

Development and Validation of Video Lessons as Supplementary Materials in Teaching Heredity Among Grade 10 Students

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Abstract

This study aimed at developing video lessons that can be used as supplementary materials in teaching heredity among grade 10 students. This study emphasizes the integration of STEM education using video lessons to explain the concept of heredity. The researchers administered needs assessment survey to five (5) in-service science teachers to gather valuable information about the significance and needs to develop video lessons on heredity. The needs assessment results show a high demand for video lessons as these will not only make learning more interactive and interesting, but they also pique the curiosity of students and teachers alike. For the development of video lessons, the researchers followed 4D model. It was designed as engaging, interactive, and provides illustrative visuals to improve the students conceptual understanding on the lessons under heredity. The developed materials were evaluated by five (5) science teachers in terms of its content, instructional, technical quality, conceptual error, accuracy and up-to-datedness of information. The evaluation result revealed that the developed video lesson passed all the categories and was rated as 'excellent' $M = 3.56$. Therefore, the developed video lessons were recommended and accepted for its distribution to utilize as instructional material in supplementing the teaching of heredity among grade ten students.

Keywords: 4D Model, Heredity, STEM Education, Supplementary Material, Video Lessons

1. Introduction

Science education plays a crucial role in shaping a society's intellectual and technological landscape. It serves as the foundation for fostering critical thinking, problem-solving skills, and a deep understanding of the natural world. In a rapidly advancing global society, scientific literacy is essential for informed decision-making and in shaping future empowered by individuals with the tools to navigate an increasingly complex and interconnected world. Globally, the Philippines lags behind other countries

in the quality education particularly in a science subject. Based on the PISA result Philippines is one of the countries that has poor performance in science and mathematics field. In the 2022 PISA result, Philippines ranked 80th in science. The recent PISA results indicate no improvement and a continued low ranking for the Philippines which may suggest several challenges within the country's education system (Malipot, 2023). Among the perceived shortcomings are the teaching strategies employed and the low level of conceptual understanding in science concepts among the students. Effective education systems usually involve engaging teaching methods, strategies, and instructional materials that can aid the teaching-learning process.

According to Mustami (2016) among the topics in biological field which become the research materials among educators is the difficulty of the students to understand the concept of genetics as well as the misconceptions on the connected materials. Teachers also find genetics as one of the topics they needed extra tool to facilitate in teaching it effectively ((Ezechi, 2021). These findings indicate how important supplementary materials in delivering the contents and to simplify complex topics which both teachers and students have difficulty in translating it into comprehensible information. Innovative teaching method such as integrating new information technology like digital videos into traditional teaching methods is far more effective because it does not only meet the needs of diverse students but enhances the learning which leads to the achievement of learning outcomes (Ivory research, 2019). The use of videos as supplementary materials can enhance the teaching-learning process as mentioned that students viewed educational videos as additional materials which supplemented conventional methodologies and supported self-learning as well as providing flexibility at no extra cost (Bebita, 2022). Video lesson became popular during the COVID-19 where students were forced to learn on their own. It paved way for many researchers to investigate the effectiveness of video lessons in facilitating the learning of the students. Esguerra (2021) determined the efficacy of using science video lesson as supplementary tool in teaching science. Akuoma and Isa (2021) examine the impact of using video instructional strategy among Nigeria students in improving their academic performance. The study of Bebita (2022) aimed to find out if using video-clip lesson will give support to the search of innovative supplementary materials that will improve conceptual understanding and motivation in science subject. Bullo (2021) integrated video lessons in teaching Grade 9 learners as instructional materials amidst pandemic crisis. Despite that, number of studies on the integration of video lessons in teaching science, in the Lanao del sur education context no research has been done on how effective video lessons as supplementary materials in teaching the topics under heredity: inheritance and variation. Furthermore, many of these studies have utilized video lessons as a stand-alone material.

To fill the gap mentioned above, this study conducted on using video lessons as supplementary materials in teaching heredity among Grade 10 students coming from one public school in Lanao del Sur are effective in improving their conceptual understanding. This study, however, will focus on the development of video lessons that will be used as supplementary materials in teaching heredity among grade 10 students. To attain the general objective, this study aimed to: (1) Identify the needs and assessment for the development of video lessons as supplementary materials in teaching heredity. (2) Develop and validate video lessons on heredity: inheritance and variation.

2. Methods

This study utilized the 4D model, a structured four-phase process for the development of the video lessons. before the development of the material a needs assessment survey was conducted to assess the demand for it.

2.1 Needs Assessment Questionnaire

The researcher adapted and modified a needs assessment survey questionnaire from the study of Hadji Shaeef et al. (2023) in press to assess the demand for the development of the video lessons. The needs assessment survey consisted of two parts. In the first part, teachers were asked to rank competencies from the Science 10 third-quarter curriculum based on difficulty, categorizing each as very difficult, difficult, fair, easy, or very easy to teach. In the second part of the needs assessment, teachers were asked about their familiarity with video lessons, challenges they face in teaching heredity, pedagogical approaches used, experience with integrating video lessons, and the perceived significance of video lessons in the teaching-learning process. The needs assessment questionnaire was administered to science teachers who were handling science subjects. Their responses, comments, and suggestions were considered during the development of the video lesson.

2.2 Development of the Video Lessons as Supplementary Materials in Teaching Heredity

Before the development of video lesson, the researcher determines first which topics should be included in the video lesson. The most essential learning competencies (MELCs) were considered in designing and conceptualization of the video lessons on heredity. The sub-topics included in the development of video lessons were protein synthesis, DNA mutation, and different types of mutation. Furthermore, the feedback from the needs assessment survey were included as basis for the development of the video lesson.

Afterwards, the researcher created a learning plan to properly guide the integration video lesson to proper classroom instruction. This was followed by gathering materials and resources to aid the script writing and crafting of storyboard. Then, the development of the video lesson preceded wherein the storyboard were transformed into digital presentation in video form by using different video editing tools.

The developed video lessons were evaluated by five (5) in-service science teachers. The criteria for selecting the evaluator were considered. These were: (1) the teacher currently in service handling science subject, (2) had at least five (5) years' experience in teaching science subject, and (3) had integrated or used videos in teaching science topics. This study utilized the adapted LDRMS evaluation rating sheet from DepEd to evaluate the developed video lessons. The comments and suggestions of the evaluators were considered for the enhancement of the developed video lesson on the topic heredity.

2.3 Data Gathering: Needs Assessment

For the pre-assessment, the respondents were five (5) in-service teachers handling science subjects for the past five (5) years, a needs assessments were administered to determine their comments on the pedagogical approaches they have used, problems encountered in teaching topics under heredity: inheritance and variation, existing videos they have used, and suggestions on how to improve such videos to fit it into their class. Prior to the implementation, the respondents were given a letter to ask for their voluntary participation in the study. The responses were treated with utmost confidentiality. The study utilized codes to protect the identity of each respondent and to maintain confidentiality. Furthermore, the respondents of the needs assessment survey were five science teachers from the school in Lanao del sur. The results of the needs assessment were tabulated and thematically analyzed.

2.4 Data Analysis

Mean was used to analyze the data on the first part of needs assessment questionnaire and the ratings on the developed video lessons. for the qualitative data, thematic analysis was used to generate themes on the responses of the science teachers on the second part of needs assessment. The mean score will be interpreted as 1.00-1.74 label as Poor, 1.75-2.49 label as Satisfactory, 2.50-3.24 label as Very satisfactory, and 3.25-4.00 label as Excellent.

3. Results and Discussions

3.1 Needs Assessment for the Science Teachers

Table 1. Summary of Responses on Identified Difficult Topics to Teach in 3rd Quarter Science 10

TOPIC	Mean	Rank	Description
Coordinated functions of the Reproductive, Endocrine, and Nervous System	3.6	2	Difficult
Heredity: Inheritance and Variation	3.9	1	Difficult
Biodiversity and Evolution	3.30	3	Fair
Ecosystems	3.2	4	Fair

Note: 5.00-4.20 = Very Difficult 4.19-3.39 = Difficult 3.38-2.58 = Fair
 2.57-1.77 = Easy 1.76-1.00 = Very Easy

The needs assessment survey consisted of two parts. Table 1 presented the result in the first part wherein teachers were asked to rank competencies from the Science 10 third-quarter curriculum based on difficulty, categorizing each as very difficult, difficult, fair, easy, or very easy to teach. The results showed that the topic of heredity—specifically inheritance and variation—had the highest average difficulty rating, ranking first overall. This was followed by the coordinated functions of the reproductive, endocrine, and nervous systems, with biodiversity and evolution in third place, and ecosystems ranked as the least challenging. These findings indicate that science teachers perceive heredity as the most challenging topic to teach, a result that aligns with studies by Ezechi (2021) and Delos Santos et al. (2021), which also found that genetics is among the most difficult topics for teachers and an area where students demonstrate low mastery.

Table 2. Summary of the Responses on Video Lessons as Supplementary Materials in Teaching Heredity

Theme	Coded for	Quote
Familiarity on Video Lessons	Supplementary materials	ST1, ST2, ST3, ST4, ST5 “Video lessons are useful in supplementing the class discussion to illustrate complex concepts”
Challenges encountered in Teaching lessons under Heredity: Inheritance and Variations	Problems in Teaching	ST1, ST2, ST5 “Lack of instructional resources and the amount of time allocated for teaching genetics.” ST2, ST3, ST4 “Insufficient knowledge of the students about the basic concepts in heredity.”

Experience on integrating video lessons to teaching instructions	Integrated videos	ST1, ST2, ST3, ST5 “Yes, I let them watch videos to visualize and illustrate concepts.” ST2 “It makes my classes more engaging and interesting.” ST4 “I have not used videos in my classes because technical materials like projector and laptops are not available.”
	Issues in the used videos	ST2, ST5 “I have to cut the video sometimes because the other part was not appropriate to the level of my students” ST3, ST4 “The videos are in a fast paced, the students find it hard to understand sometimes.” ST1, ST5 “the narrator are usually American-native speaker, we have to put the subtitle”
Significance of video lessons in teaching-learning process	Useful Instructional Tool in Teaching and Learning Process	ST1, ST3, ST4, ST5 “Integrating video lessons in pedagogical approaches can be useful to supplement traditional teaching strategies and improve students’ comprehension of lessons like heredity.” ST2 “Video lessons are very useful because topics in Biology cannot be understood by merely explaining it and letting the students imagine things they cannot perceive.”

Table 2 present the result of the second part of the needs assessment, teachers were asked about their familiarity with video lessons, challenges they face in teaching heredity, pedagogical approaches used, experience with integrating video lessons, and the perceived significance of video lessons in the teaching-learning process. There were five identified key themes: familiarity, teaching challenges, integration experiences, and significance. Respondents were unanimously familiar with video lessons and had integrated them into their classroom discussions. Familiarity on video media is important as it is important to use appropriate teaching media and methods to organize and present only relevant information in classroom activity to increase the efficiency of the self-learning process (Mendoza et. al., 2015). Challenges encountered in teaching Heredity: Inheritance and Variations aligned with Ezechi's (2021) findings, including teaching methods, inadequate teaching aids, and insufficient time. Science teachers utilize video lessons to visualize complex concepts, overcoming the limitations of traditional teaching methods. One respondent emphasized the efficiency of animations over relying on students' imagination. Issues with existing online videos included the need to cut the video or play certain part only of the video content to suit students' levels and comprehension. These challenges underscore the importance of designing video lessons with the target audience in mind to

effectively serve the purpose of developing learning materials. Video lessons offer numerous benefits, including simplifying complex topics through visual aids and animations. Respondents agreed that utilizing video in classroom instruction enhances understanding, engagement, and retention compared to traditional methods (Khan, 2019; Bullo, 2021; Joshi, 2022).

3.2 Develop Video Lessons on Heredity

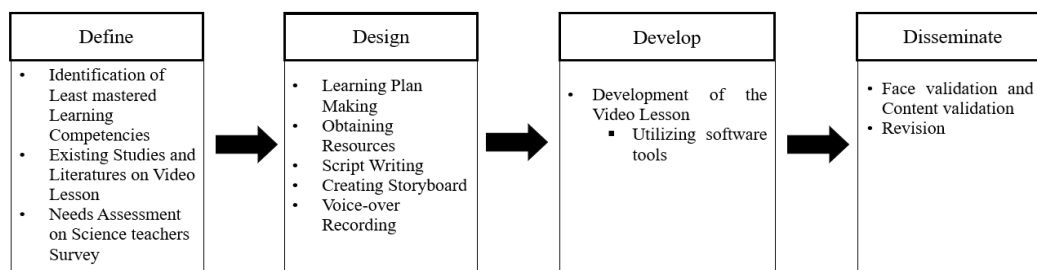


Figure 1. 4D Model on the Development of the Video Lessons

The researcher developed the video lessons using the 4D Model, a structured four-phase process. In the Define phase, least-mastered competencies were identified based on the DepEd report. Then, relevant literature and studies related to video-based instruction was reviewed to identify research gaps. This was followed by conducting needs assessment survey among science teachers to determine the demand for the development of the materials. The insights gained from this phase aided the subsequent phase. During the Design phase, a detailed learning plan was developed to ensure the video lessons would effectively complement classroom instruction. Relevant resources were gathered and reviewed for scriptwriting and storyboarding for the content of the video lessons, followed by voice-over recording. The resources include science 10 textbook and DepEd science 10 modules, the content of the videos was aligned to these materials to ensure the relevance and consistency of the video content to the intended target user. In the Develop phase, the storyboard was transformed into digital illustrations with synchronized narration using software such as Adobe Premiere Pro, CapCut, and Adobe Photoshop. The completed video lessons underwent face and content validation by a panel of five evaluators science teachers, who evaluated them using the DepEd-adapted rating sheet. Necessary revisions were made based on the feedback received.

3.3 Validation of Video Lessons on Heredity

The developed video lessons were evaluated by five (5) in-service teachers using the DepEd LDRMS evaluation rating sheet for non-print materials. Their comment and suggestions were considered for the improvement of the developed video lessons. the distribution of ratings for each the adapted DepEd rubric criteria is presented in table 3.

Table 3. Summary of Evaluators' Rating on the Developed Video Lessons on Heredity

Factor	VIDEO 1	VIDEO 2	MEAN OF MEANS	Description
Content quality	3.64	3.74	3.69	Excellent
Instructional quality	3.56	3.26	3.41	Excellent
Technical quality	3.30	3.49	3.39	Excellent
Accuracy and Up-to-date-ness	3.75	3.60	3.67	Excellent
Overall Average	3.56	3.52	3.54	Excellent

The components of rating the developed video lessons are content quality, Instructional quality, technical quality, and accuracy and up-to-date-ness. Based on the table 3, all the four factors acquired an average rating of 3.39 to 3.67 which are given a description of 'Excellent'. This demonstrates that the developed video lessons designed as supplementary materials in teaching heredity has guaranteed quality as an instructional tool used in this study. This result is aligned with the claims of Prieto (2017) which affirmed that any innovations used, either in a module format or video presentation must possess precise concepts which are acceptable, relevant, and appropriate to the levels of the students for them to attain validity. Instructional videos are part of audio-visual materials that facilitate students' inferencing skills by giving real-life examples (Akay, 2021).

4. Conclusions and Recommendations

The video lessons were found to be useful to integrate in teaching heredity, with evidence drawn from the following findings: it was revealed that science teachers used videos to illustrate complex concepts and allow students to visualize it rather than imagining things they cannot perceive. Second, science teachers believed that integrating video lessons can be useful to supplement traditional teaching and improve students' comprehension of lessons like heredity. Third, the developed video lessons were rated as an excellent teaching and learning tool. This suggests that the developed video lessons are powerful tool that can help to facilitate the delivery of the content and improve students' conceptual understanding.

The following recommendations can be considered for future studies. It was recommended that science teacher in Grade 10 can integrate video lesson in teaching heredity in their classrooms. Video lesson can be applied to ease the difficulty in delivering complex topics like heredity. Furthermore, this video lessons as supplementary materials research work can be a reference to future researchers who may like to conduct other studies about pedagogical approaches, learning instruction activities and improving students' conceptual understanding using video lessons as supplementary materials approach.

References

- Akay, E. (2021). The Use of Audio-Visual Materials in the Education of Students with Hearing Loss. Canadian Center of Science Education.
<https://doi.org/10.5539/ies.v14n7p1>
- Akram, S., Sufiana, & Malik, K. (2012). Use of audio visual aids for effective teaching of Biology at secondary schools level. *Eliir Leadership Mgmt.* 50 (2012) 10597-10605.

- Akuoma, U. & Isa, M.J. (2021). Video Instructional Strategy on Biology Students' Academic Performance in Port Harcourt, Nigeria. *Britain International of Linguistics, Art and Education Journal*. 3(3): 194-202.
<https://doi.org/10.3325/biolae.v3i3.537>
- Bebita, D. J. A. (2022). Supplementary Materials Via Video Clip (SIMVI): Effects on Grade 9 Students' Conceptual Understanding and Motivation. *International Journal of Multidisciplinary: Applied Business an Education Research*. 3(11), 2462-2479. DOI:// 10.11594/ijmaber.03.11.29
- Brame, C. (2016). Effective Educational Videos: Principles and Guidelines for Maximizing Student Learning from Video Content. *CBR Life Sci Educ*. 2016 Winter; 15(4): es6. <https://doi.org/10.1187/cbe.16-03-0125>
- Bullo, M. (2021). Integration of Video Lessons to Grade 9 Science Learners Amidst COVID-19 Pandemic. *International Journal of research Studies in Education*. <https://doi.org/10.5861/ijrse.2021.670>
- Delos Santos, J. T. D., Lim, R. R., & ROgayan, D. V. Jr. (2021). Least mastered competencies in biology: Basis for instructional intervention. *JPBI(Jurnal Pendidikan Biologi Indonesia)*, 7(2), 208-221.
<https://doi.org/10.2219/jpbi.v7i3.17106>
- Etobro, A. B. & Banjoko. S. O. (2017). Misconceptions of Genetics Concepts Among Pre-service Teachers. *Global Journal Education Research*. Retrieved from: <http://dx.doi.org/10.4314/giedr.v16i2.6>
- Ezechi, N.G. (2021). The Problems of Teaching and Learning Genetics in Secondary Schools in Enugu South Local Government Area of Enugu State. *British International Journal of Education and Social Sciences*
- Joshi, N. (2022). Benefits of Video Based Learning. Retrieved from: <https://www.evelynlearning.com/benefits-of-video-based-learning>
- Kareem, A. (2018). The Use of Multimedia in Teaching Biology and Its Impact on Students' Learning Outcomes. *The Eurasia Proceedings of Educational & Social Sciences (EPESS)*, 9, 157-165.
- Khan, S. (2019). Effectiveness of Video Based Instruction Among Secondary School Biology Students' Academic Achievement: Empirical Study. *International Journal of Social Science and Humanities Research* 7(2), 152-157.
- Malipot, M. (2023). 2022 PISA results a 'clear indication' that PH education system is in 'worst state'. *Manila Bulletin*. Retrieved from: <https://mb.com.ph/2023/12/6/2022-pisa-results-a-clear-indication-that-ph-education-system-is-in-worst-state-pb-ed>
- Mendoza, G., Caranto, L., David, J. (2015). Effectiveness of Video Presentation to Students' Learning. *International Journal of Nursing Science* 2015. 5(2): 81-86. DOI: 10.5923/j.nursing.20150502.07
- Ogbewei, O. (2017). Why written objectives need to be really SMART. *British Journal of Healthcare Management*. Vol. 23, No. 7.
<https://doi.org/10.12968/bjhc.2017.23.7.234>
- Prieto, N., Naval, V., Carey, T. (2017). Practical Research for Senior High School. *Lorimar Publishing Inc*. Quezon City, Metro Manila