

INTERACTIVE WORKSHEETS: INSTRUCTIONAL MATERIALS IN SCIENCE AND THEIR EFFECT ON THE ACADEMIC PERFORMANCE OF GRADE 9 LEARNERS

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ABSTRACT: In response to the 2022 PISA results where the Philippines ranked 77th out of 81 countries, indicating low performance in mathematics, reading, and science, this study aimed to assess the effectiveness of intervention strategies, specifically interactive worksheets, on Grade 9 students' science academic performance. A one-group pretest-posttest design was specifically used for the low-performing section. Employing an explanatory sequential design, quantitative data was initially collected and analyzed, followed by qualitative data. Quantitative analysis included mean, standard deviation, and paired t-test for significant differences. Regression analysis explored the impact of interactive instructional materials on academic performance. The Likert scale gauged student responses, while thematic analysis was applied to qualitative data from focus group discussions. Findings showed a significant improvement in posttest scores compared to pretest scores, a mean difference of 6.075 with a t-value of -15.660 is statistically substantial, $p=0.000<0.05$, suggesting the efficacy of interactive worksheets. However, regression analysis didn't establish a significant correlation between post-test scores and interactive worksheet scores. The correlation coefficient (r) was found to be 0.026, and the p -value was calculated as 0.437, which is greater than the conventional significance level of 0.05.

Overall, the findings suggest that interactive worksheets are effective in improving student engagement, motivation, and academic performance, although the direct correlation between worksheet scores and academic results needs further investigation. The positive reception and suggested improvements highlight their potential as a valuable educational tool.

Keywords: interactive worksheets, instructional materials, intervention strategies

1. INTRODUCTION

Science education fosters critical thinking, problem-solving skills, and an understanding of the natural world among learners. Despite its importance, students often struggle to master science subjects, which can hinder their academic performance and diminish their interest in scientific pursuits.

One of the primary challenges in science education is the complexity of the subject matter. Each field in science has its unique concepts, terminology, and methodologies. Students often struggle with abstract ideas and understanding and applying theoretical knowledge to practical situations. This cognitive demand can lead to confusion and frustration, making it difficult for learners to grasp fundamental principles and retain information.

Another significant challenge is the quality and accessibility of instructional resources. Effective science education relies on well-equipped laboratories, up-to-date textbooks, and engaging digital tools. However, many educational institutions, particularly in underfunded areas, lack the resources to provide students with a comprehensive and hands-on learning experience. This disparity in resource availability can result in unequal learning opportunities and hinder students' ability to perform experiments, visualize complex processes, and develop a deep understanding of scientific concepts.

Additionally, students' attitudes and perceptions towards science significantly impact their learning outcomes. Science subjects are often perceived as complex, causing fear and worry and making one feel unsure among learners. This negative perception can create a self-fulfilling prophecy, where students' fear of failure inhibits their willingness to engage fully with the subject matter.

Moreover, teacher expertise and pedagogical approaches also play a crucial role in shaping students' experiences in science education. Educators who lack a strong science background or are not adequately trained in innovative teaching methods may

struggle to convey complex ideas effectively. Traditional lecture-based approaches may fail to engage students, leading to passive learning and reduced motivation. In contrast, interactive and inquiry-based teaching strategies have been proven to improve student involvement and comprehension, yet their implementation remains inconsistent across educational settings.

A wide range of strategies are needed to address these challenges. This includes enhancing instructional resources [1, 2, 3], training educators in effective teaching methods [4, 5], fostering positive attitudes toward science [6, 7, 8, 9], and providing targeted support for students with language and literacy difficulties. By understanding and mitigating these obstacles, educators and policymakers can create a more equitable and effective science education system that empowers all students to achieve their full potential. Teachers must embrace innovation [10, 11] to address these challenges and make science learning more appealing. The integration of technology in science education is crucial. Integrating technology in science aligns with the guidelines outlined in DepEd Order No. 78, s. 2010, which emphasizes the integration of technology in the classroom. By leveraging technological advancements [12, 13] and innovative teaching practices [14, 15, 16, 17, 18], educators can better engage students [19, 20, 21], foster a deeper understanding of scientific concepts [22, 23, 24], and ultimately enhance academic performance [25, 26, 27]. Integration of technology, like using digital tools in the classroom, is now in trend for the 21st-century generation. Integrating technology into lessons for 21st-century learners involves utilizing digital tools and resources to enhance the educational experience, making it more interactive, engaging, and effective.

One of the utilized interactive materials in contemporary education is interactive worksheets. These digital worksheets combine traditional worksheet formats with interactive

elements to enhance student engagement and learning outcomes.

The objectives of this study are multifaceted, aiming to comprehensively evaluate the role of interactive worksheets in science education. Firstly, the study seeks to evaluate the impact of interactive worksheets on student engagement in science classes, examining how these digital tools influence students' interest and participation. Secondly, it aims to assess the effect of interactive worksheets on academic performance in

Web-based Interactive Learning Materials

The Internet and the World Wide Web have emerged as significant catalysts for change in education, leading schools to reevaluate their strategic plans and incorporate online learning into their educational frameworks. This shift has allowed for greater flexibility in learning, expanded access to academic resources, and the ability to engage in multi-modal forms of instruction. Schools are recognizing the benefits of integrating online learning and adapting their approaches to fulfil the changing requirements of students in the digital era.

Interactive learning materials refer to educational resources intentionally designed to facilitate the acquisition of specific learning objectives through engaging and interactive experiences. Several articles and studies indicate the significance of interactive learning materials. Samat et al. [28] found that implementing multimedia learning in teaching reading comprehension was effective, as the integration of various media elements supported and enhanced the comprehension process.

Despite these strengths, there is a gap in understanding how different interactive learning materials affect diverse student populations and subjects. However, teachers encounter digital inequality due to their required digital proficiency, attitudes, and institutional views regarding technology integration in education. This highlights a gap in research focused on professional development programs that can bridge these digital divides.

Further studies are needed to explore how professional development can improve teachers' technological skills and strategies to ensure equitable access to digital learning.

Martinez et al. [29] and Abdulrahman [30] emphasize the importance of multimedia technologies in creating interactive and immersive learning environments. They highlight the need for learning materials to assist the learner in focusing, given today's numerous distractions.

Paje et al. [31] found that using interactive instructional materials significantly uplifted students' learning interests and concept understanding, with positive effects on student engagement and performance outcomes. These findings highlight the significant positive impact of interactive materials on student learning outcomes and engagement. More research is needed to determine the long-term effects of these technologies on student outcomes. Additionally, understanding students' perceptions and feedback regarding the use of these tools can provide valuable insights for further improving these digital tools.

Live worksheets as an Interactive Instructional Material in Science

The integration of technology in education has significantly transformed traditional teaching methods, introducing various digital tools to enhance learning experiences. One such tool is

science, determining whether the use of these resources can lead to improved understanding and retention of scientific concepts. Thirdly, the study will analyze students' perceptions and feedback regarding the use of interactive worksheets in their learning process, gaining insights into how students view these tools and their effectiveness. Finally, the study intends to identify the strengths and limitations of using interactive worksheets in science education, providing a balanced view of their potential benefits and challenges. Liveworksheets, a platform that allows educators to create interactive and dynamic worksheets. This literature review examines the effectiveness of Liveworksheets in science education, discussing its strengths and identifying existing gaps in research.

Effectiveness of Liveworksheets in Science Education

Live worksheets provide an innovative approach to science education by offering interactive and engaging learning materials. According to Saito et al. [32], web-based investigative learning, including tools like Liveworksheets, can motivate teachers to incorporate technology into their teaching practices. Widhanto et al. [33] demonstrate that Liveworksheet websites positively impact teaching and learning experiences, empowering students to take ownership of their learning journey and improve academic performance. However, potential challenges, such as the need for reliable internet access and technological issues, should be addressed. Madden et al. [34] found that live worksheets effectively engage students, foster autonomy, and enhance the recall and application of information. Paspania et al. [35] found that interactive student worksheets, when supported by live worksheets, can enhance students' scientific literacy. Additionally, these tools can foster improvements in creativity, critical thinking, and overall engagement in science lessons while Rumadan et al. [36] provide evidence supporting its validity and practicality in university-level chemistry courses to enhance student development. The study also found that Liveworksheets promote student engagement and motivation, leading to increased levels of challenge and activity during the learning process. This finding is reinforced by Ambarwanti and Wilujeng [37], who showed that Liveworksheets effectively enhance students' learning motivation towards local wisdom and culture.

Alfira et al. [38] highlight that teaching materials assisted by Liveworksheets, enriched with a contextual approach, significantly enhance a more interactive and comprehension-focused learning environment. Maysara et al. [39] found that students using interactive student worksheets based on discovery learning and supported by Liveworksheets showed improved post-test learning outcomes, particularly in teaching complex science concepts like electrolytic cells.

Strengths of Liveworksheets in Science Education

Enhanced Student Engagement: Research by Saito et al. [40] indicates that Liveworksheets increase student motivation and engagement by offering interactive and dynamic learning experiences.

Improved Academic Performance: Studies by Rumadan et al. [41] show significant improvements in academic achievements in science subjects, particularly in junior high and university-level courses.

Interactive Learning Environment: Alfira et al. [38] found that Liveworksheets facilitate a more interactive and comprehension-focused learning environment, enriching the educational experience.

Versatility and Practicality: The tool's versatility and practicality allow educators to create customized learning materials tailored to diverse educational needs and contexts Maysara et al. [39].

Limitations and Gaps in Existing Research

1. Student Perceptions and Feedback: While numerous studies highlight the effectiveness of Liveworksheets, limited research explores students' perceptions and feedback regarding their use. Understanding student experiences is crucial for further improving these digital tools and ensuring they meet learners' needs.

2. Long-term Impact on Learning Outcomes: Most studies focus on short-term improvements in academic performance and engagement. Further research is needed to explore the long-term effects of using Liveworksheets on student outcomes and knowledge retention.

3. Diverse Student Populations: There is a lack of research on the impact of Liveworksheets on diverse student populations, including those with different learning styles, backgrounds, and abilities. Investigating the tool's effectiveness across varied educational contexts can provide more comprehensive insights.

4. Professional Development for Educators: While the potential of Liveworksheets is well-documented, there is limited research on effective professional development programs to train teachers to utilize these tools effectively. Exploring how to best support educators in integrating Liveworksheets into their teaching practices is essential.

5. Focus on Specific Science Disciplines: Existing research generally provides an overview of Live worksheets in science education. More detailed studies examining the tool's impact on specific science disciplines, such as biology, chemistry, physics, and environmental science, are needed to tailor instructional materials to the unique needs of each field.

Although improvements in learning outcomes are noted, there is less focus on how these tools affect student engagement and motivation. Research exploring the relationship between interactive tools and student attitudes towards learning would be valuable. This is where the researcher needs to fill in the research gap. Apart from enhancing academic performance, student feedback and perceptions are essential for creating effective, engaging, and responsive educational environments. They offer critical insights that quantitative data alone cannot provide, ensuring that educational research and practice are aligned with the needs and experiences of students.

Students' Performance in Science

Scientific literacy is crucial for students to address global challenges effectively. A person's scientific literacy is vital when comprehending scientific concepts and utilizing that knowledge to solve diverse environmental issues. Based on the 2022 PISA results, the Philippines ranked 77th out of 81 countries conducted by the OECD [41]. This signifies that the Philippines' mathematics, reading, and science performance remained low. It is significantly below the average observed in OECD countries, highlighting the notable performance

disparity between the Philippines and the other 80 nations participating in the assessment.

The PISA report stated that long-term absenteeism among students in the Philippines is one of the factors contributing to the country's poor performance in international assessments. Furthermore, PISA results showed that almost no Filipino students were top performers in science. This means they were proficient at level 5 or 6, representing only 7% of the OECD average. Regarding satisfaction with life, PISA reported that 17% of students in the Philippines were unsatisfied with their lives, rating their satisfaction with life between 0-4 on a scale from 0 to 10. This highlights a gap in identifying effective interventions to improve science performance among Filipino students.

Numerous studies show the different factors affecting the low performance of students in their academic areas. Calleja et al. [42]. revealed that the following factors influenced the poor performance of students in science literacy: metacognitive reading strategies, classroom and school experiences, students' affect and motivation, family experiences, and learning resources at home. These factors highlight the multifaceted nature of the problem, indicating that both internal (student-related) and external (environment-related) influences play a significant role.

Strengths of Existing Research

Comprehensive Identification of Factors: Existing research effectively identifies a broad range of factors that influence science performance, from personal motivation to environmental resources [42, 43]

Correlation with Behavioral Patterns.

Impact of Learning Strategies: Research by Albarico et al. [44] emphasizes the positive influence of active learning strategies and appropriate learning attitudes on science performance.

Limitations and Gaps in Existing Research

1. Lack of Effective Interventions: While many studies identify factors contributing to poor performance, there is a notable gap in research focused on developing and testing effective interventions to address these issues. For instance, Gouveia et al. [45], there is a strong need to develop mixed-method and longitudinal designs that will further our knowledge about what type of measure works, while considering a situated and contextual perspective, instead of a one-size-fits-all approach

2. Focus on Short-Term Outcomes: Research by Bibon [46] suggests that professional development for teachers is crucial, yet there is insufficient exploration of the long-term impact of such programs on student outcomes and teacher practices.

3. Limited Contextual Adaptation: Many studies do not account for the diverse contexts in which students learn, particularly in underfunded or resource-limited settings. This limits the generalizability of findings and their applicability to different educational environments.

4. Inconsistent Measurement of Engagement: There is a need for more consistent and comprehensive measures of student engagement and its direct impact on academic performance.

Addressing the Identified Problems

Interactive worksheets are intended to address these challenges by:

1. **Enhancing Engagement and Motivation:** By incorporating multimedia elements such as videos, animations, and interactive simulations, these worksheets make learning more engaging and visually appealing, helping capture students' attention and maintain their interest in the subject matter.
2. **Providing Instant Feedback:** Interactive worksheets offer immediate feedback on students' responses, allowing them to understand their mistakes and correct them in real-time. This timely feedback is crucial for reinforcing learning and preventing the persistence of misconceptions.
3. **Facilitating Hands-on Learning:** Through drag-and-drop activities, simulations, and virtual experiments, interactive worksheets offer hands-on learning experiences that enhance conceptual understanding and make abstract concepts more concrete.
4. **Supporting Personalized Learning:** These digital tools can be tailored to meet individual learning needs and paces, ensuring that all students, regardless of their proficiency levels, can benefit from the worksheets.
5. **Improving Resource Accessibility:** Interactive worksheets do not require extensive physical resources, making them an ideal solution for schools with limited access to laboratory equipment and up-to-date textbooks, thereby levelling the playing field.
6. **Aiding Teacher Support:** For educators, interactive worksheets offer an efficient way to design and deliver lessons, track student progress, and identify areas where students need additional support. They also provide a platform for teachers to experiment with innovative teaching methods without extensive training.

Objectives of the Study

This study is designed to assess how interactive worksheets, as instructional materials in science, impact the academic performance of Grade 9 students. It aims to:

1. Determine if there is a significant difference between the mean scores of the learners' pretest and posttest.
2. Evaluate the significant difference in learners' pretest and posttest mean scores after utilizing interactive worksheets.
3. Assess the effect of interactive worksheets on learners' academic performance.
4. Investigate learners' perceptions regarding the effectiveness, engagement, user-friendliness, and overall utility of interactive worksheets as a supplementary learning tool.
5. Explore the learning experiences of the learners in utilizing the interactive worksheets.

2. MATERIALS AND METHODOLOGY

Research Design

The study employed an explanatory sequential design, commencing with the collection and analysis of quantitative data, followed by the collection and analysis of qualitative data. The aim is to elucidate or expand upon quantitative results through qualitative insights. The methodology involves the initial collection of quantitative data to analyze patterns and correlations between variables, evaluating the impact of interactive worksheets as educational tools in science on the academic achievement of Grade 9 students. Subsequently, qualitative data is collected to offer a deeper comprehension or explanation of these patterns.

A one-group pretest-posttest design was specifically used for the identified low-performing section. Despite not having a control group, the pretest scores can serve as a baseline measure for comparison. Due to the design's practicality and feasibility, researchers often opt for a one-group pretest-posttest design due to its practicality, especially in real-world settings where it may be challenging to recruit and manage multiple groups of participants. This design simplifies data collection and reduces logistical complexities [47]. Research by Rusnayati et al. [48] also utilized a one-group pretest-posttest design to investigate the effects of a flipped classroom learning model. This design facilitated the comparison of learning outcomes before and after the intervention within a single group of students. Patmanthara et al. [49] explored the effectiveness of using Ladder Snake Games to enhance learning outcomes in computer networking. They employed a pre-experimental one-group pretest-posttest design, which involves observing a single group both before and after the intervention without the use of a control group. This design was selected for its suitability in demonstrating the differences in learning outcomes attributed to the intervention. Their study contributes to the body of research by highlighting the potential benefits of gamification in educational settings, particularly in the field of computer networking. By comparing participants' pretest scores to their posttest scores, researchers can assess changes over time within the same group. Any improvements or declines observed can be attributed to the intervention or treatment.

The Self-assessment Tool used a Likert scale to gauge students' responses. In this format, respondents expressed their level of agreement or disagreement with various statements on a scale. Regression analysis was used to determine if interactive worksheets affect students' academic performance. An interview guide question was used in the focus group discussion. The responses to the interview questions served as the qualitative data. A thematic analysis was used to analyze the data.

Population and Sampling

The researcher used purposive sampling to choose participants for the study. This non-random sampling method involves selecting individuals based on specific criteria pertinent to the research objectives. In this instance, the researcher focused on selecting 40 estimated participants from the Grade 9 class sections, specifically targeting the low-performing section. The estimated sample size of the low-performing section is 40. If the initially identified low-performing sections have insufficient students to achieve the desired sample size, alternative selection strategies like expanding inclusion criteria will be used where the researcher can broaden the inclusion criteria to include additional students who may not be part of the initially identified low-performing sections but still meet certain criteria indicative of academic challenges. This could include students with lower grades, standardized test scores, or teacher recommendations.

Sample Size

The sample for this study has been selected from Grade 9 students, identified as low-performing based on their overall average academic performance. A thorough evaluation of their grades across various subjects and assessments has revealed that their overall performance falls below the expected standards for their grade level.

The identification of low performance is based on objective assessment criteria, including examination scores, classroom participation, and teacher evaluations, as provided and certified by the Grade 9 curriculum chairman. This selection provides a representative sample for studying the impact of educational interventions on low-performing students.

Given this assessment, it is anticipated that the findings will inform the implementation of appropriate interventions and support measures to address the academic challenges faced by these students and promote their academic success.

Justification for Purposive Sampling

Purposive sampling is appropriate for this study because it allows the researcher to focus on the specific subgroup of Grade 9 students that aligns with the research objectives. By targeting the low-performing section, the researcher can gain insights into the experiences, challenges, and needs of students who may require additional support or interventions to improve their academic performance.

Respondents of the Study

This research was conducted at Victorino Mapa High School in San Miguel, Manila, a public school in Manila City within the National Capital Region. The study focused on students from the low-performing section, identified through an analysis of the average grades of each class and validated by data obtained from the school's Grade 9 Curriculum Chairman.

Research Instrument

The researcher developed interactive worksheets using Liveworksheets, an online platform. These materials encompassed topics derived from the Essential Learning Competency by the science curriculum guide of the Department of Education. Worksheets were meticulously chosen from the module and restructured into interactive content, leveraging their existing quality assurance and validation. Permission to use these materials was obtained from the *DepEd Bureau of Learning Resources*. Since some modifications were necessary during the conversion process, instructional leaders evaluated and validated the materials to ensure their effectiveness.

Liveworksheets is a user-friendly platform designed for crafting interactive exercises integrating music, images, video, animation, and more. It enables the conversion of conventional printable worksheets and class materials (in formats like doc, pdf, jpg) into interactive online exercises with automated grading, making them dynamic and interactive. With its variety of question types, Liveworksheets offers an engaging and game-like learning experience, breaking away from monotony. The following delineates the procedures for registering an account on Liveworksheets and converting printed worksheets into interactive ones.

Table 1. Most Essential learning Competencies/Activities covered for interactive material.

4 th Quarter Modules (Physics)	MELC (Most Essential Learning Competencies)	Objective Code	Duration	Pages to be converted into interactive material
-Module 1: The Horizontal and Vertical Motions of a Projectile -Module 2: Height and Range of a Projectile	-Describe the horizontal and vertical motions of a projectile.	S9FE-IVa-34	Week 1	6-9, 11-12-13-17
	-Investigate the relationship between the angle of release and the height and range of the projectile	S9FE-IVa-35		11-13,
-Module 3: Impulse and Momentum -Module 4: Conservation of Linear Momentum	-Relate impulse and momentum to the collision of objects	S9FE-IVb-36	Week 2	2,4,7-9,
	-Infer that the total momentum before and after collision is equal	S9FE-IVb-37		2-15
-Module 5: Conservation of Mechanical Energy (Activities) -Module 6: Law of Conservation of Mechanical Energy Module 7: Heat and Work	-Perform activities to demonstrate the conservation of mechanical energy.	S9FE-IVd-40	Week 3	4, 7-10
	-Infer that the total mechanical energy during any process remains the same	S9FE-IVe-41		4-5, 7-14
	- Construct a model to demonstrate that heat can do work.	S9FE-IVe-42		5, 8-15
Module 8.1: Electricity & Magnetism Module 8.2: Heat, Work, and Efficiency Module 9: Geothermal Energy	-Explain how electrical energy is generated, transmitted, and distributed	S9FE-IVh-j-46	Week 4	3-4, 9-15, 1821
	-Infer that heat transfer can be used to do work and how work involves the release of heat	S9FE-IVf-43		10-14
	- Explain how heat transfer and energy transformation make heat engines like geothermal plants work.	S9FE-IVh-j-46		10-13, 17

Live worksheets Registration

1. Open the www.liveworksheets.com.

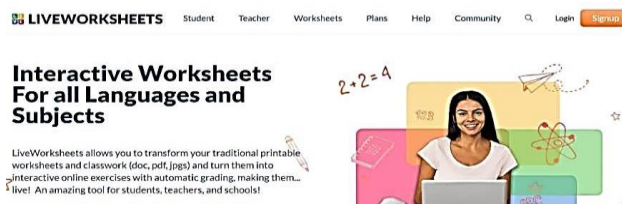


Figure 1. Live worksheets Platform

2. Create a teacher account.



Figure 2. Live worksheets Account Set Up

2. The registration form should be filled out with the name, email, country, and other details. After clicking the register button, an activation email will be sent.
3. To activate the account, click the link sent in the activation email.

In Liveworksheets, a variety of question styles can be implemented, utilizing elements such as text fields, single choice options, checkboxes, selection features, word search, speech input, drag and drop functionality, matching exercises, audio (MP3) integration, value enhancement, open-ended responses, plain text presentation, listening exercises, hyperlinks, PowerPoint integration, and YouTube embedding. The researcher will utilize the following elements in creating the interactive worksheets: 1. Drag and Drop Activities. Live worksheets enables the creation of drag and drop activities, where students can manipulate objects or text elements by dragging them to different locations on the worksheet. This interactive feature is particularly useful for exercises that involve categorization, sequencing, or spatial relationships. 2. Fill-in-the-Blank Exercises. Live worksheets enable the creation of fill-in-the-blank exercises where students are prompted to complete sentences, equations, or diagrams by typing their responses directly into designated spaces on the worksheet. This interactive format allows for personalized and adaptive learning experiences. 3. Matching Games. Live worksheets support the creation of matching games where students are presented with pairs of items that they must match correctly. This interactive activity helps reinforce vocabulary, concepts, or relationships by requiring students to make connections between related terms or concepts. 4. Interactive Diagrams. Live worksheets enables the creation of interactive diagrams or visual

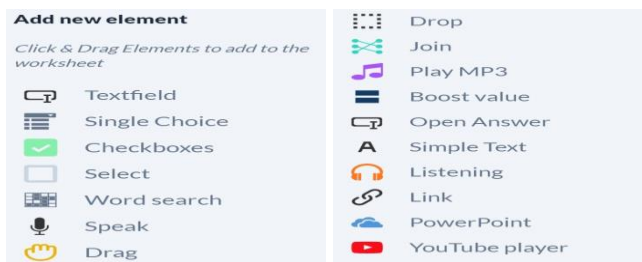


Figure 3. Live worksheets Elements

representations that students can interact with directly on the worksheet. This may include labelling parts of a diagram, annotating images, or exploring interactive graphs and charts to deepen understanding of complex concepts. 5. Simulations. While Liveworksheets primarily focuses on interactive exercises and activities, Liveworksheets enables to embed of external links to simulations or virtual labs within the worksheet. These simulations allow students to explore scientific concepts through hands-on experimentation and observation, enhancing their understanding of real-world phenomena. 6. Audio and Video Integration. Live worksheets support the integration of audio and video elements into the worksheet, allowing the researcher to incorporate multimedia resources such as instructional videos, audio recordings, or interactive tutorials to complement written content and engage students across different learning modalities. By incorporating these interactive elements into Liveworksheets, educators can create dynamic and engaging learning experiences that promote active participation, critical thinking, and a deeper understanding of course content. These interactive materials

can enhance traditional instructional methods and cater to diverse learning styles and preferences among students.

In Liveworksheets, students appreciate the diverse range of questions available, as solving them simulates participation in an educational game. When formulating questions on Liveworksheets, the integration of language commands or scripts is imperative. These commands play a critical role in ensuring the proper functioning of the questions during processing.

Developing Interactive Worksheets

In generating new worksheets on the Liveworksheets platform, the researcher used Canva for design and saved them in JPEG format. Subsequently, the completed worksheets were uploaded to the Liveworksheets platform as either JPG or PNG files. Following the upload, the editing phase commences, which entails the inclusion of commands in the form of scripts. These scripts delineate the correct answer key by establishing a box and inputting the appropriate answer script. Embedding links for video presentations and Phet simulations. Elements used were interactive like drag and drop, fill in the blanks or text field, connecting ideas or join, audio, quizzes, single choice, and multiple choice using clickable elements,

There are two options available for saving the worksheets. The first option involves saving and sharing them publicly, while the second option entails saving them privately, restricting access only to students and selected individuals designated by the researchers. The researcher opted to save the developed worksheets privately for the study. The Liveworksheets platform facilitates the seamless distribution of worksheets to students by providing copyable links. Once students complete the interactive worksheets, their scores are automatically calculated and displayed on the worksheets. Students can review which topics they answered correctly and which parts they missed. The teacher also receives a copy on the Liveworksheets account. There are a total of eight worksheets the researcher has developed with different numbers of items. Each worksheet represents the Most Essential Learning Competencies (MELC) that the learners needed to acquire for a certain topic in the 4th Quarter of the S.Y 2024.

Validation of Interactive Worksheets

The researcher conducted a rigorous validation process to ensure the quality and effectiveness of the interactive worksheets. Four validators were selected, including two external experts and two internal experts: a Master Teacher I and the Head Teacher VI, who also serves as the Learning Resource Coordinator. The researcher provided the validators with links to the developed worksheets for them to experience firsthand. Brief instructions were given on using the Evaluation Rating Sheet for Non-Print Materials, adapted from the DepED 2008 Regional Handbook. Each validator independently reviewed the worksheets, focusing on the criteria specified in the Evaluation Rating Sheet for Non-Print Materials. Revisions were made based on the comprehensive feedback, and the updated worksheets were submitted for a final review by the validators. This meticulous process ensured that the interactive worksheets were thoroughly evaluated and refined to maximize their impact on student engagement and academic performance.

Pretest and Posttest

Identifying topics for the pretest and posttest questions was based on data sources, specifically essential learning competencies outlined in the DepEd science curriculum guide. A specification table was employed to determine the allocation of questions for each learning competency across different cognitive levels of Bloom's Taxonomy. The pretest and posttest, each comprising 30 multiple-choice questions, were developed by the researcher to align with the most crucial learning competencies in Science 9 for the fourth quarter, encompassing eight physics modules. To ensure the quality of the assessment, the 30-item multiple-choice test underwent validation and evaluation by the Science Master Teacher, Head Teacher, and two external validators. Before the experiment, pilot testing was conducted, and subsequent item analysis was performed to assess the test items' quality. Furthermore, the researcher administered a self-assessment tool to elicit student feedback on the developed interactive materials.

Data Gathering Procedure

The data-gathering procedure followed strict ethical standards. Permission was obtained from the principal, and parents approved a Parental Consent Form with a Data Privacy Statement. During data collection, participants received an informed consent letter and were briefed on the privacy policy. The timeline for data collection is detailed in the table below.

Table 2. Timeline of Data Gathering

Activity	Timeline	Description
-Informed Consent and Data Privacy Policy -Pretest Administration	2 nd Week of April Date: April 17-18, 2024	<ul style="list-style-type: none"> • Provided Informed Consent Letter to Parents along with the Data Privacy Policy and Agreement Form. • Provided and discussed Informed Consent to participants and the Data Privacy Policy and Agreement Form • Pretest Administration
Intervention Period	3 rd Week of April – 2 nd Week of May Date: April 19-May 19, 2024	<ul style="list-style-type: none"> • 4-Week period of intervention implementation using Interactive Worksheets
-Posttest Administration -Self-Assessment Tool and Focus Group Discussion	3 rd Week of May Date: May 20, 2024	<ul style="list-style-type: none"> • Posttest Administration • Self-Assessment Tool Administration • Focus Group Discussion

The data-gathering process followed a structured timeline designed to adhere to ethical guidelines and research protocols. Initially, the researcher provided an Informed Consent Letter to Parents along with the Data Privacy Policy and Agreement Form, ensuring that parents understood the study's purpose and procedures, and how their child's data would be handled. Participants were then informed about the study and provided their consent before the pretest was administered in the second week of April to establish baseline data.

Following the pretest, the intervention was implemented over 4 weeks from the third week of April to the second week of May, using Interactive Worksheets. Throughout this period, specific activities and strategies were implemented according to the study design to assess their impact on the participants.

In the third week of May, the posttest was administered to assess the effects of the intervention. Simultaneously,

participants completed a self-assessment tool to gather qualitative data, and a focus group discussion was conducted to gather insights and feedback about their experiences with the intervention.

This systematic approach ensured that all data were gathered effectively, respecting participant privacy and ethical considerations. The timeline allowed for a comprehensive evaluation of the intervention's effectiveness and provided valuable insights into the participants' experiences and perceptions.

Data Analysis

Data obtained from diverse sources underwent processing and analysis using appropriate computer software. Both Excel and SPSS Version 27 were employed to assess descriptive quantitative statistics to evaluate the impact of interactive instructional science materials on the academic performance of Grade 9 students.

For quantitative data, a t-test was conducted to determine significant differences, and regression analysis was used to assess the impact of the interactive instructional materials on students' academic performance. The Likert scale was employed to measure students' responses in the Self-assessment Tool.

For qualitative data, the researcher collected all responses from the interview guide questions during focus group discussions. Following Braun and Clarke's (2006) method, thematic analysis was used to extract themes from the participants' responses. This technique involves identifying, analyzing, and reporting patterns or themes within the data. It was employed to explore participants' experiences with the Interactive Worksheets by identifying, analyzing, and presenting themes from the collected data.

Ethical Considerations

The researcher meticulously considered various ethical factors during the study to uphold ethical standards, actively mitigating bias and ensuring equity. This encompassed treating all participants and data sources with impartiality and respect. The researcher considered several pivotal considerations.

Initially, the researcher ensured that all study participants were thoroughly briefed on the purpose, procedures, potential risks, and their right to voluntary participation, including the option to withdraw at any stage, and respected their autonomy by obtaining their consent.

Purpose. The researcher communicated to the respondents that the study aims to assess how interactive instructional materials impact the academic performance of Grade 9 students in their science studies. The respondents were also informed about the importance of having ethical considerations during the process to promote integrity, respect, and responsibility in all aspects of researcher and participant interactions, safeguarding the rights, well-being, and dignity of every individual involved. The data collected were used for research purposes only, including the conducting of research studies, analysis, generating research reports, publications, and presentations and contributing to the advancement of knowledge in the respective field of study.

Procedures. The researcher ensured the respondents that their participation involved the following: completion of the

informed consent form, answering the pretest, answering the interactive instructional materials, answering the posttest, and answering the self-assessment tool.

Potential Benefits and Risks. The researcher informed the respondents of the potential benefits and risks associated with participating in the study. The potential benefits include the improvement in academic performance in science of the grade 9 learners and the potential risks include limited accessibility if the learners may not have access to technology or devices required for interactive worksheets, leading to potential disparities in learning opportunities and technical glitches or malfunctions in the interactive platform may disrupt the learning process. The researcher has alternative means to let respondents continue participating in the study, such as extra devices to lend and shareable data.

Voluntary Participation. The researcher ensured that the respondents acknowledged that their participation in the study was entirely voluntary and that they had the right to refuse to answer any question or withdraw from the study at any point without penalty and would not affect their grade in the subject.

Anonymity. All participants involved in this study remained anonymous to ensure confidentiality and protect their privacy. Any information collected in the research process was treated with the utmost discretion and was used only for this study. Personal identifiers such as names, addresses, and contact information were removed and replaced with pseudonyms to prevent the identification of individual participants. Additionally, the data and findings presented in reports and publications were aggregated to maintain anonymity. Participants can rest assured that their identities will not be disclosed in any form of dissemination arising from this study.

Secondly, to uphold the privacy and confidentiality of all participants, the researcher implemented anonymous data collection methods, securely stored the data, and confirmed that no personally identifiable information was disclosed without explicit consent.

Data Privacy and Agreement. The researcher ensured that the respondents and their parents or guardians understood the Data Privacy Statement and Agreement before affixing their signatories.

Confidentiality. The researcher ensured the respondents that all information collected in the study would be kept confidential, that any data shared will be anonymized and stored securely. The researcher will inform the respondents that only the researcher and the research adviser will have access to the data.

Use of Data. The researcher ensured that the respondents understood that the data collected from their participation would be used for research purposes only. It may be analyzed, published, or presented, but their identity will remain confidential. The gathered data will be securely stored in a safety cabinet accessible only to the researcher.

Retention of Data. After the analysis and publication of the research, all physical copies of data will be shredded, and all

electronic copies will be permanently deleted. The online activities have password protection, and it is set to private use only. Only the researcher has access to view the scores of the activities and it will only be stored in the duration of the research process. Once done, all data will be deleted.

Thirdly, the researcher focused on minimizing any potential physical, psychological, or emotional harm to participants as a primary concern. Throughout the research process, the well-being of participants was given utmost priority. If the participants experience discomfort, they can immediately approach the researcher. The contact information of the researcher was provided in the Data Privacy Statement, in Parental Consent Form, and the Informed Consent Form for the respondents.

Parental Consent Form. The researcher provided a Parental Consent Form to help safeguard the rights and well-being of minors who may not have the capacity to fully understand the research and its implications. Parents or legal guardians are in a better position to evaluate the risks and benefits of their child's participation and make informed decisions on their behalf.

Informed Consent Form. The researcher provided an Informed Consent Form to allow respondents to make voluntary and informed decisions about whether to participate in the research study based on a clear understanding of what it entails, ensuring that they are fully aware of the purpose, procedures, risks, and benefits of the study before agreeing to participate. This empowers respondents to make choices that are in their best interest and minimizes the potential for coercion or exploitation.

Focus Group Discussion Informed Consent. The researcher provided participants with detailed information about the study, ensured they understood what participation entails, and obtained their voluntary agreement to take part.

Fourthly, to uphold rigorous standards of research integrity, the researcher maintained transparency, honesty, and precision throughout the processes of data collection, analysis, and reporting. The researcher strictly avoided any form of data manipulation or fabrication. Ethical considerations are paramount in all stages of research, including pilot testing, where researchers ensure that the study is conducted with integrity, respect for participants' rights, and adherence to ethical guidelines. Pilot testing involves assessing the reliability and validity of research instruments, such as surveys or questionnaires and pretest and posttest before full-scale implementation. The result of reliability for the instrument during pilot testing is 0.709 Cronbach's Alpha. The instrument is reliable with 30 items from the original 40 questions. The Self-assessment tool or the Feedback Questionnaire is reliable at 0.785 Cronbach's Alpha. All instruments were validated by the experts.

Lastly, the researcher obtained ethical approval from research ethics committees or institutional review boards, ensuring the study adhered to ethical standards and guidelines. It is essential to establish solid procedures and measures for implementation.

3. RESULTS

Table 3. Pretest and Posttest Mean Scores in Science of the Low-performing Class of Grade 9 Learners

Test Type	Mean	Std. Deviation
Pretest	12.18	3.218
Posttest	18.25	3.418

The Pretest score of 12.18 with a standard deviation of 3.218 indicates a baseline level of understanding among the students. However, this initial assessment also reveals significant room for improvement, suggesting a gap in comprehension and retention of scientific concepts. The post-test score of 18.25, coupled with a standard deviation of 3.418, showcases a noteworthy enhancement in academic performance.

Table 4. Pretest and Posttest Mean Scores in Science of the Low-performing Class of Grade 9 Learners After Utilizing Interactive Worksheets

Test Type	Mean	Std. deviation	t-value	Sig. value	Interpretation	Decision to Ho
Pretest	12.18	3.218	-15.660	0.000	Significant	Reject
Posttest	18.25	3.418				

$\alpha = 0.05$ Level of Significance

The table above shows the paired samples t-test (correlated means) results of the pretest and post-test. It can be gleaned from the table that there is a significant difference between these tests. A mean difference of 6.075 with a t-value of -15.660 is statistically substantial, $p=0.000 < 0.05$. The significant improvement observed in the posttest scores following the intervention of using interactive worksheets echoes the conclusions drawn from prior literature. Numerous studies have highlighted the efficacy of interactive learning strategies, such as interactive worksheets, in enhancing students' academic performance and engagement across various subjects, including science. Research by Widiantho et al. [33] highlights the advantages offered by Liveworksheets websites, such as tailored learning, prompt feedback, heightened involvement, monitoring progress, adaptability, and ease of access. The findings presented affirm the constructive influence of Liveworksheets platforms on educational practices, empowering students to assume control over their learning process and enhance their scholastic achievements.

Table 5. The Effect of Interactive Worksheets in the Academic Performance of the Low-performing Class of Grade 9 in Science

Variables	Pearson r	Sig. value	Interpretation	Decision to Ho
Posttest*Interactive Worksheets scores	0.026	0.437	Not Significant	Accept

$\alpha = 0.05$ Level of Significance

Table 6. The model summary on regression analysis of posttest result and the total score of on interactive worksheets.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.026 ^a	.001	-.026	3.461	.001	.025	1	38	.874

Predictors: (Constant), IW_TOTAL

From the model summary, it can be noted that the interactive worksheets do not influence the student's academic performance with a coefficient of determination, of $R^2=0.001$. In this regression analysis, a correlation matrix was conducted to examine the relationship between two variables: posttest scores (representing academic performance) and the total score on interactive worksheets. The correlation coefficient (r) was found to be 0.026, and the p-value was calculated as 0.437, which is greater than the conventional significance level of 0.05. These results indicate that there is no significant relationship between the variables. Therefore, the null hypothesis, which posits no significant correlation between post-test scores and total scores on interactive worksheets, is accepted.

The findings from the regression analysis, which indicate no significant relationship between posttest scores and total scores on interactive worksheets, might seem contradictory to the positive outcomes observed by Tarigan et al. [50]. and Domasig [51] regarding the effectiveness of interactive learning materials. However, it's essential to recognize that different methodologies and contexts could lead to varying results. Tarigan et al. [48] demonstrated that students using interactive digital learning modules experienced enhanced learning outcomes and retention compared to those in other settings. This aligns with the potential benefits of interactive learning highlighted in the regression analysis. Similarly, Domasig [51] found that utilizing interactive learning materials during synchronous classes improved student performance, further supporting the notion that interactive teaching methods can positively impact learning outcomes. Widiantho et al. [33] complement these findings by presenting data indicating that Liveworksheets positively impact teaching and learning experiences.

While this supports the general trend observed in the literature, they also caution against potential challenges such as the need for internet access and technological issues. This highlights the importance of considering practical constraints when implementing interactive learning tools.

The mean, central tendency, and variability of data from Survey Feedback Questionnaire.

1. Overall quality of the interactive instructional materials:
The mean rating for the overall quality is 3.87, with a standard deviation of 0.335. This indicates that, on average, participants rated the quality of the materials quite high. The central tendency, represented by the mean, suggests that most respondents were very satisfied (rated 4 on the scale). The variance of 0.112 indicates that the ratings for quality were relatively consistent, with not much variability among respondents.

2. Overall features of the interactive instructional materials:
The mean rating for the overall features is 3.78, with a standard deviation of 0.423. Like the quality, the mean

indicates a generally positive rating for the features of the materials. Most respondents also rated the features as very satisfied (4 on the scale). The variance of 0.179 suggests some variability in ratings compared to the quality, but overall, the ratings were relatively consistent.

3. *User-friendliness of interactive materials:* The mean rating for user-friendliness is 3.70, with a standard deviation of 0.516. This indicates that, on average, participants found the materials to be user-friendly, though slightly less so compared to quality and features. Most respondents still rated the user-friendliness as very user-friendly (4 on the scale). The variance of 0.267 suggests some variability in ratings, indicating that opinions were more diverse compared to quality and features.

4. *Effectiveness of interactive materials in understanding and retaining content:* The mean rating for effectiveness in understanding and retaining content is 3.60, with a standard deviation of 0.632. This suggests that, on average, participants found the materials to be effective, though the rating is slightly lower compared to other aspects. Most respondents still rated the effectiveness as very effective (4 on the scale). The variance of 0.400 indicates some variability in ratings, with opinions more spread out compared to previous aspects.

5. *Effectiveness of interactive materials as a teaching resource:* The mean rating for effectiveness as a teaching resource is 3.47, with a standard deviation of 0.640. This indicates that, on average, participants found the materials somewhat effective as a teaching resource, though the rating is lower compared to other aspects. Most respondents still rated the effectiveness as very effective (4 on the scale). The variance of 0.410 suggests a relatively higher level of variability in ratings compared to other aspects.

6. *Overall satisfaction with using interactive materials in learning:* The mean rating for overall satisfaction is 3.65, with a standard deviation of 0.483. This suggests that, on average, participants were quite satisfied with the interactive materials. Most respondents rated their satisfaction as very satisfied (4 on the scale). The variance of 0.233 indicates some variability in ratings, with opinions moderately spread out.

Overall, the data shows generally positive ratings for the interactive instructional materials across various aspects. While there is some variability in ratings, particularly in effectiveness-related aspects, the central tendency suggests that most respondents were quite satisfied with the materials.

The frequency and percentage of responses for technical difficulties encountered and for improvement needed.

1. Encountered any technical issues or challenges while using interactive instructional materials:

No (0-NO): 29 respondents (72.5%) reported not encountering any technical issues or challenges while using the materials.

Yes (1-YES): 11 respondents (27.5%) reported encountering technical issues or challenges.

Cumulatively, 72.5% of respondents did not face any technical issues, while 27.5% did.

2. Noticed any improvement in your learning outcomes since using interactive instructional materials:

No (0-NO): 3 respondents (7.5%) did not notice any improvement in their learning outcomes since using the materials.

Yes (1-YES): 37 respondents (92.5%) noticed improvement in their learning outcomes.

Cumulatively, 92.5% of respondents noticed improvement, while 7.5% did not.

These interpretations provide insights into respondents' experiences with technical issues and perceived improvements in learning outcomes when using interactive instructional materials. Most respondents noticed improvements in learning outcomes, while a smaller percentage encountered technical issues.

The evaluation of the interactive instructional materials revealed generally high satisfaction levels across various aspects. Users reported very high satisfaction with the overall quality and features of the materials, as well as their user-friendliness. Technical issues were minimal, with nearly no reported challenges. Furthermore, the materials were perceived as highly effective both in understanding and retaining content and as teaching resources. Overall satisfaction with the use of interactive materials in learning was notably positive. Additionally, users noticed a clear improvement in learning outcomes. These findings suggest that the interactive instructional materials were well-received and effective in enhancing the learning experience, with minimal technical difficulties reported.

Learning experiences of the learners in utilizing the interactive worksheets.

Results from Focused Group Discussion.

1. Exploring the Impact of Interactive Worksheets on Understanding and Engagement in Science Lessons

Detailed Analysis

Understanding Concepts (UC) appears multiple times, highlighting its central role in both understanding and overall experience. This consistency indicates its importance across different aspects of the learning process. Video Lesson (VL) is prevalent in various themes, particularly in Multimedia and Technology Integration and Engagement and Motivation, showing the critical role of multimedia in modern learning environments. Preparation (PR) and Ease of Access (EA) are key components of Preparation and Accessibility, stressing the need for accessible and well-prepared learning materials. Engaging Features (EF) and Interactive Games (IG) significantly contribute to Engagement and Motivation, demonstrating the importance of interactive elements in keeping learners motivated. Great Experience (GE) and Overall Assessment (OA) are central to Overall Experience and Satisfaction, indicating that the learners' perceptions and satisfaction are crucial for evaluating the learning experience.

The result implies that the learners found the experience of using interactive worksheets in science lessons to be highly beneficial. The worksheets helped them understand difficult concepts by providing interactive features such as video lessons and interactive games. These elements not only enhanced engagement and motivation but also contributed to a positive overall learning experience. The preparation and accessibility of the worksheets were key factors that supported learners in engaging with the material effectively.

Overall, interactive worksheets were perceived as effective tools for learning, enhancing understanding, engagement, and satisfaction among students.

2. Reflecting on the Benefits of Interactive Worksheets: Enhancing Learning Beyond Traditional Methods

Detailed Analysis

Interest and Engagement is a central theme, appearing multiple times across different codes, highlighting its importance in fostering engagement and interest among learners. Comparison with Printed Materials (CPM) and Comparison with Books (CB) are specifically grouped under Effectiveness and Preference, indicating a preference for certain types of learning materials and methods over others. Multimedia and Interactive Features emerge as a significant theme, encompassing the effectiveness of video lessons, interactive tools, immediate feedback mechanisms, and the ease of multiple-choice assessments. Instructional Effectiveness is noted separately, focusing on how well instructional methods support learning objectives. Self-directed Learning is highlighted for its convenience and preference among learners.

The result implies that the Interactive Worksheets were found to significantly enhance learning compared to traditional methods such as textbooks or lectures, primarily by increasing interest and engagement. Learners preferred the multimedia and interactive features of these worksheets, finding them effective in supporting learning objectives and promoting self-directed learning. The results suggest that integrating interactive elements into educational materials can improve engagement, effectiveness, and overall learning experiences for students.

3. Identifying Challenges in Using Interactive Worksheets: Confusing Features and Less Helpful Activities

Detailed Analysis

Technical Issues are a prominent theme, encompassing various challenges related to internet connectivity, technical difficulties, and issues with video lessons. Resolution and Support highlight the importance of timely assistance and effective problem resolution by teachers. Errors and Challenges captures the different types of challenges and errors encountered during the learning process, including difficulty with questions and submission errors. Smooth Experience and Clarity and Effectiveness indicate positive experiences where no significant difficulties were encountered and where learning materials were clear and helpful.

The result implies that while using interactive worksheets, learners encountered several challenges and difficulties, primarily related to technical issues such as internet connectivity problems, technical glitches with video lessons, and errors with questions or submissions. Timely resolution and support from teachers or support staff were crucial in overcoming these challenges. Overall, learners appreciated clear and effective learning materials that provided a smooth experience, despite occasional technical difficulties. Clarity in instructions and activities was valued, whereas confusing or less helpful features within the worksheets were noted as areas needing improvement to enhance the overall learning experience.

4. Assessing the Impact of Interactive Worksheets on Class Participation, Engagement, and Motivation

Detailed Analysis

Motivation and Engagement is a dominant theme, encompassing various aspects of motivation, engagement, and excitement for learning across different contexts. Learning Support and Enhancement highlights the support provided for learning enhancement, understanding boost, and the acquisition of new learning. Review and Asynchronous Learning focuses on activities related to reviewing lessons and engaging in asynchronous learning environments, including the suspension of face-to-face classes. Enjoyment and Fun reflect the positive experiences of enjoyment and fun during learning activities. Class Participation and Engagement emphasizes active participation, involvement, and engagement in class activities, including teacher engagement and worksheet involvement. Decision Making and Comparison addresses support for decision-making and comparisons between different learning modes. Confidence and Boost indicate the boost in confidence experienced by learners during the learning process.

The result implies that Interactive Worksheets had a positive impact on learners' participation and engagement in class discussions and activities. They enhanced motivation and involvement in the learning process by providing enjoyable and supportive learning experiences. Learners felt more confident and engaged, actively participating in class activities facilitated by the interactive features of the worksheets. The worksheets supported both face-to-face and asynchronous learning, contributing to a more comprehensive and engaging educational experience overall.

5. Suggestions for Enhancing the Effectiveness and Usability of Interactive Worksheets: Recommendations and Desired Features

Detailed Analysis

Feedback and Recommendations. This theme encompasses student feedback and suggestions for improving learning materials. Key suggestions include adding more videos, enhancing interactive layouts and elements, and providing additional information in videos. The theme also includes general satisfaction feedback, indicating areas where students feel content. *Learning Experience and Engagement.* This highlights the overall learning experience, focusing on student engagement and enjoyment. Students find answering questions enjoyable and easy, appreciate the gamification of learning activities, and generally report positive learning experiences. *Knowledge Enhancement and Satisfaction.* It captures the effectiveness of learning activities in enhancing students' knowledge and their satisfaction with their learning progress. Students feel that the activities significantly contribute to their understanding and are satisfied with their educational outcomes. *Technical Issues and Ease of Use.* It addresses technical challenges and the ease of using learning materials. It includes fixing technical difficulties, especially those related to numbers, promoting learning innovations, and providing necessary assistance to ensure smooth learning experiences. *Interactive Learning Tools.* It focuses on the role of interactive learning tools, particularly video lessons, in enhancing the learning process. Video lessons are

seen as a key component in making learning more dynamic and engaging for students.

The result implies students' valuable feedback and recommendations for improving the Interactive Worksheets' effectiveness and usability. Key suggestions included adding more videos, enhancing interactive layouts, and providing additional information in videos to make learning more engaging and comprehensive. Students appreciated the enjoyable and easy nature of answering questions and the gamification of learning activities, which contributed to a positive learning experience. They felt that the interactive worksheets significantly enhanced their knowledge and were satisfied with their educational progress. Addressing technical issues and ensuring ease of use were also highlighted as important factors. Fixing technical difficulties and providing necessary assistance were crucial for maintaining a smooth learning experience. Video lessons were particularly valued for their dynamic and engaging nature, and enhancing these tools could further improve the learning process.

Overall, students recommended focusing on enhancing interactive elements, providing more comprehensive multimedia content, and ensuring technical reliability to improve the effectiveness and usability of interactive worksheets in future versions.

4. DISCUSSION

The results from the study reveal significant insights into the impact of interactive worksheets on the academic performance and engagement of low-performing Grade 9 learners in science. The analysis of pretest and posttest scores demonstrates that the use of interactive worksheets led to a substantial improvement in students' academic performance, as evidenced by a mean increase of 6.075 points and a statistically significant t-value. This suggests that interactive worksheets are effective in enhancing the understanding and retention of scientific concepts, aligning with previous research that supports the efficacy of interactive learning strategies.

The positive outcomes from the use of interactive worksheets are further reinforced by the data collected from a survey and focus group discussions. Most students reported high satisfaction with the quality, features, and user-friendliness of the interactive materials, and they noted a marked improvement in their learning outcomes. The survey results show consistent ratings across various aspects of the interactive materials, indicating that students generally found them to be valuable educational tools. The focus group discussions also highlighted that the interactive worksheets significantly boosted students' engagement and motivation, leading to more active participation in class discussions and activities.

However, the regression analysis presents an interesting contrast, revealing no significant relationship between the total scores on interactive worksheets and post-test academic performance. This finding suggests that while interactive worksheets contribute to overall improvement in student performance, they may not be the sole factor influencing academic outcomes. The lack of a strong correlation could be due to several factors, such as the diversity of student

learning styles, the varying levels of support provided during the learning process, or potential limitations in the design or implementation of the worksheets themselves.

In addition to the positive findings, the study also identified challenges and areas for improvement. Some students encountered technical difficulties, particularly related to internet connectivity and issues with video lessons. These challenges underscore the importance of providing reliable technical support and ensuring that learning materials are accessible and easy to use. Students' feedback also highlighted the need for enhancing the interactive features of the worksheets, suggesting that incorporating more videos and improving the layout could further enhance the learning experience.

Overall, the results indicate that interactive worksheets are a valuable tool for improving academic performance and engagement among low-performing students in science. The significant improvement in post-test scores, coupled with positive feedback from students, supports the integration of interactive learning materials in educational settings. However, the findings also suggest that further refinement of these tools is necessary to maximize their effectiveness, particularly by addressing technical issues and enhancing the interactive components. By incorporating students' recommendations and focusing on continuous improvement, educators can better leverage interactive worksheets to support diverse learning needs and promote academic success.

5. CONCLUSION AND RECOMMENDATIONS

Based on the summary of findings, the following conclusions were drawn:

1. The targeted interventions and instructional strategies like using interactive worksheets have led to significant enhancements in the learners' understanding and application of scientific principles.
2. The implementation of interactive worksheets as an intervention has had a beneficial impact, contributing to the observed enhancements in academic performance among the targeted learners.
3. Based on regression analysis, there is insufficient evidence to support the presence of a significant correlation between academic performance, as measured by posttest scores, and the total score on interactive worksheets.
4. The interactive instructional materials were well-received and successful in enhancing the learning experience, with minimal technical obstacles encountered, thereby contributing to a more effective educational environment.
5. Interactive worksheets were recognized as valuable tools for enhancing learning experiences in science subjects, contributing significantly to student engagement and comprehension.

The recommendations emphasize specific actions to enhance educational outcomes using interactive worksheets. Science teachers should regularly incorporate these tools into their lesson plans, utilizing video lessons and quizzes to explain complex concepts and engage students; for instance, by creating weekly assignments with multimedia content and interactive exercises. School administrators should integrate

interactive worksheets into the curriculum and provide training sessions to demonstrate their effective use, alongside ongoing technical support for teachers. Curriculum developers should expand the use of interactive worksheets to other subjects like math, history, and language arts, customizing them to address specific learning objectives and collaborating with teachers to tailor content for areas where students struggle. Researchers should conduct further studies on the impact of interactive worksheets on academic performance across various subjects and demographics, investigating factors such as student engagement, motivation, and retention rates, and comparing the effectiveness of interactive worksheets with traditional methods in diverse classroom settings.

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