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P - ISSN 2984-7842
E - ISSN 1908-3181

Canva-Assisted Instruction in Teaching Visible Light Color Energy

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Received: 20 May 2025 **Revised**: 22 June 2025 **Accepted**: 23 June 2025

Available Online: 24 June 2025

Volume IV (2025), Issue 2, P-ISSN – 2984-7567; E-ISSN - 2945-3577

https://doi.org/10.63498/etcor380

Abstract
Aim: This study aimed to assess the effectiveness of Canva-assisted instruction in improving Grade 12 students' conceptual understanding of Visible Light Color Energy. Specifically, it sought to determine the students' pre-test and post-test scores, assess significant differences within and across groups, and develop an enhanced lesson plan using Canva-integrated strategies under the 7Es instructional model.
Methodology: A quasi-experimental design with nonequivalent groups was employed involving 100 Grade 12 students—25 in the control group and 75 in three experimental groups. The control group received traditional instruction, while the experimental groups were taught using Canva-assisted materials with varied visual and interactive designs. A validated 30-item test (KR-20 = 0.762) measured conceptual understanding before and after the intervention. Data were analyzed using descriptive statistics, Shapiro-Wilk, Kruskal-Wallis, and Mann-Whitney U tests.
Results: The post-test results revealed that all experimental groups outperformed the control group, with statistically significant differences ($p < 0.05$). Among the experimental groups, Canva-assisted instruction incorporating interactive and visual learning tools led to higher levels of conceptual understanding in visible light color energy. The findings confirmed that integrating Canva in science instruction enhances student engagement, comprehension, and performance.
Conclusion: Canva-assisted instruction significantly improves students' conceptual understanding of abstract Physics topics such as Visible Light Color Energy. The developed lesson plan offers a practical, scalable, and engaging instructional model that aligns with curriculum standards and supports student-centered learning.
Keywords: *Innovation, Engagement, Instruction, Comprehension, Science Education*

INTRODUCTION

Science education, particularly in the field of Physics, plays a pivotal role in shaping students' intellectual and practical capabilities. It lays the groundwork for future innovations, especially in technology and engineering. Within the broader Science, Technology, Engineering, and Mathematics (STEM) curriculum, Physics is crucial in equipping students with knowledge to understand the physical world (Halliday et al., 2023). The subject encourages critical thinking and problem-solving skills, laying the foundation for advancements across various fields, such as technology, renewable energy, and environmental science.

However, certain abstract concepts, such as light and energy, continue to challenge students in Physics, particularly when it comes to understanding visible light color energy. As Martínez-Borreguero et al. (2024) point out, light and energy, being complex phenomena, are difficult for students to grasp. The wave-particle duality of light, its interaction with matter, and concepts such as refraction, diffraction, and the electromagnetic spectrum demand a high level of abstraction, making them hard to conceptualize (Maes, 2023). Furthermore, understanding how color relates to photon energy, a critical concept in quantum physics, adds another layer of complexity (Mercree, 2024).

Numerous studies highlight the struggle students face in learning about visible light color energy. For instance, Xu and Ouyang (2022) found that students often enter classrooms with preconceived ideas about light that conflict with scientific explanations. These misconceptions further hinder their understanding. Uwamahoro et al. (2021) also identified that students often fail to grasp how different colors of visible light possess varying energy

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levels, a misunderstanding rooted in the abstract nature of the topic. Additionally, Quicho and Rivera (2023) observed that misconceptions in visible light color energy are prevalent among Grade 12 students in the Philippines, especially in the context of the K–12 curriculum, which is intended to prepare students for STEM fields. These challenges underscore the need for effective teaching strategies to address abstract concepts like light and energy.

The Philippines' performance in international assessments further highlights the need for enhanced science instruction. In the 2022 PISA assessment, the Philippines ranked third-lowest in science out of 81 participating countries, with an average science score of 356, significantly below the global average of 489. The results indicated that only 27% of Filipino students achieved proficiency in science, signaling the urgent need for better pedagogical interventions in science education (OECD, 2023). This has been consistent with findings from the Trends in International Mathematics and Science Study (TIMSS), where the country performed poorly, particularly in Physics (Bernardo et al., 2023).

Visible light color energy remains one of the least understood concepts in the Philippine science curriculum. Studies have shown that traditional methods of teaching Physics, such as lecture-based instruction, fail to engage students effectively, particularly in abstract topics. At Antonio G. Tuason National High School (AGTNHS), for instance, the Summative Test results from 2021 to 2024 show that students consistently fail to meet the passing mark of 75%, indicating that the current instructional approaches are insufficient (Antonio G. Tuason National High School, 2024).

In response to these challenges, innovative teaching strategies are needed. One such strategy is the use of technology-assisted instruction, which has shown promise in engaging students and enhancing learning outcomes. The integration of visual tools such as Canva for teaching abstract concepts like visible light color energy has been identified as one of the approaches. According to Branch (2009) and Martin and Ritzhaupt (2017), frameworks like the ADDIE model, which guides instructional design through a systematic process (Analysis, Design, Development, Implementation, Evaluation), can ensure that these strategies are well-designed and contextually relevant to the learners' needs.

Despite these advancements in instructional methods, there remains a significant gap in the literature. Most studies focus on the outcome of technological interventions, while few explore the development process or the specific context in which these interventions are applied. Furthermore, there is a lack of research specifically targeting the teaching of visible light color energy within the Philippine educational context. This study seeks to fill this gap by developing an enhanced lesson plan using Canva-assisted instruction tailored to Filipino students' needs. By focusing on visible light color energy, this study aims to provide science educators with practical tools that can be adapted for teaching abstract topics effectively, thereby contributing to the improvement of science education in the Philippines.

Objectives

This study aimed to assess the effectiveness of Canva-assisted instruction in improving Grade 12 students' conceptual understanding of Visible Light Color Energy.

Specifically, it sought to answer the following objectives:

1. determine the level of conceptual understanding of the groups of respondents in terms of their;
   1.1 pre-test mean scores; and
   1.2 post-test mean scores;
2. determine the significant difference between the pre-test and post-test mean scores of the groups of respondents;
3. determine the significant difference between the post-test mean scores across the groups of respondents; and
4. develop an enhanced lesson plan for Visible Light Color Energy during collaborative learning sessions.

Hypotheses

Given the stated research problems, the following hypotheses were tested:

H_0:There is no significant difference in the pre-test and post-test mean scores of students taught using the innovative teaching strategy and those taught using traditional teaching methods in learning Visible Light Color Energy.

H_0:There is no significant difference between the post-test mean scores of students taught using the innovative teaching strategy and those taught using traditional teaching methods in learning Visible Light Color Energy.

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METHODS

Research Design

The research utilized a quasi-experimental design with a nonequivalent pre-test and post-test control group approach to evaluate the effectiveness of Canva-assisted instruction in enhancing students' conceptual understanding of Visible Light Color Energy.

Population and Sampling

The participants were 100 Grade 12 students enrolled in Physical Science during the academic year 2024–2025. Four intact classes were purposively selected and grouped as one control group (25 students) and three experimental groups (75 students). Each group was assigned based on availability and consent to participate. Students with more than two absences during the implementation were excluded from the final data set to ensure consistent exposure to the intervention.

Instrument

The main research instrument was a validated, researcher-made 30-item multiple-choice test designed to assess conceptual understanding of Visible Light Color Energy. The test aligned with the Department of Education's Most Essential Learning Competencies (MELCs) and covered topics such as photon energy, color hierarchy, applications of visible light, and perception of color. The instrument demonstrated good reliability, with a Kuder-Richardson Formula 20 (KR-20) coefficient of 0.762.

Data Collection

Data collection was conducted during the fourth quarter of the academic year 2024–2025 at Antonio G. Tuason National High School. The study spanned two weeks and involved four intact Grade 12 Physical Science classes. In the first week, a researcher-made 30-item pre-test was administered to both the control and experimental groups under standardized classroom conditions to assess students' baseline knowledge of Visible Light Color Energy.

Following the pre-test, the instructional phase was implemented over a period of four consecutive class days. The control group received traditional lecture-based instruction, while the experimental groups were exposed to Canva-assisted instructional materials that included infographics, animations, and interactive worksheets tailored to the 7Es lesson model. In the second week, a post-test—identical in structure and content to the pre-test—was administered to all participants to measure learning gains. Both pre- and post-tests were conducted within the regular class schedules, with the same amount of time allotted per group to ensure consistency across the data collection process.

Data gathered from both tests served as the primary basis for evaluating the effectiveness of Canva-assisted instruction in enhancing students' conceptual understanding of Visible Light Color Energy.

Treatment of Data

Descriptive statistics such as mean and percentage were used to summarize student performance. The Shapiro-Wilk test assessed the normality of the data. Due to the non-normal distribution of scores, non-parametric tests were used: the Kruskal-Wallis test compared post-test scores across groups, while the Mann-Whitney U test was employed for pairwise comparisons. All statistical analyses were performed using SPSS, with a significance level set at $p < 0.05$.

Ethical Considerations

Prior to data gathering, ethical clearance and administrative approvals were obtained to ensure the study's compliance with institutional and educational standards. Formal permission was secured from the Schools Division Office and the principal of Antonio G. Tuason National High School to conduct the research within the campus.

Informed consent was obtained from all participating students and their guardians. Each participant was provided with a consent form explaining the purpose of the study, procedures, duration, and their rights, including the option to withdraw at any time without penalty. All participants were assured that their identities would remain anonymous and that the data collected would be used solely for academic research purposes.

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Confidentiality was strictly maintained throughout the study. Student responses were coded and securely stored to prevent unauthorized access. Only the researcher and thesis adviser had access to the raw data. These measures ensured the ethical integrity of the research and protected the welfare of all participants.

RESULTS and DISCUSSION

This section presents a comprehensive analysis and interpretation of the data collected, organized according to the specific research objectives of the study.

Level of Conceptual Understanding in Visible Light Color Energy

The table below presents the comparison of conceptual understanding levels of students in the control and experimental groups based on their pre-test and post-test results.

Table 1. Level of Conceptual Understanding in Pre-Test and Post-Test Results of the Control and Experimental Groups

		Pre-test				Post-test			
Level of Conceptual Understanding	**Percent age Range**	**Control Group 1 (f)**	**Experimental Group (f)**			**Control Group 1 (f)**	**Experimental Group (f)**		
			Group 2	**Group 3**	**Group 4**		**Group 2**	**Group 3**	**Group 4**
Outstanding	90-100%	0	0	0	0	3	9	19	17
Very Satisfactory	85-89%	0	0	0	0	2	4	1	1
Satisfactory	80-84%	0	0	0	0	5	9	2	4
Fairly Satisfactory	75-79%	1	0	0	0	2	1	1	1
Did Not Meet Expectation	Below 75%	24	25	25	25	13	2	2	2

Pre-test and Post-test Mean Scores of Students in Visible Light Color Energy

		Pre-test			Post-test		
Group	**n**	**Mean**	**MPS**	**Description**	**Mean**	**MPS**	**Description**
Control Group 1 (*Lecture Method*)	25	12.24	41%	Did not Meet the Expectation	22.52	75%	Fairly Satisfactorily
Experimental Group 2 *(Canva-Assisted Instruction)*	25	12.04	40%	Did not Meet the Expectation	25.68	86%	Very Satisfactorily
Experimental Group 3 *(Canva-Assisted Instruction)*	25	12.44	42%	Did not Meet the Expectation	27.08	90%	Outstanding
Experimental Group 4 *(Canva-Assisted Instruction)*	25	12.16	41%	Did not Meet the Expectation	26.72	89%	Very Satisfactorily

***Legend:** 90-100: Outstanding, 85-89: Very Satisfactory, 80-84: Satisfactory, 75-79: Fairly Satisfactory, Below 75: Did Not Meet Expectations (DepEd Order No. 8, s. 2015).*

Table 1 reveals that in the pre-test, all groups—control and experimental—fell under the "Did Not Meet Expectation" category, indicating limited prior knowledge and comparable baseline understanding of Visible Light

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Color Energy. Post-test results, however, showed notable improvement in the experimental groups exposed to Canva-assisted instruction.

While most students in the control group remained below the expected level, the experimental groups showed significant gains. In particular, Experimental Group 3 had 76% of students achieving "Outstanding," and Group 4 had 68%, demonstrating strong conceptual grasp. These outcomes highlight the effectiveness of Canva-assisted instruction in promoting engagement and deeper understanding.

The results suggest that visually rich, interactive learning materials enhance student comprehension more effectively than traditional lectures. These findings are supported by Astuti et al. (2024) and Septiani et al. (2023), who found similar improvements in problem-solving and writing skills through Canva-based learning strategies.

Educators are thus encouraged to adopt digital tools like Canva to support student-centered instruction, especially in subjects involving abstract concepts. Doing so can foster higher-order thinking, improve retention, and lead to better learning outcomes.

Comparison between the Pre-test and Post-test Mean Scores of the Groups of Respondents

The table below presents the comparison between the pre-test and post-test mean scores of the control and experimental groups.

Table 2. Kruskal-Wallis Test Results on Pretest and Posttest Scores Across Groups

Test	χ^2 (Chi-Square)	df	p-value	Interpretation
Pretest Scores	0.929	3	0.818	NS/Accept Ho
Posttest Scores	27.185	3	0.000	S/Reject Ho

$p < 0.05$ indicates significant difference.

The Kruskal-Wallis test results show no significant difference in pre-test scores among the four groups (χ^2 = 0.929, p = 0.818), indicating comparable prior knowledge. However, a significant difference was found in the post-test scores (χ^2 = 27.185, p = 0.000), suggesting that the variation in learning outcomes resulted from the instructional strategies applied.

Students exposed to Canva-assisted instruction significantly outperformed those in the traditional group, confirming the effectiveness of digital tools in enhancing conceptual understanding. These findings align with studies by Hutapea et al. (2024), Kandukoori et al. (2024), and Astaño (2025), which highlight the benefits of integrating technology in improving student engagement and performance.

Educators are encouraged to adopt Canva-assisted instruction to foster interactive and student-centered learning, while school leaders should support training on digital instructional design to maximize its impact in classrooms.

Comparison of Post-Test Mean Scores Across the Groups of Respondents

To identify specific differences in post-test performance across the groups, a post-hoc analysis was conducted using the Mann-Whitney U Test, following the significant result obtained from the Kruskal-Wallis Test.

Table 3. Pairwise Comparison of Posttest Scores Using Mann-Whitney U Test

Comparison	U Value	Z Value	p-value	Interpretation
Control Group 1 vs Experimental Group 2	141.00	-3.36	0.00	S/Reject Ho
Control Group 1 vs Experimental Group 3	98.00	-4.19	0.00	S/Reject Ho
Control Group 1 vs Experimental Group 4	107.50	-4.00	0.00	S/Reject Ho
Experimental Group 2 vs Experimental Group 3	179.50	-2.62	0.01	S/Reject Ho
Experimental Group 2 vs Experimental Group 4	226.00	-1.70	0.09	NS/Accept Ho
Experimental Group 3 vs Experimental Group 4	275.50	-0.73	0.47	NS/Accept Ho

Note: *$p < 0.05$ indicates significant difference.*

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Further analysis revealed a significant difference between Experimental Groups 1 and 2 (U = 179.50, p = 0.01), suggesting that variations in Canva-based activity designs or group dynamics may have influenced learning outcomes. No significant differences were found between Groups 1 and 3 (p = 0.09) and Groups 2 and 3 (p = 0.47), indicating similar performance among them.

These findings confirm that Canva-assisted instruction positively impacts student understanding of complex science concepts like Visible Light Color Energy. Its integration promotes engagement, caters to diverse learning styles, and aligns with the shift toward technology-enhanced, student-centered education.

The results are consistent with studies by Septiani et al. (2023), Musabbihan et al. (2023), and Rogayan et al. (2021), which reported improved academic performance and motivation across various disciplines using Canva and related digital tools.

Given its effectiveness, educators are encouraged to integrate Canva-assisted strategies into their lessons. Professional development programs focusing on Canva integration should also be implemented to maximize its instructional potential. Future studies may explore how specific Canva-based activity designs and classroom contexts affect learning outcomes across subjects.

Developed Enhanced Lesson Plan for Visible Light Color Energy

Table 4 presents how Canva was strategically integrated into each part of the four-day lesson sequence on Visible Light Color Energy.

Table 4. How Canva is Integrated into the Lessons

Parts of the Lesson	**Day 1 Lesson: Wavelength and Frequency of Visible Light**	**Day 2 Lesson: Seeing in Color: How the Eye Detects Different Wavelengths**	**Day 3 Lesson: Practical Applications of Visible Light Color Energy**	**Day 4 Lesson: Color and Power: Comparing Energy in the Visible Spectrum vs. Ultraviolet Light**
ELICIT	*Used Canva-printed electromagnetic spectrum chart*	*Presented Canva infographic of the visible spectrum*	*Showed Canva-printed collage of real-world red light applications (e.g., darkrooms, observatories)*	*Used Canva-made color cards for human spectrum activity*
ENGAGE	*Used Canva-made infographic showing light colors with wavelengths and frequencies*	*Shared Canva interactive whiteboard link with eye diagram; played Canva-based GIF of cone cells*	*Played short video embedded in Canva showing red vs. blue light reactions*	*Presented Canva cartoon strip "Meet the Lightwaves!" to illustrate power of colors*
EXPLORE	*Printed data table designed in Canva for color, wavelength, frequency, and energy analysis*	*Distributed printed cone sensitivity graph and activity sheet using Canva layout*	*Provided Canva-made data table and cutout cards for kinesthetic group activity*	*Provided Canva-made data table and cards for sorting task comparing visible and UV light*
EXPLAIN	*Displayed Canva slide with light wave animations from red to violet*	*Used Canva slide on Additive Color Mixing to explain cone functions*	*Presented Canva slide with wavelength-energy chart to explain red light's low energy*	*Explained wavelength vs. energy using Canva slide with biological effects chart*
ELABORATE	*Distributed matching worksheet designed in Canva*	*Distributed Canva-designed worksheet titled "What Color Do You See?"*	*Distributed Canva-based worksheet titled 'Real-Life Light Lab' with scenario-based analysis*	*Gave Canva worksheet 'Energy vs. Effect' with real-life scenario comparisons*
EVALUATE	*Students created Canva digital*	*Used Canva-generated visuals for matching*	*Evaluation included Canva-enhanced*	*Students completed Canva-designed Venn*

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	flashcards summarizing wavelength, frequency, and energy	*type and short response evaluation*	*multiple-choice and essay questions*	*diagram comparing visible and UV light*
EXTEND	*Homework: Add real-world application to Canva flashcard/poster*	*Homework: Research color blindness and add insights to Canva poster or notebook*	*Assigned Canva one-slide infographic: 'Where We Use Red Light and Why?'*	*Assigned Canva comic strip comparing visible light and UV for homework*

The enhanced lesson plan aligned with the Grade 12 Physical Science MELCs and followed the 7Es model: Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend. Canva was used as the core instructional tool for its accessibility, user-friendly features, and offline capability. Materials included infographics, interactive worksheets, animations, and printable visuals designed to reinforce conceptual understanding through visual learning—supported by studies like Septiani et al. (2023) and Astuti et al. (2024).

Canva supported the visualization of abstract concepts, collaborative learning, and real-world application—promoting critical thinking and higher-order skills (Darobi et al., 2023; Musabbihan et al., 2023). All materials were reviewed by subject experts to ensure quality and curriculum alignment (Rogayan et al., 2021).

Through DepEd's partnership with Canva for Education, teachers gained free access to premium features, enabling the creation of dynamic and localized content. This addressed teachers' need for engaging, curriculum-aligned resources and enhanced science instruction with creative, technology-integrated approaches (Naeem & Ozuem, 2022).

The quantitative data—derived from the comparison of pre-test and post-test scores of students in both the control and experimental groups—validated the effectiveness of the enhanced instructional strategy. Through the analysis of students' performance outcomes, the study demonstrated measurable improvements in conceptual understanding, thereby strengthening the credibility, reliability, and significance of the findings. This result underscores the value of using empirical data to assess instructional innovations in educational research.

Conclusions

The findings of this study affirm the effectiveness of Canva-assisted instruction in significantly improving the conceptual understanding of Grade 12 students in the topic of Visible Light Color Energy. The experimental groups exposed to Canva-generated instructional materials consistently demonstrated higher post-test scores compared to the control group that received traditional lecture-based instruction. This suggests that the use of visually enriched, interactive digital content helps bridge the gap between abstract physics concepts and student comprehension. By incorporating Canva within the 7Es instructional model—Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend—the strategy not only supported knowledge acquisition but also fostered student engagement, critical thinking, and collaborative learning. These results underscore Canva's potential as a pedagogical tool, especially in schools with limited access to high-tech laboratory facilities. Furthermore, the study validates the integration of digital platforms like Canva as a viable, low-cost innovation in science education that can address persistent learning gaps in content-heavy and abstract disciplines such as Physics.

Recommendations

In view of the positive outcomes observed in this research, it is strongly recommended that science educators integrate Canva-assisted instruction into their regular teaching practice, particularly when dealing with topics that involve abstract or visual concepts. The ease of access, intuitive design, and multimedia capabilities of Canva make it a practical tool for promoting student-centered learning. To ensure effective implementation, school administrators and educational leaders should organize capacity-building initiatives such as professional development workshops, lesson planning clinics, and peer-sharing sessions to equip teachers with the skills and confidence to design Canva-based materials. Curriculum developers are likewise encouraged to incorporate Canva-supported resources into learning modules and official instructional guides. In addition, future research is recommended to explore the scalability and sustainability of Canva-assisted strategies across different grade levels, subject areas, and learner profiles. Studies may also examine long-term effects on student retention, motivation, and academic performance to build a stronger evidence base for digital innovation in science education.

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