Designing and Developing Video Lessons in Mathematics Using Code-Switching: A Design-Based Research

Roberto G. Sagge, Jr.* and Rufino T. Segura, Jr.

***Abstract*—Unlike books and audio clips, videos provide stronger visual cues. They are made to help learners comprehend the events particularly when situations call for language interpretation. This design-based research developed a module in the form of video lessons covering the least-mastered competencies in Mathematics for Grade 9 students. This study identified the least-mastered competencies through a survey. Using the snowball sampling method, the researcher chose fifty public school teachers as participants in the study. The module was designed and developed with five video lessons, each lesson covering one competency. During the implementation stage, the lecturer employed code-switching to facilitate instruction. Forty Grade 9 learners had utilized the said module, which was evaluated by both learners and experts according to various criteria. Overall, the module was rated "acceptable" by both learners (M=4.44) and experts (M=4.65). Moreover, the module was deemed "highly acceptable" in terms of learning outcomes (M=4.58), and style and presentation (M=4.61). Code-switching as the medium of instruction, was also evaluated and rated by learners as "highly acceptable" in terms of attention (M=4.62), attitude (M=4.53), and success (M=4.74). The developed module achieved its objectives and opened opportunities for technology integration to cater to 21st-century learners. This approach to education caught the learners' attention in helping them improve their knowledge and critical thinking ability, which are the goals of the secondary school mathematics curriculum. The output of this research may be used by other Mathematics educators as instructional material, and further assessment of its effectiveness is recommended.**

***Index Terms*—Design-based research, least-mastered competencies, code-switching, video lessons**

I. INTRODUCTION

Learners are robbed of their brighter future if they are taught using the same teaching techniques, methods, and strategies from the past. For this reason, teachers should integrate technology into their classrooms to fully engage and educate students of this generation [1].

The declaration of the global pandemic COVID-19 changed people's lives in different ways. Because of the extra precautions observed to avoid the disease, employment, health care, travel, the economy, and many others were affected. The rise of the pandemic dampened the educational system to boot, as there was a shift of emphasis on distance learning curriculum. For schools that can afford distance learning, online platforms like Khan Academy, Byju, and Coursera have provided access to quality virtual education. However, the only option for remote areas and developing countries is a modular approach in the form of printed materials.

The Department of Education in the Philippines modified the K to 12 curriculum competencies into the "Most Essential Learning Competencies" (MELCs). It presents the necessary yet attainable competencies in all subjects from kindergarten to senior high school. In this connection, some topics in the past curriculum were omitted. The content and performance standards were reviewed and studied to ensure that no learner would be left behind.

Sanchez [2] stated in 2017 that out of 67 million adult Filipinos (16 years and older), 60 million are active Internet users. 87% of Filipino users watch online video content, and the figure continues to rise indefinitely. YouTube is among the most popular social media sites for entertainment, information, sports, and music. Known as a top site used by Filipinos, students also use this platform to either look for solutions to their assignments or clarifications for their lessons [3]. Others say they sometimes learn their lessons better through YouTube videos compared to their teacher.

Since videos are readily available, human beings innately see their effectiveness as a learning tool. Most Higher Education Institutions (HEIs) have greater online learning environments now that internet-related infrastructure is more affordable and potent, and more video content is being sought after [4]. Thus, the use of video snippets makes the process of thinking and remembering more effective [5].

Several studies and learning theories were studied and applied to maximize the learnability of learning materials. Globally, these studies were taken into consideration in curriculum planning and development. Education, in general, was very flexible. Every year, the curriculum was reviewed and modified, and teachers continued to explore suitable teaching strategies to cope with the changes. Kahrmann [6] mentioned that while students use video tutorials to learn Mathematics, they tend to improve their understanding of Math concepts using these instructional videos and real-life activities. With this scenario in mind, the researcher was eager to determine the efficacy of videos, tutorials, or video-related instructions as a potential tool for learning.

The influence and benefits of technology integration as a teaching strategy have inspired new ideas for instructors nowadays. From the first to the last quarter of 2020–2021, Azlan and Narasuman [7] produced 60 YouTube videos covering themes appropriate for Grade 9 students that totaled 12 hours of information. Math lessons were taught to kids in Filipino to give them the same educational experience as the usual lecture in school. They observed that students who prefer learning visually or having a teacher explain the lesson through visual aids have reported that videos have helped

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Roberto G. Sagge, Jr. was with the College of Education, West Visayas State University, Iloilo City, Philippines.

Rufino T. Segura, Jr. was with the College of Education, Iloilo Science Technology University, Iloilo City, Philippines.

*Correspondence: robertosagge@wvsu.edu.ph (R.G.S.J.)

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them a lot. Because of the videos, students do not feel the pressure to attend synchronous classes, since videos serve as an alternative or a supplement to textbooks and learning guides.

Meanwhile, code-switching was defined by Jamshidi and Navehebraim [8] as the process of alternating the use of two languages within only one discourse, sentence, or constituent. Several studies have been conducted in various countries examining code-switching and its use in the classroom. Junaidi [9] reports that learners who are permitted to code-switch in the classroom can communicate with their peers and teachers better. Learners usually end up either interrupting themselves while answering a question or declaring that they do not know the answer (even if they do) because they fail to express their ideas and communicate effectively in English. More commonly, code-switching is utilized pedagogically rather than unintentionally. Mangila [10] reports that teachers code-switch for pedagogic purposes such as instructional or content acquisition, and reformulation and facilitation. The study also mentioned that code-switching among Filipino teachers commonly involves two languages: Filipino (or Tagalog) as the native or local language, and English as the official second language of the Philippines [11].

Categorically, the positive results of the studies conducted by Azlan *et al.* [7] and Junaidi [9] have inspired teachers to try and look into the efficacy of video-based modular instruction in the delivery of continuous quality education, with the belief that students may experience the advantages when lessons are taught in the learner's native language [12–14].

Besa [15] likewise argued that the implementation of Mother-Tongue-Based Language (MTBL) education engendered a positive effect of multilingualism among learners. In an experimental study by Obod *et al.* [12], findings suggested that MTBL effectively taught the concept of fractions to second-grade learners. The same result was revealed by Ricablanca [16] when implementing similar interventions for first-grade learners and third-grade learners [17].

In addition, Gempeso and Memdex [18] conclusively posit that having language barrier is one of the factors that balk students' ability in comprehending test questions. Practically, the implementation of the K to 12 Mother Tongue-Based Multilingual Education (MTBMLE) programs both enhances learners' understanding of Mathematics and preserves the local language.

The Philippine Mathematics Curriculum was designed with the dual objectives of fostering students' capacity for critical thought and problem-solving [19]. These two abilities caught the interest of local and international educators because of their usefulness in coping with this rapidly changing modern environment. Though mathematics curriculum in secondary schools has long been delivered in the English language, teachers in traditional classroom settings employ code-switching in the delivery of this subject for as long as the twin goals are achieved. Across the globe, teachers commonly use code-switching to disseminate knowledge to learners in bilingual and multilingual contexts [20].

It is impossible to overstate the value of language skills in the study of Mathematics. Numerous studies have established a connection between poor linguistic proficiency in the classroom and poor mathematical success [21]. In nations where the language of instruction is not the learners' first language, code-switching is seen as a crucial component of mathematics learning and teaching. Teachers are observed to use this style of speech for the reformulation of instructions, among other things [21].

Paz [22] conducted an experimental study using local Bicol languages to deliver math lessons. As he compared the students' scores between two groups— one taught in pure English instruction, and the other taught using multilingual instruction (a combination of English, Filipino, and Bicol dialects)— he noticed that their scores differ significantly. Furthermore, the paper suggests that multilingual instruction is essential in underscoring students' performance.

On the other hand, Metila [23] has a different stance on the use of code-switching in math classes. He claimed that code-switching continues to raise concerns among educators, administrators, and even parents. He confirmed in his research that code-switching by mathematics professors was proven to have detrimental consequences on the subjects' learning. His investigation pointed out that pupils were puzzled by teachers' code-switching, which had an impact on how well they retained the material. In summary, students had considerably higher accomplishments when their teachers engaged in less disruptive discussion and explanation, such as code-switching, and indicated definitions.

Considering the research coverage of studying code-switching in education, this study hoped to provide empirical, discipline-specific, and detailed information on the use, effectivity, and influence of code-switching in teaching and learning Mathematics.

This study aimed to develop video lessons to enhance the least-mastered Most Essential Learning Competencies (MELCs) of Grade 9 learners in their Mathematics subject. Specifically, this research sought to answer the following questions:

(1) What are the Grade 9 learners' least-mastered MELCs in the third quarter Mathematics?

(2) What instructional material can be developed to address the Grade 9 learners' least-mastered MELCs in the third quarter Mathematics?

(3) What is the overall level of acceptability of the developed video lessons when assessed according to (a) learning objectives; (b) content; (c) learning activities; (d) style and presentation; (e) organization; (f) creativity; and (g) assessment, as evaluated by the experts and learners?

(4) What is the overall level of acceptability of the use of code-switching instruction in the developed video lessons in terms of (a) attention; (b) attitude; and (c) success?

II. Research Design and Methodology

This study used the ADDIE (Analysis Design Development Implementation Evaluation) approach of design-based research. Design-based research, in contrast to other research techniques, may take the shape of several qualitative and quantitative research procedures, as it is less likely to be identified with just those methodologies. The goal of design-based research is to promote the impact, transfer, and translation of education research into better practice. It was created by and for educators. Its crucial features were described as a systematic but adaptable methodology. It aimed to enhance educational practices through iterative analysis, design, development, and implementation based on collaboration between researchers and practitioners in actual settings, producing contextually sensitive design principles and theories.

Design-based research was defined by Plomp and Nieveen [24] as either designing and developing educational interventions (e.g., learning processes, learning environments) to develop or validate theories, or designing and developing educational interventions (e.g., programs, teaching-learning strategies, and materials, products, systems) as a solution to a complex educational problem.

This study employed design-based research because it aimed to develop and evaluate video lessons that carry out the continuous and effective delivery of mathematics lessons amidst the pandemic. According to Easterday *et al.* [25], scientific discoveries may also be the end outcome of a design process. For instance, when experimenting, scientists might concentrate on a particular subject, comprehend the relevant literature, formulate a hypothesis, design an experiment, acquire and analyze data to create a proof, and then evaluate the veracity of their conclusions through peer review or other means.

A. Research Participants

To determine the least-mastered yet most essential learning competencies among the third quarter Mathematics competencies, the researcher utilized a checklist to rate the level of mastery of the competency according to the observation and experiences of the teachers who have taught the subject in the third quarter of the school year 2020–2021. The participants were gathered using snowball sampling. The researcher had communicated with the mathematics supervisor of the province, who then recruited qualified teachers (who met the criteria) to participate in the study. Data gathering took three weeks, and every response was checked time and again to ensure that sufficient detailed information was extracted from the desired respondents. Eventually, a quota of 50 responses was met. To support the results of the checklist, the researcher asked the respondents about the least-mastered competencies. The five least-mastered competencies were the basis of the generation of the topics to be covered in the video lessons prepared by the researcher.

Learners. Instruction facilitation through utilization of the developed module was implemented among 40 Grade 9 learners in a national high school in the second district of Iloilo, school year 2021–2022. Afterward, they were tasked to rate the module based on the level of their acceptability and to provide written feedbacks on the developed video lessons.

Experts. Nine experts, including the subject teacher, evaluated the video modules' acceptability. Among the nine experts are an ICT expert, a curriculum and development expert, and seven public secondary school teachers.

B. Data Gathering Instruments

To evaluate the acceptability of the developed module: two questionnaires were used. Firstly, a researcher-made five-point Likert scale questionnaire was used to assess the module in terms of learning outcomes, content, style and presentation, organization, activities, and assessment. Each participant was asked to check the appropriate column for his/her answer.

Secondly, a five-point Likert scale questionnaire was adopted from the study of Yusob *et al.* [26] to collect data on the experiences and perceptions of the participants on the use of code-switching as a medium of instruction in the delivery of these Mathematics lessons. A formal letter of request was sent to the main author of the instrument to obtain permission to utilize the instrument. An immediate reply was received with approval from the author to use such an instrument for the current study.

In both instruments used for the evaluation of the acceptability of the lessons, each participant was asked to check the appropriate column for his/her answer. To score the responses, the following five-point scale was used: 5— "Strongly Agree (SA)," 4— "Agree (A)," 3— "Moderately Agree (MA)," 2— "Disagree (D)," and 1— "Strongly Disagree (SD)."

Additionally, the opinions and experiences of the participants about the developed module were also gathered. The questions pertaining to the use of video presentations as a learning module were adopted from the study of Ou *et al.* [27] were.

C. Research Procedure

The whole procedure of this research followed the ADDIE model.

1) Analysis. In this stage, the researcher distributed a checklist to the teachers to determine the least-mastered competencies of the third quarter Grade 9 Mathematics.

With the limitations caused by the pandemic, the researcher used the Google Forms platform to facilitate the distribution of the instrument. Google Forms is part of Google's web-based apps that allows anyone to create surveys, quizzes, and worksheets. Using a Gmail account, a teacher may be able to participate in answering the checklist. To increase the scope and number of the teacher-respondents, the researcher asked for help from the Mathematics education supervisor of DepEd, Iloilo, to distribute the Google form link.

Checklist administration and data gathering were carried out for three weeks to collect enough information from the respondents. The data was then analyzed to determine the least-mastered competencies. After the five least-mastered competencies had been identified, another Google Form was distributed to the same set of teachers to inform them of the result and ask for their justification on the least-mastered competencies through a written interview. This is to ensure that teachers who provided the written justification had identified these competencies to be the least-mastered ones through their checklist results.

2) Design. The results of the checklist were analyzed and used as the basis for the development of the video modules. The five least-mastered competencies are the focus of the competencies to be presented and discussed in the video modules. The instructional plan or the format of the video modules was adopted from the lesson presentation by

Ou *et al.* [27]. Each video lesson has the main objective to help learners attain one least-mastered competency. Each video lasted for an average of 30 minutes.

The presentation of the lecture was integrated with activities and exercises to attain mastery of the different aspects of the mathematics concept. The format of a lecture follows the four-phase instruction—activation, demonstration, application, and integration—to provide a comprehensive discussion of the topics to be covered [28].

i) Activation. Each lesson began with a preview where the lecturer introduces the topics that would be covered. Additionally, they instructed learners to think about them and relate them to any prior knowledge and experience that would serve as a basis for the new information. Oftentimes, it may be referred to as the "review", determining the extent of knowledge of the learners, especially on the topics that are pre-requisite of the current topic. This part covered five minutes of the whole lesson.

ii) Demonstration. The lecturer used a variety of real-world examples to illustrate the various approaches, tasks, and applications during this phase. These examples were presented through graphics, tablet capture, illustrations, animation, and simulation. In a nutshell, this was the section of the phase where the content was covered in depth. The researcher aligned the nature of the problems and presentation of topics in the printed modules distributed in schools. This part covered ten minutes of the whole lesson.

iii) Application. The video courses include interactive tasks so that learners may put what they have learned from the demonstrations into practice. The lecturer also discusses how the new information may be used in the actual world. In this stage, the learner performs the provided exercises in the video relevant to the topic or concept/s previously discussed. Depending on the learner's pace, the video may be paused while the learner is working on the exercises. After the exercises, the questions are answered by the lecturer so that the learner can verify if his/her solutions are correct. A series of exercises were presented to allow the learner to master the targeted competency and to eventually grasp the whole concept. For recall purposes, learners' involvement was encouraged by letting them answer questions after the discussion. This part covered ten minutes of the whole lesson.

iv) Integration. The lecturer concluded the video by summarizing the topics or concepts covered and making connections between them and listing the topics to be addressed in the succeeding lesson. In addition, the lecturer also looked at how the topics or concepts relate to human cognition. Learners were asked to think about and record their key takeaways before the end of the video. Three minutes of the entire video were devoted to this section.

The remaining two minutes were intended for the preliminary part of the lesson which includes the presentation of the topic and the specific objectives. Also, this part reminds the learners of some important guidelines in watching the video.

3) Development. In this stage, the researcher developed video modules for each least-mastered competency. Initial validation of the developed module was done in this stage. Three experts assessed the module by looking at different aspects. One junior high school teacher of Grade 9 mathematics and one curriculum and instructional development expert checked the alignment of the content of the video to the MELCs. Lastly, one ICT specialist looked into the integration of technology in the delivery of mathematics concepts to improve the presentation and quality of the video module.

4) Implementation. In the implementation stage, the researcher asked permission from the principal of the school to implement the video modules in Grade 9 learners through a formal letter. The implementation took place during the third quarter. After securing written consent from the learners, the researcher created an online group chat so that the researcher can give detailed and additional instructions to the learners and answer further queries about the implementation. The video modules were distributed through an OTG (On-The-Go) external device that can be plugged into a student's phone, laptop, or tablet. The parents or guardians received both the video modules (in an external device) and the printed modules. In addition, learners' works are also checked to monitor their participation. Finally, ethical considerations have been looked into as one of the top-most priorities during and after the conduct of the study. All data were treated with utmost respect based on the respondents' informed consent, voluntary participation, and confidentiality.

III. Results and Discussion

A. Least Mastered MELCs in the 3rd Quarter Grade 9 Mathematics

Research Question No. 1: What are the Grade 9 learners' least-mastered MELCs in the third quarter Mathematics?

A survey questionnaire was used and distributed to the respondents to answer this research question. The survey revealed the five least-mastered competencies as follows: (a) proves theorems on the different kinds of the parallelogram, (b) proves the conditions for similarity of triangles by special right triangle theorems, (c) proves theorems on trapezoids and kites, (d) proves the conditions for similarity of triangles by Angle Angle (AA) similarity theorem, and (e) proves the conditions for similarity of triangles by right triangle similarity theorem. (See Table I). Among these five competencies, the least-mastered competencies are: proving the conditions for the similarity of triangles by AA similarity theorem ($M = 3.28$, $SD = 0.72$), and proving the conditions for similarity of triangles by right triangle similarity theorem ($M = 3.28$, $SD = 0.72$). The mathematics curriculum, regardless of the education system, includes many essential competencies that are expected to be learned and/or mastered by learners after a specified time. Weber [29] also highlights the role of teachers in recognizing learners' struggles and finding ways to help them overcome them. Additionally, Weber [29] also studied the common struggles of students in mathematical proofs; which is similar to the initial findings of this study. Moreover, Ereño and Benavides [30] also agree that proving (or proofs, in general) is an absolutely difficult mathematical concept and skill for students to learn and master.

TABLE I: LEAST MASTERED MOST ESSENTIAL LEARNING COMPETENCIES (MELCS)

MELCs in Grade 9 Mathematics	M	SD	Rank
proves theorems on the different kinds of parallelogram (rectangle, rhombus, square) (M9GE-IIIc-1);	3.22	0.78	1.5
proves the conditions for similarity of triangles by special right triangle theorems (M9GE-IIIg-h-1);	3.22	0.67	1.5
proves theorems on trapezoids and kites (M9GE-IIId-2);	3.26	0.74	3
proves the conditions for similarity of triangles by AA similarity theorem (M9GE-IIIg-h-1); and	3.28	0.72	4.5
proves the conditions for similarity of triangles by right triangle similarity theorem (M9GE-IIIg-h-1).	3.28	0.72	4.5

Bacio and Sagge [31] stressed that competencies aid students in drawing and building upon what they know, how they think and what they can do. There is, then, a remarkable importance to examine the competencies learned and mastered by students in any subject matter or discipline. It was confirmed by Sagge and Espiritu's [32] research that identified least-mastered competencies indicate that some learners still cannot fully master a particular competency even after completing the course. This poor retention may hinder learning. Offering alternative and/or additional instructional resources to students can help them master the competencies required of them [33, 34]. Similarly, this current study was initiated due to learners' low mastery level of competencies. Hence, this set of information was utilized to develop instructional materials, specifically, video lessons employing code-switching.

B. Developed Video Lesson Using Code-switching

Research Question No. 2: What instructional material can be developed to address the Grade 9 learners' least-mastered MELCs in the third quarter Mathematics?

The results of the initial survey may imply that the learners do not fully comprehend the topic or concept involved in the competencies identified. Prabowo and Ambarini [35] discussed that educators must develop instructional materials with focus on the subjects or topics where students mostly encounter difficulty. To help learners master the identified least-mastered competencies, the researcher produced video lessons with the use of code-switching in delivering the lesson.

Nilep [36] revealed that code-switching of teachers is effective in transferring knowledge to learners. Additionally, it is a useful technique for encouraging interaction in multilingual mathematics classrooms. Code-switching is also deemed a method of contextualizing discourse [37]. Using contextualized instructional materials is recommended to assist learners in mastering essential learning competencies [38]. Contextualization is essential because many of the materials available are written by foreign authors and their presentation of the subject matter may not always be appropriate or suitable for Filipino students [39, 40]. The developed video lessons may be considered one of the best options for distance learning considering the many relevant researches mentioned in this study. This instructional material was chosen to provide learners equal access to continued learning during the pandemic. The video modules were compiled on an external device providing each learner sufficient time to watch it without needing an internet connection. The video modules were composed of a learning guide and lecture discussions. The five least-mastered competencies were discussed separately following the same format adopted in the study of Ou *et al.* [27]. Shown in Fig. 1 is a screenshot collage of a sample video lesson.

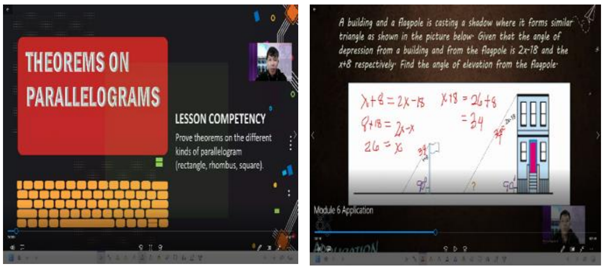

Fig. 1. Sample of the developed video lessons using code-switching.

Code-switching was among the focal points of this study. It was utilized in the delivery of instruction (i.e., in discussing the content of the video modules). The results revealed that both the learners and experts found using code-switching to be a successful instructional technique. It helps learners understand the lessons better. Some learners also shared that it is both effective and efficient as it lessens their anxiety about learning the subject, thereby, increasing their exposure to learning mathematics and improving their achievement. This was also evident in the findings of the study of [41] Portana *et al.* [41], that is, code-switching was mainly used by lecturers for the sake of learners' understanding of concepts. Other times, code-switching may also be commonly done when the speaker wants to present the context of a conversation [42].

C. Learners' and Experts' Acceptability Evaluation

Research Question No. 3: What is the overall level of acceptability of the developed video lessons when assessed according to (a) learning objectives; (b) content; (c) learning activities; (d) style and presentation; (e) organization; (f) creativity; and (g) assessment, as evaluated by the experts and learners?

TABLE II: OVERALL ACCEPTABILITY OF THE VIDEO LESSONS

	Learners		Experts		Overall Mean	SD	Description
	M	SD	M	SD			
Learning Objectives	4.55	0.60	4.73	0.49	4.58	0.58	Highly Acceptable
Content	4.39	0.70	4.73	0.57	4.45	0.71	Acceptable
Activities	4.35	0.68	4.51	0.72	4.38	0.69	Acceptable
Style and Presentation	4.62	0.51	4.58	0.54	4.61	0.51	Highly Acceptable
Organization	4.43	0.61	4.76	0.48	4.49	0.60	Acceptable
Creativity	4.39	0.59	4.51	0.62	4.41	0.60	Acceptable
Assessment	4.33	0.69	4.76	0.43	4.40	0.67	Acceptable
Overall Rating	4.44	0.64	4.65	0.57	4.48	0.63	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) 1.00–1.50 (Not Acceptable)

Table II presents the results of the evaluation of the acceptability of the video lessons. The developed video lessons were rated "acceptable" by both learners and experts with an overall mean of 4.48 (SD = 0.63). It implies that the video modules have satisfactorily met the set standards and very few revisions were suggested. More specifically, the module was rated "highly acceptable" in terms of learning outcomes (M = 4.58, SD = 0.58), and style and presentation (M = 4.61, SD = 0.51). This suggests that the module was well-constructed and that the objectives were aligned with the content of the lecture. Consequently, it may be also implied that the presentation of the lesson encouraged student engagement and motivation. Meanwhile, it is rated "acceptable" in terms of its content (M = 4.45, SD = 0.71), activities (M = 4.38, SD = 0.69), organization (M = 4.49, SD = 0.60), creativity (M = 4.41, SD = 0.60), and assessment (M = 4.40, SD = 0.67). These findings are coherent with the results of the research conducted by Salcedo [34] which found that instructional materials may be considered acceptable and appropriate for their intended users if their objectives, content, activities, and evaluation are sufficient. Moreover, learners' comprehension of a material is increased when this is presented to them with both visual and auditory cues [32, 34]. Lin [43] also emphasized that learning and instructional materials should be developed or created while considering several factors like instructional content, procedure, relevance, knowledge and practical applications, clarity, development of higher thinking skills, and alignment with the thrusts and goals and, objectives of the university. Similarly, this paper reports on the acceptability of the developed video lessons concerning similar and other factors.

D. Acceptability Evaluation of Code-Switching in the Video Lessons

Research Question No. 4: What is the overall level of acceptability of the use of code-switching instruction in the developed video lessons in terms of (a) attention; (b) attitude; and (c) success?

This research question was answered through the responses of the respondents to the questionnaire about their experiences and perceptions on the use of code-switching in delivering the mathematics lessons in the videos.

As shown in Table III, the developed module was also evaluated based on its utilization of code-switching in the discussion. The instrument was rated "highly acceptable" (M = 4.63, SD = 0.55), suggesting that the use of code-switching was highly approved by the evaluators, and no revisions were needed. Moreover, all parameters were rated as "highly acceptable": attention (M = 4.62, SD = 0.54), attitude (M = 4.53, SD = 0.59), and success (M = 4.74, SD = 0.48).

TABLE III: OVERALL ACCEPTABILITY OF THE USE OF CODE-SWITCHING INSTRUCTION

	M	SD	Description
Attention	4.62	0.54	Highly Acceptable
Attitude	4.53	0.59	Highly Acceptable
Success	4.74	0.48	Highly Acceptable
Overall Rating	4.63	0.55	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) 1.00–1.50 (Not Acceptable)

Although code-switching is believed to be a common linguistic phenomenon among bilingual populations [44], it is not formally and widely recorded or studied in the local setting—Philippines. A comprehensive report of the current status of the literature on this research topic shares positive findings from two experimental research studies conducted [45] that using L1 (native language) allows learners to focus more on the meaning of the whole text rather than on processing the cognitive load of trying to fathom what the text is about [45], and that code-switching among teachers is superior over using only one language (more commonly, non-native or foreign language) in classroom teaching [45]. Furthermore, findings of various studies also found similar positive outcomes [9, 10, 36]. All these previous researches are consistent with the findings of the current study.

IV. CONCLUSION

The learners struggle to learn and master the competencies required in the topics on proving triangles and parallelograms. Taking into consideration the limitations of distance learning, learners have a weak motivation to learn mathematics in the form of printed modules. Learners have poor critical and analytical thinking skills; hence, their status threatens the quality of education. This realization is an emergent problem and must be provided with a solution.

The developed module was customized for the learners and contained specific topics that started by introducing the objectives, reviewing the necessary concepts, discussing the topic, and providing application problems. From time to time, they were also tasked to answer content-related activities. At the end of the lesson, there is a summary of the whole topic and a 10-item assessment to check learners' understanding. More learners were reached by the video modules because these were stored in an external device that can be plugged into their mobile phone or any compatible device and can be accessed anytime without an internet connection. They can study and learn the lessons in their own comfortable time and place.

The learning objectives, style, and presentation were adequate, sufficient, and appropriate for the intended users. The developed video modules met the standards of instructional material; thus, they may serve as supplementary instructional material to help learners learn at their own pace. It is tailored-fit to learners' level of thinking so as to engage them in learning topics, especially those that require proving concepts.

The modules presented in the form of videos were integrated with code-switching. The lecturer used two languages—Hiligaynon and English—to discuss the lessons in the videos. This was found to be effective and successful because it helped increase learners' engagement and lessened their anxiety about learning mathematics. The video module paralleled the needs and learning styles of 21st-century learners. The integration of technology, together with engaging, innovative, flexible, and colorful presentations, caught the learners' attention in helping them improve their knowledge and critical thinking ability, which are the goals of the secondary school mathematics curriculum.

Moreover, it is recommended that there is a need to do a case study of two groups, one is the experimental and the other is the controlled one to generalize the results.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Segura designed and conducted the research and drafted the paper; Sagge contributed by providing advice and suggestions for the improvement of the study, checking the manuscript, proofreading the article, and finalizing the format; and both authors approved the final version.

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