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RESEARCH ARTICLE

DEVELOPMENT AND VALIDATION OF VIDEO LESSONS IN SCIENCE FOR GRADE 10 LEARNERS

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Abstract

The study aimed to develop and validate video lessons in Science for Grade 10 learners. The research used the Research and Development (R & D) design. Purposive sampling was used to determine the video lessons' validators, including the eighth Grade-10 Science teachers from the different public high schools in San Mariano II District. Data collection techniques comprised an eight-factor evaluation tool for radio/ETV scripts and a 5-point Likert Scale questionnaire validation tool adopted from Robles (2016). Statistical tools, such as Mean and Standard Deviation, were utilized for the data analysis. The findings showed that the developed video lessons were acceptable and applicable to a great extent regarding suitability, relevance, usability, and appropriateness. Therefore, the developed video lessons were well-received, relevant, aligned with the learning competencies, and ensured accessibility and flexibility, crucial for modern education. Further, the study recommends experimentation to test their effectiveness.

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INTRODUCTION

Science is the study of facts related to the natural and material world. Studies show that its ultimate goal is for students to acquire basic scientific literacy (Karisan & Zeidler, 2016; Hsiao et al., 2018; Härtig et al., 2020). However, the modern era has shifted science education from objective fact-based knowledge to a practical activity that caters to the learners' skills, attitudes, values, and understanding (Jessani, 2015). Likewise, Huang et al., (2022) examined that countries around the world are paying more attention to scientific literacy as the concept of core literacy has been deepened. Hence, many policymakers worldwide have tried to revise and improve science education by altering the curriculum (Cuban, 2013; Laswadi et al., 2023).

As such, the Philippine government has implemented the most comprehensive education reform, which expanded the country's basic education cycle, known as the Republic Act 10533 or the K-12 Basic Education Program (Barlongo, 2015). Through the program, the Department of Education (DepEd) has embarked on a major plan to raise the overall quality and improve the effectiveness and efficiency of basic education. One of the features of the K-12 curriculum includes enhanced Science education where concepts and skills are taught in a spiral progression (K to 12 Curriculum Guide, 2016). Science content and processes are interwoven and arranged progressively with challenging tasks that draw students' interest and desire to learn and appreciate the subject to be relevant, useful, and facilitate deeper understanding and retention of concepts (Cabansag, 2014). Corpuz (2014) concluded that this design allows learners to better understand and master core concepts. Despite efforts to improve the Science curriculum, Ambag (2018) stated that Science education in the Philippines is not seen as a strength as Filipino students' performance lagged behind other countries in national and international educational research studies.

In 2016, 2017, and 2018, the World Economic Forum ranked the Philippines 67th out of 140, 79th out of 138, and 76th out of 137 participating countries for international competitiveness in quality Science education, respectively (Fuente, 2019; Nidar & Lumanlan, 2021). The disappointing outcomes in international standards for high-quality science education align with the country's underwhelming performance in the 2018 and 2022 PISA (Programme for International Student Assessment). The latest results of the PISA 2022 hosted by the Organization for Economic Co-operation and Development (OECD) showed a decline in the country's mean score in Science, marking an 11.08-point drop from 2018 to 2022. The country's performance in 2018 did not significantly improve as measured by the current PISA 2022 test results (Acido and Caballes, 2024).

Accordingly, the Philippines, with a score of 249, was the lowest in Science among the 58 countries involved in the 2019 TIMSS (Trends in International Mathematics and Science Study). Furthermore, the result of the study revealed that 13% of Filipino students were in the low benchmark, which means that students showed limited understanding of scientific concepts and knowledge of foundational Science facts (Mullis et al., 2019).

Consequently, Albano (2019) found that the 2018 National Achievement Test (NAT) had a 44.59% Mean Performance Score in Science for Secondary. The results did not meet the target score of 75% set by the government (Nidar & Lumanlan, 2021). Specifically, based on the issued 2019 Unnumbered Regional Memorandum of DepEd Region 02, the 2018 NAT result in Region 02 showed a 36.91% MPS in Science of Grade 10 students. Moreover, the

result revealed that no examinee was highly proficient in Science while 0.41% was proficient. Therefore, it was found that nearly 100% of the examinees did not fall under the proficiency level in Science (Regional Memorandum, 2019).

Unfortunately, with the move of the K-12 curriculum, Llagas et al. (2016), as cited by Acedo and Robles (2019), reported that public schools in the Philippines need more instructional materials to meet the growing diverse learning needs of the learners. Thus, teachers are encouraged to develop instructional materials to meet time demands (DepEd Order No. 035, s. 2016).

In this technologically driven environment, integrating technology into the teaching-learning process provides teachers an excellent opportunity to enrich students' learning performance (Prestoza, 2024; Zakaria et al., 2022). Essential to this is the development of multimedia instructional materials, such as educational video lessons, to serve as tools for learners to achieve mastery of the concepts and skills in Science. As technology continues to dominate the educational system, teachers must innovate or develop materials such as video lessons to meet these challenges.

Several studies have shown that video lessons can be highly effective educational tools (Cruse, 2017; Gaudin & Chaliès, 2015). Bullo (2021) emphasized the importance of introducing video lessons in the new normal, particularly in Science, as they have proven to be highly effective. Likewise, Prestoza & Banatao (2024) and Pérez-Torregrosa et al. (2017) emphasized that video lessons help to verbally explain concepts, engage students, and facilitate learning. Additionally, video lessons have been shown to spark learners' interest, motivate them (Barut & Dursun, 2022; Mhamdi, 2017), and aid in understanding essential science concepts. Moreover, Tugirinshuti et al., (2022) and Amarulloh and Dzakiria, (2021) suggested that a Video-Based Multimedia instructional strategy could be an effective methodology to use as a long-term response to Covid-19 and future shocks to reduce students' learning difficulties.

Hence, classroom-focused research on the use of multimedia, specifically video lessons, is emerging and is positioned as augmenting and becoming a central component of curricula, particularly about practical work in Science (Higgins et al., 2018). Furthermore, due to the swelling production of online videos, there is mounting interest in validating educational videos for authentic learning (Acedo & Robles, 2019). Thus, leveraging the development and validation of innovative educational resources is a window of opportunity to advance the skills and master the competencies of 21st-century learners. Likewise, this may offer teachers a responsive strategy to promote students' learning.

Research Problems

This study aimed to develop and validate video lessons in Science for Grade 10 learners. Specifically, it sought answers to the following research questions:

1. What is the level of acceptability of video lessons in Science in terms of:
    1.1 suitability, and
    1.2 relevance?
2. What is the level of applicability of video lessons in Science in terms of:
    2.1 usability, and
    2.2 appropriateness?

METHODOLOGY

Research Design and Participants

The study utilized the Research and Development (R and D) design. According to Said and Syariff (2016), research and development is a process used in developing and validating educational products that aim to create new knowledge for instructional and non-instructional products or enhanced models that govern their development. Besides, this design has proven relevant in the educational setting (Cabrera & Pentang, 2023). Purposive sampling was used in choosing the validators in the video scripts and video lessons. Five (5) teacher-respondents of Villa Miranda Integrated School belonging to the School Quality Assurance Team evaluated the 16 video scripts while eight Grade-10 Science teachers from the different public high schools in San Mariano II District, namely San Mariano II Central Integrated School; Alibadabad National High School; Marannao Integrated School; San Jose Integrated School; San Isidro Integrated School; Panninan Integrated School; Del Pilar Integrated School; and San Mariano II Central Integrated School-Luzcon Annex validated the video-lessons. The validators ranged from 29 to 47 years old; seven were Teacher 3, and one was Teacher 1. They had been teaching for more than six (6) years, had earned their Master's degrees, and all of them had district training on development and quality assurance of video lessons.

Research Instruments

First, an 8-factor evaluation tool for Radio/ETV Script developed by the SDO Isabela with the following factors: intellectual property rights compliance, learning competencies, instructional design, presentation and organization, assessment, accuracy and timeliness of information, language, script writing conventions, and technical design. This tool was employed to evaluate the video scripts used in the study. It encompasses eight factors essential for assessing the quality and effectiveness of the scripts, ensuring they meet the educational standards. Second, a 5-point Likert scale questionnaire validation tool was adopted from Robles (2016) to assess the level of acceptability and applicability of the video lessons regarding suitability, relevance, usability, and appropriateness.

Data Gathering Procedures

The researcher obtained the necessary permissions from the school and district authorities to conduct the research. Following these initial steps, the researcher downloaded, reviewed, and identified the competencies in the K-12 Science Curriculum Guide to appropriately select three specific learning competencies in Quarter 2 of Science 10. Also, the researcher conceptualized the contents and considered the flow of discussion to be included in the production of the video lessons based on the students' needs.

Then, the researcher developed 16 video scripts for the three (3) topics under the chosen learning competencies namely: 1) types of electromagnetic waves; 2) practical applications of electromagnetic waves; and 3) effects of electromagnetic radiation. The scripts followed the DepEd format provided by the Schools Division Office of Isabela with components such as OBB (Opening billboard), Introduction, Review of prior knowledge, Drill/game, Discussion, Exercise #1 (LOTS), Exercise #2 (HOTS), Assignments/reminders, Extro spiel, CBB (Closing billboard), and References. Moreover, the scripts adhered to Mayer's multimedia principles. Studies suggest that managing essential overload, reducing extraneous processing, and employing social cues can improve learning outcomes from

video lessons (Mayer et al., 2020). Furthermore, the video scripts were written in a storyboard format with detailed instructions for the audio and visual steps.

Additionally, the researcher sought permission from SDO Isabela to utilize the eight-factor evaluation tool for the Radio/ETV script in validating the video scripts. The scripts were validated by the School Quality Assurance Team consisting of five members with their respective positions namely: content evaluator, language evaluator, design and layout evaluator, SQAT co-chairman, and SQAT chairman using the tool. They found the scripts compliant with the minimum requirements of all eight factors. The researcher considered the SQAT's suggestions and recommendations. Then, the scripts underwent a second round of evaluation. They found the video scripts compliant with all factors and thus recommended them for production and development.

Furthermore, the filming of the video lessons was based on the validated video scripts by the SQAT. The researcher himself was the broadcaster/narrator, videographer, and editor. The video lessons used two of the eight common video styles Choe et al. (2019) identified, particularly the weatherman and slides on/off video styles. In the weatherman style, the teacher was filmed in front of a green screen then the slide presentations were overlaid during editing. Pi et al., (2019) observed that students found the video lessons engaging when the image of the teacher is included. Accordingly, Garcia and Yousef (2023) suggest that this presentation style is very effective such that it requires an emotional connection, the art of communication, and visual cues like good posture, body language, and eye contact. Besides, the researcher considered providing questions, prompts, and feedback in the video lessons. Results of the study by Wijnker et al. (2019) showed that videos with posed questions were associated with increased students' interest and learning, while video feedback strongly impacted teacher-student interactions (Bloomberg et al., 2014). Hence, the researcher considered these concepts in developing the video lessons.

Conversely, the researcher used his Oppo F9 mobile phone and Teleprompter application in filming and recording the Microsoft PowerPoint slide presentations. Then, the raw videos were edited using the Kinemaster editing application. The images, music, and video clips in the video lessons were obtained from Google and YouTube Creative Commons, an international organization, that permits artists to utilize when sharing their outputs online.

Moreover, the video lessons were validated by eight Grade 10 Science teachers from the eight different public high schools in the San Mariano II District using a 5-point Likert Scale questionnaire validation tool adopted from Robles (2016). The questionnaire assessed the video-based materials' level of acceptability and applicability regarding suitability, relevance, usability, and appropriateness.

Data Analysis

Based on the results gathered, descriptive statistics using mean (M) and standard deviation (SD) were used in the data on experts' validation of the video lessons. The following guidelines were used in assigning qualitative description (QD) to the mean scores:

Mean	Qualitative Description
4.50 to 5.00	Very High (VH)
3.50 to 4.49	High (H)
2.50 to 3.49	Moderate (M)
1.50 to 2.49	Low (L)
1.00 to 1.49	Very Low (VL)

RESULTS AND DISCUSSION

Experts' Ratings on the Level of Acceptability of Video-lessons

Table 1 shows the experts' ratings of the 16 video lessons' level of acceptability in terms of suitability and relevance. The table indicated that all the video lessons were deemed very highly suitable (x = 4.75) and very highly relevant (x = 4.71). The average mean score of 4.73 indicates that the video lessons were very highly acceptable. The high acceptability rating implies that the video-based instructional materials were highly suitable and relevant to the learning objectives, comprehension levels, and learning styles, as they offer systematic explanations that align with the learning competencies. Similarly, they were seen as a creative approach as they enhance students' 21st-century skills. This can be linked to the research of Acedo and Robles (2019) and Guo et al. (2014), which found that videos are globally valuable resources for enhancing students' 21st-century skills. Furthermore, the consistently high ratings across suitability and relevance demonstrate that video lessons were practical methodology that can adapt well to different contexts and needs, making them versatile tools in regular and challenging situations such as pandemics or extreme weather conditions.

Accordingly, research show the role of video lessons as highly effective and acceptable instructional tools for improving student learning outcomes, especially in Science education. Rasi et al. (2021) emphasize how video lessons enhance digital literacy and foster inclusive learning environments, while Mayer and Fiorella (2021) highlight the impact of generative learning strategies embedded in videos on comprehension and critical thinking. Likewise, Lai and Hwang (2022) demonstrate the positive effects of personalized video guidance on problem-solving skills, especially in scientific contexts. Consequently, Zheng and Zhang (2023) affirm that interactive video lessons significantly improve engagement and academic achievement, while Huang and Chen (2023) emphasize the role of timing and structure in videos for maintaining engagement and aiding retention of knowledge.

Collectively, these studies provide both practical and theoretical backing for the use of video-based learning in modern educational environments. Thus, the video lessons illustrate that they are widely accepted, suitable, and relevant educational tools for students and teachers, which may help enhance students' learning performance in Science.

Table 1. Experts' Ratings on the Level of Acceptability of Video-lessons

Video Lesson	Acceptability		Ave. Mean	QD
	Suitability	Relevance		
1	4.83	4.85	4.84	VH
2	4.95	4.90	4.93	VH
3	4.98	4.95	4.96	VH
4	4.93	4.65	4.79	VH
5	4.80	4.73	4.76	VH
6	4.68	4.70	4.69	VH
7	4.68	4.60	4.64	VH
8	4.75	4.55	4.65	VH

9	4.73	4.75	4.74	VH
10	4.54	4.66	4.60	VH
11	4.68	4.63	4.65	VH
12	4.65	4.58	4.61	VH
13	4.70	4.73	4.71	VH
14	4.70	4.75	4.73	VH
15	4.70	4.80	4.75	VH
16	4.75	4.55	4.65	VH
Ave. Mean	**4.75**	**4.71**	**4.73**	**VH**

Experts' Ratings on the Level of Applicability of Video-lessons

Table 2 presents experts' ratings on the applicability of the 16 video lessons regarding usability and appropriateness. The very high usability ratings, ranging from 4.65 to 4.95, suggest that the video lessons were accessible, user-friendly, and easy to navigate. This signifies that the video lessons were considered innovative materials to enhance, maximize, and reinforce students' learning. Likewise, very high appropriateness ratings, ranging from 4.65 to 4.94, reflect that the contents and delivery of video lessons aided learners in developing critical thinking skills and applying new learning. Generally, with an overall average rating of 4.77, the video lessons received a very high level of applicability since they were very highly usable (x = 4.77) and very appropriate (x = 4.77). The finding shows that the video lessons were instrumental and appropriate in improving learning performance, engagement, and student comprehension. This supports the findings of Giannakos (2013), who found that the length and style of videos significantly improved student engagement as relevant, appropriate, and well-structured content and elements likely contributed to positive outcomes. The findings further affirm the study of Kay (2012) on the use of video in education where usability was a critical factor for student satisfaction and was crucial for effective learning. Accordingly, Weston and Barker (2022) stress the importance of the usability and appropriateness of video content for improving learning outcomes and engagement while Rosenthal and Rosenbaum (2022) identify a direct link between the usability of video lesson materials and enhanced student performance.

Furthermore, the results of the study support the following research findings. Alqurashi (2019) emphasizes the role of video usability in increasing student satisfaction and perceived learning. Van der Keylen et al. (2022) found that well-designed instructional videos improve knowledge retention and learning outcomes, supporting the importance of video design. Relatively, the production quality, video length, and style influence engagement and comprehension, which aligns with high usability ratings (Guo et al., 2014). Meanwhile, Ibrahim and Nat (2019) show that video lessons can foster critical thinking, which is consistent with high appropriateness ratings. Brame (2016) provides guidelines for creating effective educational videos that enhance learning and engagement, while Mayer and Fiorella (2021) confirm that structured and relevant content increases video applicability and usability. On the other hand, Smutny and Schreiberova (2020) and Shin and Hickey (2021) discuss the benefits of video lessons in improving engagement through flexible and user-friendly content. Moreover, Morris and Lambe (2020) note the positive impact of video learning tools on engagement when aligned with educational objective while Hrastinski (2021) discusses the role of video lessons in blended learning, contributing to higher engagement and accessibility. In addition, the study results relate to Hodges et al. (2020) on the importance of video lessons, which reflects the flexibility and adaptability of video

lessons to meet learners' needs in diverse learning environments and during disruptions like pandemics and extreme weather conditions.

These studies further confirm the applicability, usability, and appropriateness of video lessons as an innovative and highly effective instructional tool in modern education. Hence, it can be concluded that all the video lessons were applicable, usable, and appropriate instructional materials in Science, especially in modern learning environments, which may increase students' engagement and improve their performance.

Table 2. Experts' Ratings on the Level of Applicability of Video-lessons

Video Lesson	Applicability		Ave. Mean	QD
	Usability	Appropriateness		
1	4.93	4.88	4.90	VH
2	4.93	4.90	4.91	VH
3	4.93	4.90	4.91	VH
4	4.93	4.95	4.94	VH
5	4.65	4.70	4.68	VH
6	4.55	4.75	4.65	VH
7	4.65	4.73	4.69	VH
8	4.75	4.75	4.75	VH
9	4.78	4.70	4.74	VH
10	4.63	4.73	4.68	VH
11	4.80	4.68	4.74	VH
12	4.73	4.75	4.74	VH
13	4.80	4.65	4.73	VH
14	4.63	4.73	4.68	VH
15	4.80	4.75	4.78	VH
16	4.83	4.80	4.81	VH
Ave. Mean	**4.77**	**4.77**	**4.77**	**VH**

CONCLUSIONS AND RECOMMENDATIONS

The study focused on developing and validating video lessons in Science for Grade 10 learners. The study revealed very high acceptability and applicability, highlighting their effectiveness as innovative teaching tools. The study findings suggest that video lessons not only align with the prescribed learning competencies but also support the broader educational objectives of promoting 21st-century skills such as critical thinking, collaboration, and digital literacy. The high ratings for both acceptability and applicability reflect the video lessons' relevance and their potential to cater to diverse learning styles, thus improving students' engagement and academic performance.

Moreover, the adaptability and user-friendliness of the video lessons emphasize their accessibility in different educational settings, particularly in the face of disruptions such as the COVID-19 pandemic and extreme weather conditions, which demanded the shift to remote and blended learning environments. These video-based materials offer a flexible resource that can be utilized by educators to reinforce learning, address students'

individual needs, and ensure continuity of education during unpredictable times. The multimedia format of the video lessons also facilitates deeper understanding of complex scientific concepts by making learning more engaging and interactive, which could potentially lead to improved retention and mastery of content.

Thus, this study underscores the significance of multimedia-based instructional strategies in addressing the challenges of modern education. With education increasingly moving towards technology integration, these video lessons present a valuable resource that can bridge gaps in traditional instructional methods and enhance learning outcomes. The use of well-structured video lessons can transform classroom dynamics, making them more interactive and student-centered, leading to heightened interest in the subject matter and improved overall academic success.

Building upon the findings of the study, several recommendations are proposed for the continued development and optimization of video lessons in science education:

1. It is recommended that the validated video lessons undergo further try-outs or experimentations to rigorously assess their effectiveness. Controlled trials should be conducted to compare the performance, engagement, and comprehension levels of students exposed to the video lessons versus those taught through traditional methods. These trials will help identify the strengths and areas for improvement in the video lessons, ensuring they are optimized for maximum educational impact.

2. Further research should explore a range of factors such as students' engagement, attitudes, perceptions, learning styles, behaviors, and academic performance following exposure to the video lessons. Investigating these aspects can provide deeper insights into how video lessons influence students' overall learning experience, their motivation to learn, and their mastery of content. Such studies can also identify specific student groups who benefit the most from this multimedia approach and tailor interventions accordingly.

3. To maximize the potential of video lessons, educators should receive professional development on how to effectively integrate multimedia resources into their instruction. Training programs should focus on the design and implementation of video lessons, how to assess their impact on student learning, and how to adapt video content to meet the evolving needs of their learners.

By implementing these recommendations, educational institutions can harness the full potential of video lessons as a tool for improving student engagement, performance, and learning outcomes. The adaptability, accessibility, and multimedia nature of video lessons make them an invaluable asset in modern education, especially in addressing diverse learner needs and navigating the challenges posed by an ever-changing educational landscape.

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