exercises (Bonwell & Eison, 1991; and Freeman et al. 2014). This step corresponds to the development of instructional materials and resources that promote active engagement and meaningful learning experiences.

Implementation Phase. During the Implementation phase, the instruction is delivered to the learners according to the plan developed in earlier phases. This phase involves conducting the instructional sessions, facilitating learning activities, and providing support to learners as needed (Guskey, 2002). The "Articulate" component of the 5A's aligns with the Implementation phase of the ADDIE Model. Articulate emphasizes clear communication and explanation of concepts, instructions, and expectations during the instructional session. This step corresponds to effectively delivering the instruction and articulating key points to ensure learner understanding and comprehension.

Evaluation Phase. The Evaluation phase involves assessing the effectiveness of the instruction and its impact on learning outcomes. This phase includes collecting feedback from learners, assessing their performance, and evaluating the overall success of the instructional design. The "Assessment" component of the 5A's aligns with the Evaluation phase of the ADDIE Model. Assessment involves measuring learner progress, understanding, and achievement of learning objectives through various assessment methods such as quizzes, tests, projects, or performance evaluations. This step corresponds to evaluating the effectiveness of the instruction and assessing learner outcomes to inform future revisions or improvements.

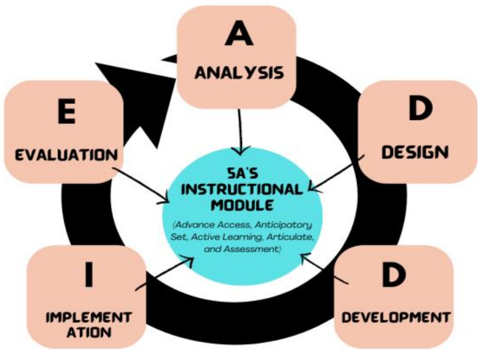

Figure 1. Integration of ADDIE Model in the 5A's Instructional Module

Overall, this research builds off existing literature regarding innovative instruction approaches aimed at enhancing STEM education outcomes specifically Physics knowledge, and better application of knowledge (Adams et al.,2017).The ADDIE model ensures that the module is designed based on the learning needs and goals of the students and is implemented effectively in the classroom. The diagram below shows the interconnectedness of the variables in the study. Moreover, It discusses deeply the concept of making the 5A's Instructional Approach Module and how the variables interplay making the research flow of the study.

1.3 Statement of the Problem

This study aimed to investigate the influence of the 5A's instructional module on students' Physics knowledge, and application of knowledge. Specifically, this study sought answers to the following questions:

1. What innovative instructional approach can be developed in teaching grade 12 physics?
2. What are the pre-test and post-test profiles of the participants in conventional group concerning:
   2.1 Knowledge; and
   2.2 Application of Knowledge
3. What are the pre-test and post-test profiles of the participants in experimental group concerning:
   3.1 Knowledge; and
   3.2 Application of Knowledge
4. Is there a significant difference between the post-test of the experimental and conventional groups regarding their knowledge and the application of knowledge?
5. What is the assessment of the students under the experimental group towards the 5A’s instructional module in learning Physics 1 in terms of content quality, instructional quality, and overall impact on learning?

II. METHODOLOGY

This study employed a quasi-experimental time-series design to evaluate the impact of the 5A’s instructional module on Senior High School STEM students' physics knowledge and application at Cagdianao National High School. The design included repeated pre- and post-tests administered three times across different topics. The experimental group received the 5A’s instructional module intervention, while the control group continued with traditional instruction. Pretests measured initial knowledge, and posttests assessed performance after each session, allowing for comparison between groups. The study involved 32 Grade 12 STEM students, equally divided into experimental and control groups. All participants met the qualification standards set by the Department of Education, ensuring no selection bias. Random assignment further mitigated potential biases, ensuring comparability. Four instruments were used: the 5A’s Instructional Module in Physics, Physics Knowledge Test (PKT), Application of Knowledge Test (AKT), and an assessment of the instructional module. Both the PKT and AKT served as pretests and posttests and were validated by physics education experts, achieving a strong reliability coefficient (≤ 0.87) through Krippendorff’s alpha analysis.

The 5A's instructional module in Physics, designed specifically for this study, included five components: advance access, anticipatory set, active learning, articulate, and assessment. Advance access provided students with relevant materials before instruction to build foundational knowledge, while the anticipatory set engaged students by capturing their interest and activating prior knowledge. Active learning emphasized participation through group discussions, experiments, and problem-solving. The articulate component facilitated clear communication of physics concepts with explanations, demonstrations, and visual aids. Finally, the assessment component evaluated progress through formative and summative assessments. The Physics Knowledge Test (PAT), a researcher-made multiple-choice test with 20 items, measured students' understanding of topics like Units and Measurement, Kinematics, and Newton’s Laws. Validated through pilot testing for clarity and reliability, it was administered before and after the intervention. The study’s findings, analyzed using descriptive and inferential statistics, indicated that the

5A's instructional module significantly impacted students' physics knowledge and application skills, underscoring its effectiveness in improving educational outcomes.

III.RESULTS AND DISCUSSIONS

Conventional Approach

The flexplot in Figure 4 and 5 provide a comprehensive visualization of the pre-test and post-test scores measuring students' knowledge and application of knowledge, respectively, across three distinct topics: A (Units and measurements), B (Kinematics: Motion along a straight line), and C (Newton's Law of Motion and Application) for a group that underwent a conventional approach. In the flexplot, the ghost line typically represents the trajectory of individual participants' scores from pre-test to post-test. In addition, the whiskers assess the extent to which the scores deviate from the mean, providing a sense of consistency or inconsistency in performance within each group.

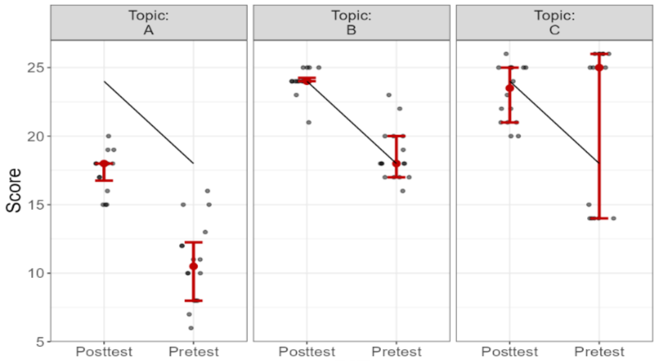

Figure 2. Pretest and Posttest Profiles of the Participants in Conventional group concerning Knowledge

For Topic A, Units and Measurements, as the whiskers show, the pre-test scores ranged from 6 to 16, with a mean score of approximately 10.93. This indicates a notable increase in performance from pre-test to post-test, with most individuals showing improvement. Additionally, the ghost line alongside the data points followed a consistent upward trend from pre-test to post-test, suggesting that most participants improved their scores across the board. On the other hand, note that the ghost line is not aligned with the main data points, indicating more variability in individual performance changes from pre-test to post-test. That is, there is a consistent improvement in scores from pretest to posttest, albeit not as much as could be achieved.

In Topic B, Kinematics: Motion along a straight line, pre-test scores ranged from 16 to 23, with a mean score of approximately 19.13. The post-test scores exhibited a slight increase, ranging from 21 to 25, with a mean score of approximately 24.13. While there was less noticeable improvement compared to Topic A, the majority of participants still demonstrated higher scores on the post-test. Moreover, the ghost line closely followed the trajectory of the main data points from pre-to post-tests, suggesting that most participants experienced similar improvements. However, the ghost line appeared to be relatively flat, suggesting gradual improvement across the board. This observation implies that, while there has been progress in understanding the topic, it may not be substantial for some students. Studies have shown that conventional teaching methods often result in moderate improvements in student performance. However, the variability in improvement across different topics suggests that certain instructional strategies may be more effective than others (Hattie, 2009).

Finally, for Topic C, Newton's Law of Motion and Application, the pre-test scores varied from 14 to 26, with a mean score of approximately 21.27. Post-test scores ranged from 20 to 26, with a mean score of approximately 23.47. This topic showed a mixed pattern of improvement, with some participants maintaining their scores while others showed slight improvement. The ghost line also appeared relatively flat, suggesting a modest rather than great improvement across the board. This means that although students are doing better, some still do not improve much.

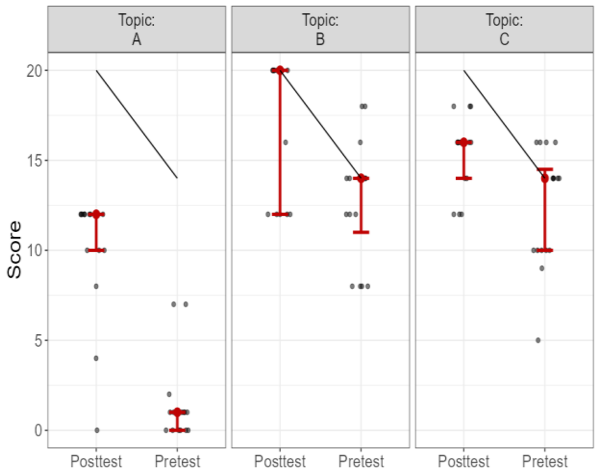

Figure 3. Pretest and Posttest Profiles of the Participants in Conventional group concerning Application of Knowledge

Looking at Topic A, as depicted by the whisker in the pretest, scores were consistent but predominantly low, clustering in the range of 1 to 2. However, the whisker is relatively higher in the post-test, which indicates a notable improvement as the scores significantly increase, primarily ranging between 10 and 12, indicating a considerable enhancement in problem-solving skills within this group. On the contrary, the data points were below the ghost line, signaling greater variability in individual performance changes from pre-test to post-test. In other words, there is a steady increase in scores from the initial test to follow-up, although there is potential for even greater improvement. As study by Mestre (2005), low scores in the problem-solving test may be influenced by the incompetence of the teaching approach; thus, enhancing students' ability to apply physics concepts to real-world scenarios should be the pillar of instruction.

For Topic B, the whisker in the pre-test was rather long and longer in the post-test. The results revealed that the pre-test scores were higher compared to Topic A, with a range from 8 to 18, suggesting a relatively better baseline performance but varied. In the posttest, there's a slight increase in mean scores across the board, with most scores ranging between 12 and 20, indicating some improvement but not as far-reaching as observed in Topic A.

Topic C displays a pattern similar to that of Topic B, with varied pre-test scores ranging between 5 and 16. Following the intervention, there was an observable increase in scores, with the majority falling between 12 and 18, showing an improvement in problem-solving abilities within this group, albeit not as pronounced as in Topic A.

5A's Instructional Module

The flexplot in Figure 6 and 7 provide insights into the pretest and posttest scores of the students' knowledge and application of knowledge, respectively, for topics A (units and measurement), B (Kinematics: Motion along a straight line), and C (Newton's Law of Motion) for the group who underwent the 5's instructional approach.

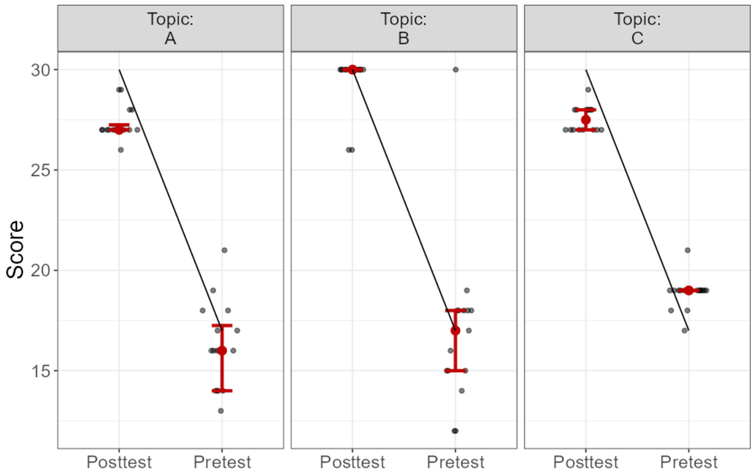

Figure 4. Pretest and Posttest Profiles of the Participants in Experimental group concerning Knowledge

For Topic A, the range of scores on the pre-test appeared to be between approximately 13 and 21, with a median score of approximately 16.2. In the post-test, the range extends from approximately 26 to 29, with a mean score of approximately 27.3. The whisker in the posttest was relatively shorter than that in the pretest, indicating less variability in scores in the posttest than in the pretest. In other words, the performance of the students in the post-test was more consistent than that in the pretest. This indicated a substantial improvement, with the mean post-test score surpassing the mean pre-test score by a significant margin. In the same way, the ghost line in Topic A shows a noticeable increase from pretest to posttest, with a relatively steep incline, suggesting a significant improvement in performance after 5A's Instructional Approach. This improvement shows relatively similar to Freeman et al., (2014). The consistent improvements observed in post-test scores suggest that this approach effectively promotes deeper understanding and retention of physics knowledge.

For Topic B, the pre-test scores ranged from around 12 to 30, with a mean score of approximately 17. In the post-test, the range remained broad, from approximately 26 to 30, with a mean score of approximately 29.5. Despite this wide range, the mean post-test score was notably higher than the mean pre-test score, indicating an overall improvement in performance. In fact, the shorter whisker in the post-test signifies consistency in the students' performance in the post-test. The ghost line for Topic B also exhibited remarkable steepness, indicating a greater improvement from pre-test to post-test. This suggests that the students experienced substantial gains after introducing 5A's Instructional Approach.

For Topic C, the range of scores on the pre-test was relatively narrow, ranging from approximately 17 to 21, with a mean score of approximately 18.9. In the post-test, the range extends from approximately 27 to 29, with a mean score of approximately 27.6. Here, the mean post-test score was only slightly higher than the mean pre-test score, suggesting a limited improvement in performance. On the other hand, as depicted by the consistent performance in both tests (indicated by the whiskers) and the steepness of the ghost line, the improvement is substantial.

Overall, the results suggest that while all topics experienced improvement from pretest to post-test, the extent of improvement varied. Topics A and B showed a wide range of scores, but also the highest post-test mean, indicating substantial progress. Conversely, Topic C demonstrates a narrower range of scores but less improvement in mean scores, suggesting a ceiling effect, in which students with initially high scores have limited room for improvement.

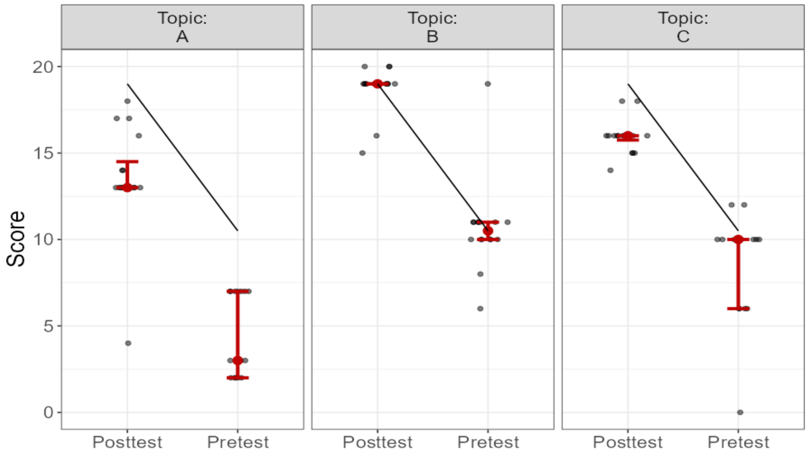

Figure 5. Pretest and Posttest Profiles of the Participants in Experimental group concerning Application of Knowledge

The flexplot analysis revealed distinct patterns in problem-solving skill improvement across the three topics (A, B, and C), following the instructional approach. For Topic A, the initial spread of pre-test scores ranged from 2 to 7, suggesting moderate variability in participants' baseline abilities. Post-test scores exhibited a wider distribution, spanning from 4 to 18, indicating a diverse range of performance levels after the instructional intervention. The mean pre-test score of approximately 4.88 sees a substantial increase to about 13.69 in the post-test, reflecting a significant enhancement in problem-solving skills within this group. Short whiskers on the plot denote a moderate spread of data, while the ghost line shows a steep ascent from pre-test to post-test, indicating consistent and remarkable improvement in problem-solving abilities.

Conversely, Topic B displays a narrower range of scores compared to Topic A, with pre-test scores ranging from 6 to 11 and post-test scores ranging from 15 to 20. Despite the narrower spread, the mean pretest score of around 10.13 rises notably to approximately 18.63 in the posttest, suggesting substantial improvement in problem-solving skills following the instructional approach. Whiskers, although slightly longer than Topic A, still indicated moderate variability within this group. Similar to Topic A, the ghost line for Topic B exhibits a steep incline, indicating a significant enhancement in problem-solving abilities from pretest to post-test.

Topic C showed the widest range of scores among the three topics, with pre-test scores varying from 0 to 12 and post-test scores ranging from 14 to 18. Despite the wider spread, the mean pre-test score of approximately 9.81 increases to around 15.94 in the post-test, indicating a significant improvement in problem-solving skills. Longer whiskers on the plot suggest greater variability in the scores within this

group. However, the ghost line demonstrates a moderate incline from pre-test to post-test, suggesting a significant but slightly less pronounced improvement compared to Topics A and B.
Overall, the flexplot analysis highlights varying degrees of improvement across different topics, with all topics showing significant progress in problem-solving abilities following the instructional approach.

Posttest Comparison

The results of the independent samples t-test, as shown in Table 1, revealed significant differences between the experimental and conventional groups in terms of both knowledge and the application of knowledge.

Table 1. Significant difference between the post-test of the experimental and conventional groups regarding their knowledge and the application of knowledge

Performance	Group	Mean (SD)	t (DF=30)	p	Remark
Knowledge	Conventional	64.6 (1.9)	-33.6	< .001	Significant
	Experimental	84.4 (1.41)			
Application of Knowledge	Conventional	42.8 (6.96)	-2.91	0.007	Significant
	Experimental	48.3 (2.93)			

* *The difference is significant when p-value is less than 0.05 significance level*

More specifically, there was a significant difference in scores between the conventional group (M = 64.6, SD = 1.9) and the experimental group (M = 84.4, SD = 1.41) in knowledge with t (30) = -33.6, and p < .001 that is less than 0.05 level of significance. The mean score of each group suggest that the experimental group had significantly higher knowledge scores than the conventional group.
In the same way, as to the application of knowledge performance, there was a significant difference in scores between the conventional group (M = 42.8, SD = 6.96) and the experimental group (M = 48.3, SD = 2.93) with t(30) = -2.91, and p = .007 which s less than 0.05 level of significance. As depicted by the mean score of both groups, it is understood that the experimental group had significantly higher scores in the application of knowledge compared to the conventional group.
These findings demonstrate that the intervention used with the experimental group was effective in improving both their knowledge and their ability to apply that knowledge, with both differences being statistically significant.

Students' Assessment on the 5a's Instructional Module

In Table 8, the descriptives on the assessment of experimental group students on the 5A's Instructional Approach Module in Physics 1 in terms of content quality are presented.

Table 2. Students' Assessment on Content Quality

Indicators	Mean (n=16)	SD	Qualitative Interpretation
1. Contents are consistent with topics/skills found in the DepEd. Learning Competencies for the subject and grade/year level it was.	4.13	0.34	Good
2. Concepts develop contribute to enrichment, reinforcement, or mastery of Physics topics.	4.19	0.40	Good

3. The module effectively covered essential Physics concepts.	4.19	0.40	Good
4. The module provided relevant and up-to-date information on Physics topics.	4.19	0.40	Good
5. Content is logically developed and organized.	4.13	0.50	Good
6. The content is free from cultural, gender, racial, or ethnic bias.	4.31	0.48	Good
7. I found the content stimulates and promotes critical thinking.	4.75	0.45	Very good
8. The sample problems and scenarios are relevant to real-life situations.	4.31	0.48	Good
9. I believe the content presented in the module has significantly contribute to my understanding of Physics.	4.19	0.66	Good
10. The content promotes positive values and support formative growth.	4.25	0.58	Good
Overall Mean	**4.26**		**Good**

The descriptive reveal an overall positive perception of content quality. The mean scores across indicators generally fall within the 'good' range, with an overall mean of 4.26, indicating a solid level of satisfaction among the students. The high mean score (4.75 for the indicator regarding the content's ability to stimulate and promote critical thinking is particularly noteworthy. This suggests that the module effectively encourages students to engage in higher-order thinking processes, which is essential for deeper understanding and problem-solving in physics (Halpern, 2014). Additionally, indicators related to the absence of bias in content and the relevance of sample problems to real-life situations received high mean scores, indicating commitment to inclusivity and practical application within the instructional materials.

Conversely, the lowest mean score was observed in the indicator regarding whether content was consistent with topics/skills found in the Learning Competencies for the subject and grade/year level and logically developed and organized with a mean of 4.13. While still falling within the 'good' range, there may be room for enhancement in ensuring that the content seamlessly aligns with the prescribed curriculum standards and progresses logically in its presentation. This finding underscores the importance of aligning instructional content with curriculum standards to ensure coherence and progression in learning (Wiggins & McTighe, 2005). By addressing these areas, educators can further optimize the instructional module to better support students' comprehension and mastery of Physics concepts, ultimately enhancing the overall effectiveness of the learning experience.

Thus, while 5A's Instructional Module in Physics demonstrates strengths in promoting critical thinking, relevance, and inclusivity, there are opportunities for further improvement to ensure that the content effectively supports students' learning and understanding of physics concepts. By addressing areas identified through descriptive analysis, educators can continue to refine and optimize instructional materials to better meet the needs and expectations of students, ultimately enhancing the overall learning experience.

In terms of instructional quality, descriptive of the experimental group students' assessment on the 5A's Instructional Approach Module Physics 1 is presented in Table 6.

Table 3. Students' Assessment on Instructional Quality

Indicators	**Mean**	**SD**	**Qualitative Interpretation**
1. The purpose of the Module is well defined.	4.88	0.34	Very good
2. The instructions provided in the module are clearly written and easy to follow.	4.31	0.79	Good
3. Learning objectives are clearly stated and measurable.	4.00	0.52	Good
4. The instructional materials facilitated my learning process effectively.	4.06	0.57	Good
5. Graphics/colors/sounds are used for appropriate instructional reason.	4.38	0.89	Good
6. Material is enjoyable, stimulating, challenging, and engaging.	4.44	0.63	Good
7. Material effectively stimulates creativity of the students.	4.50	0.73	Very good
8. I appreciated the variety of instructional methods used in the module.	4.75	0.45	Very good
9. The module's instructional design encouraged active participation and engagement.	4.06	0.44	Good
10. Instruction is integrated with the students' previous experience.	4.00	0.52	Good
Overall Mean	**4.34**		**Good**

The descriptive analysis of the experimental group students' assessment of 5A's Instructional Module Physics reveals several key insights regarding instructional quality. Overall, the module is rated as "good," with an impressive mean score of 4.34. Looking at the specific indicators, it is evident that the module performs exceptionally well in certain areas. For instance, the purpose of the module was deemed well-defined, with a mean score of 4.88, indicating a very good level. Similarly, indicators such as the stimulation of creativity (4.5) and variety of instructional methods used (4.75) also received very good ratings. These aspects suggest that the module effectively engages students and encourages their active participation.Moreover, the instructions provided within the module were generally perceived as clear and easy to follow, although not as highly rated as other indicators, still earning a respectable mean score of 4.31. Additionally, the use of graphics, colors, and sounds for instructional purposes (mean score of 4.38) positively contributed to the overall quality of the module.

However, there are areas in which the module can potentially be improved. For instance, while the learning objectives are considered clear and measurable (mean score of 4), there might be room for enhancing the integration of instruction with students' previous experiences, as they received a comparatively lower mean score of 4.Generally, the descriptive analysis indicates that 5A's Instructional Module Physics is generally effective in delivering quality instruction, with particular strengths in defining purpose, stimulating creativity, and employing diverse instructional methods (Lee & Jones, 2016). Nonetheless, there are areas for refinement, such as further clarifying instructions and enhancing integration with students' prior experiences, to potentially further elevate overall instructional quality.

Table 4. Students' Assessment on Overall Impact on Learning

Indicators	Mean	SD	Qualitative Interpretation
1. The module positively influenced my understanding of Physics concepts.	4.81	0.40	Very good
2. I felt motivated to participate in the activities provided in the module.	4.06	0.68	Good
3. I enjoyed interacting with the content and materials in the module.	4.19	0.40	Good
4. The module stimulated my curiosity and desire to learn more about Physics.	4.75	0.45	Very good
5. I found myself actively involved in discussions and group activities.	4.81	0.40	Very good
6. The module's interactive elements enhanced my learning experience.	4.31	0.60	Good
7. I feel more confident in my ability to apply Physics principles after completing the module.	4.19	0.54	Good
8. The module enhanced my critical thinking skills in relation to Physics.	4.31	0.60	Good
9. I believe the module has contributed to my overall academic growth in Physics.	4.25	0.45	Good
10. I would recommend this module to other students as a valuable learning resource.	4.38	0.50	Good
Overal Mean	**4.41**		**Good**

With an overall mean score of 4.41, the module is deemed to have a "good" influence on learning according to the qualitative interpretation. The analysis highlights several areas in which the module enhances students' understanding and engagement with physics concepts. Notably, indicators such as positive influence on understanding physics concepts (mean score of 4.81), stimulation of curiosity (mean score of 4.75), and active involvement in discussions and group activities (mean score of 4.81) received very good ratings, suggesting that the module effectively fostered deep engagement and interest among students.

Furthermore, the module was successful in promoting confidence in applying physics principles (mean score of 4.19) and enhancing critical thinking skills (mean score of 4.31), indicating that it contributed positively to students' academic growth and development. The positive perception of the module's interactive elements (mean score of 4.31) further emphasizes its ability to create an enriching learning experience.

However, there are areas in which the module could potentially improve its impact on learning. While students generally felt motivated to participate in the activities provided (mean score of 4.06), this aspect received a slightly lower rating compared to other indicators. Additionally, while the module is recommended as a valuable learning resource by students (mean score of 4.38), there may be opportunities to further enhance its appeal and effectiveness for a wider audience.

Accordingly, the descriptive analysis underscores the effectiveness of 5A's Instructional Module Physics in positively influencing students' understanding, motivation, and engagement with physics concepts (National Science Foundation, 2020). While it demonstrates strengths in various aspects of learning impact, there remains the potential for refinement to further enhance student motivation and expand the module's appeal as a valuable resource for physics education.

Table 5. Experimental Group Students' Assessment on 5A's Instructional Module in Physics

Factors	Mean	SD	Qualitative Interpretation
Content Quality	4.26	0.23	Very Good
Instructional Quality	4.34	0.41	Very Good
Overall Impact on Learning	4.41	0.27	Very Good

The findings indicated a consistently positive perception of modules across these dimensions. In terms of Content Quality, the module is rated as "very good" with a mean score of 4.26, suggesting that students perceive the content of the module to be of high quality, well-structured, and relevant to their learning needs. Similarly, the Instructional Quality of the module receives a mean score of 4.34, also classified as "very good," indicating that students find the instructional materials and methods to be effective, engaging, and conducive to learning.

Furthermore, the Overall Impact on Learning is rated as "very good" with a mean score of 4.41, highlighting the positive influence the module has on students' understanding, motivation, and academic growth in physics. This assessment underscores the module's effectiveness in achieving its intended learning outcomes and fostering meaningful learning experiences for the students.

The results suggest that 5A's Instructional Module Physics is successful in delivering high-quality content through effective instructional strategies, ultimately resulting in a positive impact on students' learning experiences and outcomes. While the module demonstrates strengths across all evaluated factors, there may still be opportunities for further refinement and improvement to enhance its effectiveness and address any areas of growth identified through student feedback and evaluation.

CONCLUSION AND RECOMMENDATIONS .

The findings of this research demonstrate that the 5A's Instructional Module in Physics significantly enhances both knowledge acquisition and the application of knowledge among students. The experimental group, which utilized this module, showed markedly higher scores in both areas compared to the conventional group. Students also provided positive feedback on the module's instructional and content quality, indicating that it effectively engaged them and supported their learning. These results suggest that the 5A's Instructional Module is a valuable educational tool that can improve students' understanding and application of Physics concepts.

The following suggestions were made in light of the findings of this study: Given the module's effectiveness in enhancing knowledge and application, it is recommended to integrate it into the standard Physics curriculum for broader use. Regularly updating the module's content to include the latest developments in Physics and ensure alignment with current educational standards is essential for maintaining its relevance and effectiveness. Continuously gathering and incorporating student feedback will help refine and enhance the module, ensuring it meets the evolving needs and preferences of learners. Providing professional development for educators on effectively implementing the 5A's Instructional Module is crucial to maximize its benefits for students. Additionally, consider developing similar instructional modules for other subjects to leverage the successful elements of the 5A's approach and improve learning outcomes across the curriculum.

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