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Research Article

Development of Flexible Learning Instruction Through Progressive, Personalized, Engaging and Diversified (FLIPPED) Video Media in Mathematics

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ABSTRACT

Video media offers a novel way of learning. With its flexible learning features, such as options for review and accessibility anywhere, individual learning needs are better met. This is advantageous when employed in a flipped learning setup for mathematics instruction, where learners need a significant amount of time to master a lesson. This developmental research design sought to develop flexible learning of instruction through progressive, personalized, engaging, and diversified (FLIPPED) video media as instructional materials for the least learned competencies in Grade 5 Mathematics, focusing on its application within a flipped classroom paradigm. The study employed a competency-based assessment tool (CBAT) in Mathematics and a researcher-made evaluation form for the acceptability of the developed video media as its primary instrument. Findings highlight specific areas of challenges in Mathematics 5, such as formulating rules for sequence progression, visualizing fraction multiplication, estimating decimal products, identifying base, rate, and percentage, and finding the circumference of a circle. Utilizing the IPO model, the video media was meticulously developed to offer flexible learning that can improve mathematics achievement. The video media was rated as "highly acceptable" in terms of its flexible learning, progressive instruction, personalized instruction, learners' engagement, and diversified instruction. The research findings conclude the efficacy of FLIPPED Video Media in addressing learning gaps and fostering a conducive learning environment that caters to diverse learning needs. The developed video media represents a paradigm shift in education, showcasing the transformative power of technology to enhance teaching and learning outcomes.

***Keywords**: Flipped classroom, Flexible learning, Video media, Grade 5 mathematics, Instructional materials*

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Introduction

Video lectures have been growing in popularity, and many organizations, universities, and open learning systems employ them as a main or self-study medium (Ilioudi et al., 2013). In fact, in 2021, when schools reopened for limited face-to-face classes, the Department of Education (DepEd), through a joint Memorandum No. 002, Series of 2021, strongly emphasized the need to use DepEd TV as part of the learning modalities under the Basic Education Learning Continuity Plan (BE-LCP).

DepEd TV episodes are in video format designed to capture learners' interest while leading them to attain targeted competencies. Since then, teachers have explored using these video lectures to keep up with the interests of post-pandemic learners who have spent several hours on their gadgets for the past quarantine years.

Giving the learners video lectures provides greater accessibility than traditional classroom learning tools. Technology-aided learning materials can take diverse forms and might affect important educational parameters such as learning performance and enjoyment (Ilioudi et at., 2013).

Husain (2014) mentioned that using multimedia has a significant impact and helps improve learning outcomes. Its goal is to maximize each learner's sense, whether it be auditory, visual, or a combination of the two.

Therefore, teachers can increase learners' interest in learning by developing multimedia materials like video lectures. Massive sources of such are available with a click on the internet. However, learners face several problems when watching long video lectures - a high cognitive load caused by information overload. Longer video duration can make learners feel bored due to short attention spans (Guo et al., 2014).

Because a person's working memory is limited, learners tend to be selective about what information to focus on during the learning process (Brame, 2016). This has important implications for creating educational materials.

In a study conducted by Guo et al. in 2014, they found that shorter videos were much more engaging. On their largest-scale study of video engagement or learners with 6.9 million video-watching sessions on the so-called many Massive Open Online Courses or MOOCs, the median engagement time of student participants is at most six minutes, regardless of total video length. These findings should be taken into consideration when teachers develop video lectures.

In their study, Zhang et al. (2006), which assessed the impact of interactive videos on learning effectiveness, emphasized that learners should be given options to control the video lectures, such as selecting important sections to review or moving backward when desired.

Video lectures nowadays are not only accessible during class hours or whenever the teacher is around. Most of these can be accessed at home, giving learners more control and their individual learning needs are better met.

Such a flexible setup is offered in a flipped classroom. The flipped classroom is a ―pedagogy-first‖ approach to teaching in which course materials are introduced outside of class, and in-class time is repurposed for inquiry, application, and assessment (University of Washington, 2022).

Nabayra (2019) added that a teacher who utilized this approach must have prepared a pre-recorded video lecture for the learners. Then, these videos would be watched at home. With this, they can have questions and prior knowledge of the topic. Learning tasks would be accomplished the next day at school with the teacher's aid. This gives the learner access to the lesson twice - at home and in the classroom, which increases the chance for better comprehension (Teach Thought Staff, 2014).

A flipped learning setup is advantageous in Mathematics instruction, especially when video lectures to be given to the learners are planned meticulously to explain mathematical concepts succinctly and to aid learners in a step-by-step process better.

Teachers should adapt to the findings to accommodate the needs of the learners of technology-aided materials if the traditional teaching method still results in low assessment results.

In a Competency-Based Assessment Tool (CBAT) test for Grade 5 Mathematics, it was shown that there were learning competencies

that learners were not able to meet the mastery level. This led the researcher to develop a learning media comprising video lectures with salient components ideal for a flipped classroom. This endeavor aimed to aid learners' performance on their least learned competencies in Grade 5 Mathematics. Specifically, this study sought to:

1. Identify the least learned competencies of learners in Grade 5 Mathematics.
2. Develop a video media to cater to the least learned competencies of learners in Grade 5 Mathematics.
3. Determine the level of acceptability of the developed video media in terms of (a) flexible learning, (b) progressive instruction, (c) personalized instruction, (d) learners' engagement, and (e) diversified instruction as evaluated by experts.

Methods

Research Design

This study employed a developmental research design. According to Richey and Klein (2005), developmental research aims to provide knowledge based on evidence that is methodically obtained from practice. In addition, it is a means to build new methods, approaches, and instruments based on a rigorous investigation of individual circumstances.

Additionally, developmental research is the study of creating, refining and assessing instructional procedures, products, and programs that must satisfy internal consistency and effectiveness standards, according to Seels and Richey (1994). Furthermore, Paler-Calmorin and Calmorin (2007) defined developmental research as decision-oriented research involving the application of the steps of the scientific method in response to an immediate need to improve existing practices.

Specifically, this study falls under Type I developmental research. Richey et al., (2004) defined type I developmental research as emphasizing the study of a specific product or program design, development, and/or evaluation projects, and its product focuses on the lessons learned from developing specific products and analyzing the conditions that facilitate their use. Based on the description by Richey and Klein (2005), Type I developmental research focuses on a certain instructional product, program, process, or tool. It is the most context-specific inquiry, and these types of studies address not only design and development but evaluation as well.

This present study is based on developmental research Type I because the researcher has developed a video media comprising five video lectures that serve as instructional material that can help improve learners' performance in Grade 5 Mathematics that experts in the field of education evaluated. Furthermore, the IPO model was the basis for developing the video media.

Participants

The twenty-five (25) Grade 5 learners of one of the schools in the province of Capiz have taken a competency-based assessment tool in Mathematics that enabled the researcher to identify the least-learned competencies. The data gathered from the competency test served as the basis for developing the video media.

Six experts were chosen purposively to evaluate the acceptability of the developed video media. These six experts have at least one expertise in the following fields: educational technology, information technology, learning resource management, and Mathematics education. Of the six, two are DepEd TV broadcasters and Television-Based Instruction editors from the Schools Division of Capiz, three are master teachers teaching Mathematics in the same schools' division and one is the Learning Resource Management System (LRMS) president, a master teacher, and video expert from the Schools Division of Iloilo.

Research Instrument

The researcher used a division-initiated Competency-Based Assessment Tool (CBAT) to assess the least learned competencies of learners in Grade 5 Mathematics. To score the acceptability of the developed video media, a researcher-made and validated evaluation questionnaire was used.

This competency-based assessment tool (CBAT) is a 50-item multiple-choice type test developed and validated by the Schools Division of Capiz and was used in this study to identify the least learned competencies in Grade 5

Mathematics. The researcher was one of the test developers and was granted the chance to acquire the results by writing permission from the school head.

The researcher developed an evaluation questionnaire for the acceptability of the developed video media by the experts. Five experts validated the researcher-made instrument to ensure its face and content validity. This instrument was used to determine the acceptability of the video media regarding Flexible Learning, Progressive Instruction, Personalized Instruction, Learners' Engagement, and Diversified Instruction. Experts used the five-point scale to score their responses: 5 - Strongly Agree (SA), 4 - Agree (A), 3 - Neutral (N), 2 - Disagree (D), and 1 - Strongly Disagree (SD).

Data Collection Procedure

The research followed the IPO model comprehensively.

Input. The input includes the test results from the CBAT [Competency-Based Assessment Tool] of one Grade 5 class coming from one of the elementary schools in the province of Capiz. The least-learned competencies were then analyzed from their test scores. The test results had undergone item analysis which revealed the five least-learned competencies in Grade 5 Mathematics.

Process. This stage includes the video media's designing, development, and evaluation phase.

Design. The following are the steps followed in the design stage adapted from the study of Abolucion and Bacio (2023):

Determining initial data. In determining the initial data for the development of the video media, the data gathered from the input stage served as the basis – these are the least-learned competencies of learners in Grade 5 Mathematics, as well as the literature that can be applied in the video media so that it can be understood and followed by learners if this will be utilized in a flipped classroom. Moreover, in this stage, the researcher also watched video lectures available online to learn how to design the video media.

Determining the content. After the initial design plan has been identified, the researcher proposed the following content and features of the video media:

Title. This is the topic of the entire lesson.

Objectives. This states the learning competency discussed in the video media. They explain the knowledge, skills, and attitudes that the video media contains and are stated in terms of the learners' behaviors. Objectives should focus on and organize the information that is presented.

Discussion. This is where the lesson is presented. Maranan (2004) explains that the participants preferred criteria such as content, clarity of presentation, and usability as the most important factors considered in learning materials.

Exercises. This includes items for learners to practice answering to apply what they have learned.

Summary. This part summarizes the important concepts in the topic, such as the definition of terms and processes involved in determining the answer to a word problem.

Design creation. After determining the design and content, the researcher created a draft or a prototype of each video lecture, including its template design and elements such as fonts' color, size, shapes, and other visual graphics using Canva. This stage also includes the writing of each script to narrate the lesson. Both were then submitted to the researcher's adviser for checking and critiquing.

Design finalization. Finally, the researcher finalized the planning and design phase after determining the initial data and the proposed content and creating prototype video lectures.

Development. The researcher improved the prototype module by adding more content based on the information gathered from the analysis in the input. In this stage, the researcher created templates and added elements to the video media using Canva. The slides made from Canva were then transferred to PowerPoint Presentation of Microsoft 365 for further enhancement of transitions and animations. Narrations for the discussions were also recorded using this software application. The improved slides were then extracted into video format. For the last stage of the video media creation, the researcher used Filmora11, a

video-editing software to adjust timing and add music background and sound effects.

After the video media development, this was submitted to the adviser for checking and six experts for evaluation.

Evaluation. The developed video media was evaluated on its acceptability by the six experts. The six (6) experts were: One DepEd TV National Teacher Demonstrator in Mathematics from the Schools Division of Capiz, one teacher demonstrator for Capiz Division TV, one Master Teacher III teaching Computer and Research from the Schools Division of Iloilo, and Three Master Teachers teaching Mathematics in the Schools Division of Capiz.

The results were analyzed to determine the level of acceptability of the video media using mean and standard deviation.

Output. The output of the study is the evaluated video media, which includes five researcher-made video lectures. Each video lecture includes the following parts: Title, Objectives, Discussions, Exercises with Solutions, and Lesson Summary. This video media will aid the learners in better understanding their least-learned competencies in Grade 5 Mathematics and can be used in a flipped classroom setting

Ethical Consideration

Ethics was properly observed in the present study based on the standards of American Psychological Association (APA) 7th Generation guidelines. The participants were not harmed in any way. Furthermore, ethical guidelines such as privacy and confidentiality were observed when conducting this research.

The researcher observed the following ethical principles in this study: (1) Permission to use the results of the Competency-Based Assessment Tool was solicited from the school head, and the privacy of data was employed. (2) The researcher informed the participants that the data gathered from them was solely for the purpose of this study. (3) School and participants' anonymity were reserved, and their confidentiality was respected.

Result and Discussion

Least Learned Competencies in Grade 5 Mathematics

This study utilized the result of the Competency-Based Assessment Tool (CBAT) administered by the Schools Division of Capiz among the twenty-five (25) Grade 5 learners from one of the schools in the province of Capiz. The least learned competencies in Grade 5 Mathematics were then determined based on the topics with the least number of learners who answered the items correctly.

Five least learned competencies were identified, as shown in Table 1. The first is formulating the rule in finding the next term in a sequence (2 or 8% of the Grade 5 learners answered the items correctly). Second, it visualizes the multiplication of fractions using models (3 or 12%). Third is the competency of estimating the products of decimal numbers with reasonable results (3 or 12%). Fourth is identifying the base, percentage, and rate of a problem (3 or 12%) and lastly, finding the circumference of a circle (3 or 12%).

Table 1. Least Learned Competencies in Grade 5 Mathematics

Least Learned Competencies	Frequency of correct responses	%	Rank
Formulates the rule in finding the next term in a sequence	2	8%	1
Visualizes multiplication of fractions using models	3	12%	3.5
Estimates the products of decimal numbers with reasonable results	3	12%	3.5
Identifies the base, percentage, and rate in a problem	3	12%	3.5
Finds the circumference of a circle	3	12%	3.5

These research findings provided valuable insights for the researcher to develop video lectures that can address the needs of learners to meet a proficient level for the mentioned

least-learned competencies. This is reinforced by Bacio and Sagge's (2022) findings, which indicate that certain learners, although having completed the lesson, have low mastery of competencies. This research highlights the critical need for tailored support and intervention strategies in mathematics education to address learning challenges and ensure learners develop a solid mathematical foundation.

Developed Video Media in Grade 5 Mathematics

Video is one form of learning media that can be employed in learning. Breslow et al. (2013) mentioned that video lectures offer a variety of interactional features that complement content delivered through various forms of both auditory and visual media. Mayer (2014) also supported video lectures as a learning media because of its salient aspect of how varied media can be combined and utilized in one material. It contributes to the way the learners perceive lectures and ultimately influences how they cognitively process information delivered to them. Learners who watch lecture videos learn by seeing and hearing words, images, and explanations simultaneously, thus improving retention (Mayer, 2009)

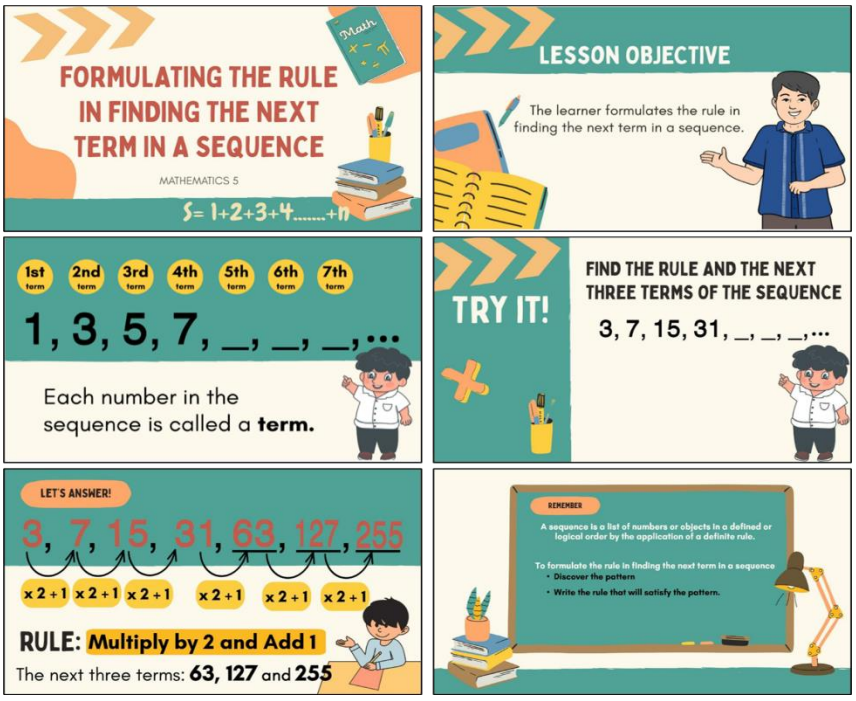

Figure 1. Sample Video Lecture for Mathematics 5

The developed video media were initially designed using Canva. The slides and elements, which include graphic images, shapes, and texts, were all added in Canva. The slides made from Canva were then transferred to PowerPoint Presentation of Microsoft 365 for further enhancement of transitions and animations. Narrations for the discussions were also recorded using this software application. The improved slides were then extracted into video format. For the last stage of the creation of the video media, the researcher used Filmora11, a video-editing software to adjust timing and add music background and sound effects.

The components of each video lecture should be the title, overview, objectives, discussion of content, self-check test, evaluation activities, and references. This format is based on Acuram's (2015) statement that the design and style may differ depending on its purpose and the institution where it is developed. The video lectures also follow the components of a typical module enumerated by Aguirre (2015), including the title, overview, objectives, learning activities, and post-test.

Title. The title is a brief but comprehensive statement of the entire theme in a specific topic that coincides with the target learning

competency. It serves as a guide for the learners on what a certain video lecture offers.

Learning Objectives. These are specific statements that would guide the learners on what was expected of them in going through each video lecture. It can be found immediately after the title slide. These objectives were congruent with the competencies found in the curriculum guide for Grade 5 Mathematics.

Discussion. This part of video media is the actual lecture, wherein every lesson is presented clearly, comprehensively, and with specific examples. It will enrich learners' understanding of the topic because of the comprehensive content for every lesson. This follows right away after the learning objectives.

Exercises. The learners take the exercise after watching the discussion part of the video lectures. These are self-check activities for the learners to work independently to discover how far they have learned.

Solution. This feature in the video media will give the learners immediate answers as feedback to the questions posed in the exercises to keep track of their progress. Ajogbeje (2023) stated that immediate feedback on learners' activities could significantly enhance learning outcomes, clear up confusion, and increase learners' engagement as they can see the impact of their efforts in real-time.

Summary. This section summarizes the key concepts and processes discussed in the video lectures.

These necessary parts and features of the video lectures support Karabulut-Ilgu et al. (2017) ideas on the benefit of employing flipped learning. When applied to learning mathematical concepts, the opportunity to pause and rewind video lectures, take notes, and work through sample problems were the benefits, especially for learners with various learning preferences and personal responsibilities.

The developed video lectures were compiled and uploaded to the researcher-made website using Google Sites since one of its goals is to become usable in a flipped classroom paradigm, offering flexibility. The website contains the following: Home, About the Video Media, Course Outline, Videos, Evaluation, Answer Key, Grade 5 Mathematics Curriculum Guide, and About the Author, and can be accessed through https://tinyurl.com/math5videomedia.

Acceptability of the Video Media

This study determined the overall acceptability of the developed video media in terms of its flexible learning, progressive instruction, personalized instruction, learners' engagement, and diversified instruction. Six experts have examined and evaluated the video media.

The experts have given a rating of ―Highly Acceptable for flexible learning (M = 5.00, SD = 0.00), progressive instruction (M = 4.96, SD = 0.08), personalized instruction (M = 4.96, SD = 0.08), learners' engagement (M = 4.96, SD = 0.08), and diversified instruction (M = 4.92, SD = 0.10).

Table 2. Acceptability Level of the Video Media

Indicators	SD	M	Description
Flexible Learning	0.00	5.00	Highly Acceptable
Progressive Instruction	0.08	4.96	Highly Acceptable
Personalized Instruction	0.08	4.96	Highly Acceptable
Learners' Engagement	0.08	4.96	Highly Acceptable
Diversified Instruction	0.10	4.92	Highly Acceptable
Grand Mean	0.03	4.96	Highly Acceptable

Note: Description is based on the following scale. 4.51-5.0 (Highly Acceptable), 3.51-4.50 (Acceptable), 2.51-3.50 (Moderately Acceptable), 1.51-2.50 (Fairly Acceptable), 1.0-1.50 (Not Acceptable)

In general, an overall rating of ―Highly Acceptable‖ was found by the experts (M = 4.96, SD = 0.03). This shows that the developed video media has excellently met the standards, and

no revision is needed, as it offers flexible learning, progressive instruction, personalized instruction, learners' engagement, and diversified instruction. Table 2 reveals the experts' evaluation of the overall acceptability of the video media.

This result follows the study of Sagge et al. (2023), who cited that the developed material is indeed reliable, as revealed by the high percentage obtained in the strongly agree category of the evaluation tool. It can be derived that the developed video media was valid for its flexible learning, progressive instruction, personalized instruction, learners' engagement, and diversified instruction and, therefore, could be used as an alternative instructional material for enrichment and remediation.

The findings of this study may help enhance learners' performance in Grade 5 Mathematics this is because the video lectures' objectives, content, activities, style and presentation, and organization were adequate, sufficient, and appropriate for the intended users, as evidenced by the high acceptability over-all rating by the experts. According to Madeline (2017), lectures that have been pre-recorded allow students to spend more time at home listening, comprehending, and taking notes. The lectures can be reviewed later in addition to the notes and assignments students completed in class, serving as a helpful study tool. This is specifically determined in the video media's personalized and diversified instruction criteria which the experts rated as highly acceptable.

Moreover, instructional videos are recognized for their ability to provide new material, give background knowledge, encourage active learning, and provide a change of pace from conventional lecture formats—all of which add to their educational value (Traynor, 2020). Such was shown in the high acceptability of the criterion, learners' engagement as rated by the experts.

The developed video media was also rated as highly acceptable on its flexibility, which suits the flipped classroom paradigm as Myllymäki et al. (2019) claimed that educational videos may be used to supplement or substitute classroom teaching. Hakala et al. (2017) also noted the flexibility that video lectures offer and because these could be accessed in a flexible manner such as time and place, they can open new participation opportunities to the learners.

The development and evaluation of FLIPPED video media for Grade 5 Mathematics has significant implications for improving both learning outcomes and instructional practices. Expert validation of these ready-to-use materials suggests their potential to effectively address learning gaps in specific mathematical competencies. Offering a flexible and engaging alternative or supplement to traditional instruction, these videos cater to diverse learning styles and promote self-paced learning by enabling anytime, anywhere access for concept reinforcement and skills practice. This accessibility empowers teachers to personalize instruction and differentiate learning experiences, creating a more effective and engaging learning environment. Furthermore, this study validates the flipped classroom approach, providing a practical example of successful video integration. By incorporating clear objectives and integrated exercises, these videos facilitate flipped classroom implementation and self-assessment. When designing video-based learning, it's crucial to consider diverse learning needs and accessibility, regularly gathering feedback to refine the approach and optimize the learning experience. Ultimately, FLIPPED video media represents a valuable technological tool for creating dynamic learning environments that cater to individual learning styles and improve learning outcomes in mathematics education.

Conclusion

The identification of least-learned competencies highlights the need for targeted interventions and additional support in mathematics education. The structured video media addresses these challenges by providing comprehensive learning experiences with clear objectives, in-depth discussions, and integrated exercises. Expert validation confirms the videos' quality and suitability for diverse learning needs, promoting flexible, engaging, and personalized instruction. As a valuable tool for 21st-century learners, video media within a flipped classroom model fosters independent learning and enhances student engagement.

Ultimately, these innovative materials represent a paradigm shift, leveraging technology to improve teaching and learning outcomes and empower learners in the digital age.

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