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Use of SAM in Developing Instructional Numeracy Materials

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ABSTRACT

In the Philippines, numeracy abilities are important because they play a major role in the country's economic development, technological advancement, and general societal advancement. This study assessed the numeracy skills and proficiency of Grade 6 students of Agaton C. Rodriguez Elementary School. Based on the Albay Numeracy Assessment Tool (ALNAT) pre-test result, the researchers were able to construct instructional videos in Mathematics 6 following the SAM model of instruction, which can help in the improvement of the students who fall in need of major support level during the numeracy assessment. The Mathematics 6 teacher and school ICT coordinator of the selected school served as the validators of the instructional videos and revisions were done according to their comments and recommendations. This study concludes that the SAM proves to be an effective and adaptable approach for designing and developing instructional content. The model promotes a user-centered process that prioritizes continuous refinement by focusing on its three core phases—Preparation, Iterative Design, and Iterative Development. The study also recommends that Instructional designers be open to revisiting earlier phases based on ongoing feedback, ensuring that the final product is continuously refined and meets learners' evolving needs. Engaged groups during the preparation and development phases help ensure the instructional content remains relevant and user-centered. Further recommends allocating adequate time for the iterative design and development process. For SAM to be successfully implemented, instructional designers should receive proper training on its principles and best practices. Additionally, fostering collaboration between design teams, subject matter experts, and developers is essential for creating high-quality educational resources. Finally, regular evaluation during each phase of the SAM process ensures that instructional content meets both pedagogical and user requirements. Continuous assessment helps identify potential issues early on, leading to more effective solutions before final implementation.

INTRODUCTION

Numeracy skills are essential for navigating the challenges of modern life, as these are the ability to comprehend, apply, and use mathematical concepts in a variety of contexts. The range of numeracy skills among learners around the world reflects various educational frameworks. Globally, several challenges prevent the development of numeracy skills. Mathematics education in the Philippines is already facing major challenges. In the 2018 Programme for International Student Assessment (PISA), the Philippines ranked among the lowest in reading comprehension and ended up in the low 70s in Mathematics and Science across 79 countries in a study done by the Organization for Economic Cooperation and Development (OECD, 2019). The deteriorating performance of Filipino students in Mathematics has become a major challenge to Philippine education.

In the context of the Philippines, numeracy abilities are extremely important because they play a major role in the country's economic development, technological advancement, and general societal advancement. As the nation continues to navigate the opportunities and challenges of the twenty-first century, policymakers, educators, and stakeholders all need to have a thorough understanding of learners' numeracy skills. The education system is essential to shape and improve these skills and match them with the demands of a world that is becoming increasingly complex.

The TPACK (Technological Pedagogical Content Knowledge) framework provides valuable insights into teaching effectiveness. Research highlights that teachers with education-related degrees exhibit significantly higher TPACK competency levels due to their academic preparation, which emphasizes pedagogy and technological integration. Conversely, teachers without education-related degrees often require additional training to enhance their TPACK skills (Ferrer *et al.*, 2025). This finding underscores the importance of providing professional development opportunities tailored to teachers' educational backgrounds, ensuring they are equipped to foster student achievement effectively.

The 2013 Enhanced Basic Education Act, Republic Act No. 10533, is the enhanced basic education system in the Philippines, which covers kindergarten and 12 years of basic education, as outlined in Republic Act No. 10533 (Enhanced Basic Education Act of 2013), also referred to as the K to 12 Law. The curriculum is designed to provide learners with a holistic education, including the development of numeracy skills.

The DepEd Order No. 31, s. 2012, which is the Policy

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Guidelines on the Implementation of Grades 1 to 10 K–12 Basic Education Curriculum, published in 2012, offers guidance on how to implement the K–12 curriculum. One of the key components of this curriculum is the development of competencies across a variety of subject areas, including mathematics, to improve students' numeracy abilities.

The Implementing Rules and Regulations of Republic Act No. 10533, which is stated in DepEd Order No. 33, s. 2013, further detail the Enhanced Basic Education Act of 2013's provisions, particularly those of curriculum development and the advancement of high-quality education. The Policy Guidelines on the National Assessment of Student Learning for the K to 12 Basic Education Program, which is DepEd Order No. 55, s. 2016, provides guidelines for the assessment of students' learning outcomes, including in numeracy skills.

The connection between this study and the Sustainable Development Goal (SDG) 2030, specifically Goal 4, aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, 2015). This study is also aligned with the Research Agenda of the Department of Education on teaching and learning, particularly in examining best practices, tactics, and enabling and impediments concerning five sub-themes, specifically: education, curriculum, students, evaluation, and learning objectives.

The Agaton C. Rodriguez Elementary School, located at Cadlan Pili, Camarines Sur, conducted the ALNAT (Albay Numeracy Assessment Tool) or ENAT (Electronic Numeracy Assessment Tool) during the first month of the School Year 2024–2025. There are eighty-two (82) Grade 6 learners who took the assessment. The result of the numeracy level of eighty-two (82) learners is 100% needs major support. The lowest numeracy skill is about estimating, with a rating of 28.78%. This prompted the researchers to conduct a study for the improvement of their numeracy skills. According to Tolento (2024), there is a necessity to strengthen the instructional strategies employed by teachers during the teaching and learning process. Teachers should prioritize professional development, particularly in the field of mathematics, to ensure they remain updated, enhance their teaching methods, deepen their subject knowledge, and ultimately facilitate student learning and success.

Beltran (2021) suggested that teachers should incorporate video courses, whether they are microteaching or comprehensive ideas based on portions of the lesson plans, so that they may properly lead and assist the students in understanding and instructing them on how to teach particular competencies using the offline version. Including video lessons and modules could be beneficial for teaching various learning competencies in mathematics and improving Grade 5 students' performance scores (Beltran, 2021). By considering the varied learning styles and needs of learners, the study on contextualized audio-visual instructional materials tackles the need for inclusive education. Learners with different skill levels and preferences can more easily access the educational approach by utilizing multimedia resources. By doing this, it helps create a more equitable learning environment by guaranteeing that all learners, regardless of their educational backgrounds or abilities, have access to excellent learning materials.

Instructional materials are one of the most important components to support the process of learning and make it more engaging and significant (Purwitaningrum & Prahmana, 2021). Increased technology use in the classroom can result in a variety of immediate and long-term social and academic benefits (Bond & Bedenlier, 2019). The use of technology in teaching has been in demand, where the study of Borja *et al.*, (2024) concluded that teaching-learning through technology such as the Virtual Learning is an affordable option to traditional classroom settings and learning.

However, the result of the study conducted by Saro *et al.*, (2023) showed that elementary schools in the Philippines mostly used traditional materials such as books, modules, supplementary reading materials, etc. while the least used materials are speakers, projectors, and TVs are the least technology-based. Most traditional teaching methods are teacher-directed and designed to get students to sit still and listen. It is frequently argued that non-traditional methods of teaching and learning may better equip students with these kinds of skills. Constructivist philosophies serve as the foundation for what is commonly referred to as "non-traditional" mathematics education. This includes incorporating strategies wherein individuals develop, construct, or rediscover knowledge to make sense of the world, or utilizing social constructivist ideals that emphasize the influence of teaching and learning strategies associated with students' motivation, self-efficacy, and achievement (Kartal, 2022). It is impossible to teach numeracy skills effectively without the aid of instructional media (Shikuku & Mwangi, 2023).

Technology has been a great asset in education, improving students' learning in mathematics and reducing the achievement gap between struggling students and typical students. Technological tools such as video lessons have had a positive impact on students' attitudes and problem-solving skills and have helped teachers address the diverse needs of their students (Zhang *et al.*, 2015; Vincent & Stacey, 2017; Parrot & Leong, 2018). Among the educational tools, video lessons were seen as a very promising and useful innovation in the teaching and learning of mathematics. As defined by Bhatia (2015), a video lesson is a video that shows educational material for a topic in a particular subject to be learned by students.

The student-centered approach is the preferred learning environment for learners as it promotes engagement rather than lecturing. Notably, game-based learning emerges as a potent strategy for enhancing academic proficiency in mathematics, proving its effectiveness compared to traditional teaching methods (Cayang & Ursabia, 2024). Game-based learning significantly enhances the teaching-learning process in mathematics and can be easily applied

in the classroom. It supports and promotes learners' motivation, making games a highly effective part of this teaching technique.

Utilizing social media and other technologies has become a crucial aspect of our everyday existence, yet the absence of technology is very evident in our classrooms (Karami, 2019). The retention and memorization of taught concepts are aided by visual media (Shikuku & Mwangi, 2023). Learning support tools are needed to improve students' numerical literacy skills. One effort that can be made is to use the help of learning media (Devi & Sutama, 2023). The capacity to apply and reason with basic numerical concepts is known as numeracy. Basic numeracy abilities include understanding basic mathematical concepts such as division, multiplication, subtraction, and addition (Umoh *et al*., 2023). Data on numeracy skills across the globe demonstrate an increasing trend, indicating that the degree of numeracy skill acquisition rises in tandem with increased use of instructional media (Shikuku & Mwangi, 2023). Physical manipulatives used in instruction, such as base-10 blocks and physical number lines, have demonstrated their efficacy in teaching fundamental properties of numbers (Kaminski & Sloutsky, 2020).

Integrating contextualized materials makes learning relevant by addressing the diverse needs and learning styles of students. Montales (2025) highlighted the importance of contextualized and culturally grounded instructional materials, such as those developed through the Pinaggikanan initiative. Further, by investigating the necessity of contextualized audio-visual materials, the research demonstrates a concern for catering to diverse learning needs. The emphasis on audio-visual instructional materials suggests an exploration of technology integration in education, as highlighted by Devi and Sutama (2023); Shikuku and Mwangi (2023). This aligns with the modern teaching and learning agenda, which recognizes the role of technology in engaging students and enhancing the learning experience.

Furthermore, there were many factors that affect the performance and numeracy level of students in Mathematics. Gratela and Janer (2022) emphasized that teacher-made video lessons can be valuable supplementary learning materials, particularly in distance learning modalities during the new normal education.

Numerous studies have demonstrated that the thoughtful application of technology can enhance both the learning of mathematical techniques and the growth of advanced mathematical abilities, such as problem-solving, critical thinking, and reasoning (Mercado, 2022). According to Mercado (2022), research that involves multidisciplinary approaches can provide substantial assistance to teachers in the development of educational materials.

SAM Instructional Design Framework

This model was used to guide the researchers in the formulation of the statement of the problem and in making the instructional video to address the needs of the students to enhance their numeracy skills in Mathematics 6.

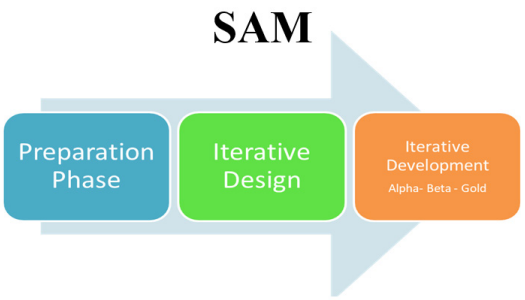

Figure 1: SAM Instructional Design Model used in this study

Statement of the Problem

This study was conducted to answer the following questions:

1.What is the numeracy level of Grade 6 learners in ALNAT for School Year 2024-2025?

2. What contextualized instructional video material can be developed to support the teaching and learning process in numeracy?

3. What is the validity of the developed contextualized instructional video material in terms of:

a. content;
b. accuracy
c. technical design and
d. presentation and organization

MATERIALS AND METHODS

Research Design

This paper used the SAM, with three phases: the preparation phase, iterative design, and iterative development. Under each phase, it includes several activities. Likewise, the study of Medrano & Pacis (2022) followed the same process in developing and validating infographics for Grade 6 Science. It followed three 3) phases namely Planning Phase, Development Phase; and Validation Phase.

Respondents of the study

Grade 6 students of Agaton C. Rodriguez Elementary School were selected as the respondents of the study. There were 82 grade 6 students whose ALNAT pre-test results were gathered to serve as the basis for the for the construction of the instructional video in mathematics 6. The grade 6 Mathematics 6 teacher serves as the validator of the created instructional video together with the school ICT Coordinator.

Research Instrument

The researchers utilized the Albay Numeracy Assessment (ALNAT) pre-test results of Grade 6 learners at Agaton C. Rodriguez Elementary School to assess numeracy proficiency. The ALNAT, designed to evaluate various numeracy skills, including computing, estimating, and reasoning, served as the foundational instrument for this study. The pre-test is consist of multiple-choice items including the different numeracy skills in Mathematics

such as knowing and understanding, computing and solving, estimating, visualizing and modeling, representing and communicating, conjecturing and reasoning, proving and decision making and applying and connecting.

The researcher also utilized the validation tools for evaluation of the instructional video patterned in the validation tools of the Division of Camarines Sur-DepEd.

RESULTS AND DISCUSSIONS

Pre-assessment result of Grade 6 learners of Agaton C. Rodriguez Elementary School in ALNAT for School Year 2024-2025.

Based on the ALNAT pre-test result of Grade 6 learners of Agaton C. Rodriguez Elementary School in ALNAT for School Year 2024-2025, majority of the students fall under needs major support level of mathematics proficiency. Among the competencies in the ALNAT estimating and applying and connecting were the least mastered skills.

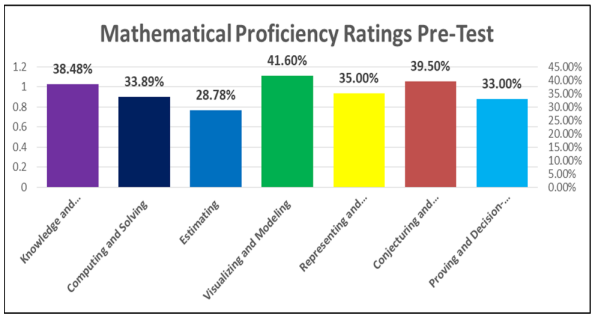

Figure 2: Mathematics Proficiency Rating

As shown in the figure above estimating got the lowest percentage ranking among the numeracy skills questions in the ALNAT which has the rating of 28. 78%. While Proving and Decision making got 33% rating. This shows that those skills need to be enforced in order to improve the skills of grade 6 students in terms of those competencies which receive the lowest rating.

Developed instructional video material to support the teaching and learning

This paper used the SAM model, which has three main phases: preparation, iterative design, and iterative development. Each phase involves several steps. The instructional videos created with SAM focused on two topics: arranging integers and solving word problems with mixed decimal numbers. These videos were aligned with the competencies in Mathematics 6, identified as needing the most support based on the ALNAT pre-test results.

Preparation Phase

The initial phase of this paper was the information collection which includes the following:

a. Conducted needs assessment of learners in Agaton C. Rodriguez Elementary School.

b. Identified participants through small group discussions.

c. Gathered pre-test results of Grade VI learners in Albay Numeracy Assessment Tools (ALNAT).

d. Identified the two competencies that have the highest result of needing major support.

e. Analysed instruction materials available in Agaton C. Rodriguez Elementary School.

f. Conducted literature review on instructional videos, Mathematics learning area and SAM.

Iterative Design Phase

In this phase, it includes design, prototype, and review.

a. Design. Made storyboard based on the competencies that need major support. Browsed applications and software based on accessibility and user-friendliness. Designed the interface of the video presentation.

b. Prototype. Laid out the step-by-step process of the instructional video.

c. Review. Conducted peer-reviewed of the two prototype instructional videos.

Iterative Development Phase

This phase includes development and evaluation, with three iterations, namely: alpha, beta, and gold versions.

a. Development of Alpha version. Produced two functional instructional videos. One was for arranging integers, and the other was problem-solving involving mixed decimal numbers. Layout and sound effects were included.

b. Evaluation of Alpha version. Consulted four Mathematics Grade 6 teachers and four Information Communication Technology (ICT) coordinators for evaluation and feedback. Conducted small group discussions about the results of feedback. The video on arranging integers needs to be edited in terms of labelling and adjusting the color of some elements. In the video on word problems, including mixed decimals, there was a need to add two more word problems. The first problem should be showing how to solve it.

c. Development of Beta version. Produced the revised instructional video. In the video of arranging integers, a minor revision was made. In the video of solving word problems, including mixed decimals, major revisions were made.

d. Evaluation of Beta version. Consulted Mathematics Grade 6 teachers and ICT school coordinators. There should be a change of some technical terms in the video of arranging integers. Instead of increasing, it was substituted with ascending and decreasing with descending. The movement of the rabbit was also suggested to hop right after the displayed answer for each box, not at the end of each question.

e. Development of Gold version. Produced a complete and detailed instructional video on arranging integers and another for word problems including mixed decimal numbers for Grade 6 Mathematics learners.

Validation of Educational Video Materials

The output of this study was the development of

educational video tutorials in Mathematics for Grade 6. The input variables for this study were the competencies incorporated in the MELCs (Most Essential Learning Competencies). This study utilized the DepEd Evaluation Rating Sheet Tool for video lessons. Selected Math teachers in Camarines Sur and Naga City assessed the content, accuracy, and up-to-datedness of the information. The format/technical design, presentation, and organization were assessed by selected ICT Coordinators in Camarines Sur and Naga City.

An initial validation was conducted by the validators. Factor 1 and Factor 4 were assessed by the Mathematics teachers. Based on the provided data from the DepEd Evaluation Rating Sheet for the video lessons titled "Arranging Integers on the Number Line" and "Multi-Step Problems Involving Multiplication and Addition or Subtraction of Mixed Decimals," here are the interpretation of the evaluation:

Factor 1. Content

1. Content suitability: The content is highly suitable for the learners' level of development, as evidenced by the rating of 4 (Very Satisfactory).

2. Achievement of specific objectives: The material adequately contributes to the achievement of specific objectives of the learning area and grade level, with a rating of 3 (Satisfactory). The evaluator suggests improving the video by adding two more problem-solving examples and including solutions.

3. Development of higher cognitive skills: The material effectively supports the development of higher cognitive skills, including critical thinking, creativity, learning by doing, inquiry, problem-solving, and 21st Century Skills, with a rating of 4 (Very Satisfactory).

4. Freedom from biases: The material is free from ideological, cultural, religious, racial, and gender biases and prejudices, achieving a rating of 4 (Very Satisfactory).

5. Interest arousal: The material successfully captures the interest of the target reader, also rated 4 (Very Satisfactory).Factor 1 got 19/20 total points. The material passes Factor I, as it exceeds the minimum required score of 15 points.

Factor 4. Accuracy and Up-to-Dateness of Information

1. Conceptual errors: There are no conceptual errors, with a rating of 4 (Very Satisfactory).

2. Factual errors: The material contains no factual errors, achieving a rating of 4 (Very Satisfactory).

3. Grammatical errors: There are no grammatical errors in the material, receiving a rating of 4 (Very Satisfactory).

4. Computational errors: There are no computational errors in the material, rated 4 (Very Satisfactory).

5. Obsolete information: The information is up-to-date, with a rating of 4 (Very Satisfactory).

6. Typographical and minor errors: There are no typographical or other minor errors, with a rating of 4 (Very Satisfactory).

Factor 4 has 24/24 total points. The material passes Factor 4, as it exceeds the minimum required score of 18 points.

Overall Recommendation for Factor 1 and 4

The supplementary learning resource meets the evaluation criteria for both content and accuracy/up-to-dateness of information. It scores highly in all areas and addresses specific learning objectives and developmental appropriateness effectively. The only suggested improvement is the inclusion of additional problem-solving examples and solutions for the two videos and specify the boxes for the video on integers.

Given this evaluation, the material is recommended for approval for use in public schools, provided that the suggested corrections/revisions are made in future editions.

Factor 2 and Factor 3 were also initially conducted by the ICT Coordinators using the DepEd Evaluation Rating Sheet for video lessons. Here are the interpretation of the evaluation:

Factor 2. Format/Technical Design

1. Volume and quality of sound: The volume and quality of sound are appropriate, achieving a rating of 4 (Very Satisfactory).

2. Pacing: The pacing is efficient and appropriate for instructional purposes, with a rating of 4 (Very Satisfactory).

3. Audio-visual effects: The audio-visual effects (music, sounds, graphics, etc.) are appropriate and effective for instructional purposes, receiving a rating of 4 (Very Satisfactory).

Factor 3 has 12/12 total points. The material passes Factor 2, as it meets the maximum score and exceeds the minimum required score of 9 points.

Factor 3. Presentation and Organization

1. Engaging presentation: The presentation is engaging, interesting, and understandable, achieving a rating of 4 (Very Satisfactory).

2. Logical flow of ideas: There is a logical and smooth flow of ideas, with a rating of 4 (Very Satisfactory).

3. Vocabulary level: The vocabulary level is adapted to the target reader's experiences and understanding, receiving a rating of 4 (Very Satisfactory).

4. Appropriate length: The length of the video/audio recording/lesson is appropriate to the attention span of the target learner, with a rating of 4 (Very Satisfactory).

Factor 3 has 16/16 total points. The material passes Factor 3, as it meets the maximum score and exceeds the minimum required score of 12 points.

Overall Recommendation for Factor 2 and 3

The supplementary learning resource meets the evaluation criteria for both format/technical design and presentation/organization. It scores high in all areas and is considered suitable for the intended instructional

purposes. The material does not require any corrections or revisions based on the current evaluation.
Given this evaluation, the material is recommended for approval for use in public schools.

Final Validation of the Video Tutorials

The final validation of the video materials was conducted by Mathematics teachers and ICT Coordinators from Camarines Sur and Naga City. The videos were edited based on the suggestions and comments from these validators. Taking into account the experts' suggestions, the video tutorials were revised accordingly. The edited videos were then viewed by learners for final validation. These revisions were made based on the comments and computed ratings from the experts. This process determined the videos' content validity, accuracy, formatting, presentation and organization. The final copies of the educational video tutorials were submitted to an education professor expert for final viewing and evaluation. Both video tutorials were accepted.

CONCLUSION

The SAM model follows a user-centered process that focuses on continuous improvement through its three core phases: Preparation, Iterative Design, and Iterative Development. The Preparation phase lays the groundwork by engaging stakeholders early, defining clear goals, and building a shared understanding of the project. In the Iterative Design phase, the team ensures the instructional materials are well-aligned with user needs through regular testing and feedback. Finally, the Iterative Development phase refines and perfects the content by incorporating multiple cycles of evaluation and adjustment. This approach not only improves the quality of educational resources but also ensures they remain relevant, accessible, and effective for learners. By emphasizing collaboration and ongoing refinement, SAM fosters a development process that is both adaptive and responsive to the needs of its users.

Recommendations

Based on the findings of this paper, several recommendations can be made for effectively implementing the SAM model in instructional design. By following these recommendations, organizations can leverage SAM model to create high-quality, learner-centered instructional content that is both effective and adaptable.
While SAM provides a structured framework, its strength lies in its adaptability. Instructional designers should be open to revisiting earlier phases based on ongoing feedback, ensuring that the final product is refined continuously and meets the evolving needs of learners.
The iterative nature of SAM benefits from regular input from both learners and other stakeholders. Engaging these groups during the preparation and development phases helps ensure the instructional content remains relevant and user-centered.
Due to the cyclical nature of SAM, it's important to allocate adequate time for the iterative design and development process. This allows for meaningful feedback to be gathered and incorporated at each stage, improving the quality of the end product.
For SAM to be successfully implemented, instructional designers should receive proper training on its principles and best practices. Additionally, fostering collaboration between design teams, subject matter experts, and developers is essential for creating high-quality educational resources.
Regular evaluation during each phase of the SAM process ensures that instructional content meets both pedagogical and user requirements. Continuous assessment helps identify potential issues early on, leading to more effective solutions before final implementation.

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