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ENHANCING GRADE 7 MATH SKILLS: AUDIO-VISUAL SIM FOR MASTERING INTEGER OPERATIONS

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ABSTRACT

This study focused on creating an Audio-Visual Strategic Intervention Material (SIM) to help Grade 7 students improve their skills in performing fundamental operations on integers in Mathematics. The research used an Educational Design Research approach and selected participants through purposive sampling. Data collection involved a checklist and rating scale, and analysis was carried out using frequency and mean. The findings revealed that mastering fundamental operations on integers had consistently been the most challenging skill for Grade 7 students during the first quarter over the past three academic years. The SIM underwent a thorough validation process done by expert validators, including Mathematics teachers and content specialists, who assessed its content, instructional design, and technical quality. The experts provided a mean rating of 3.63, indicating that the material was of very high quality. The high validation scores affirmed that the Audio-Visual SIM met high standards in terms of content accuracy, instructional effectiveness, and technical presentation. The study highlights the potential of audio-visual materials as an effective tool for addressing learning gaps in Mathematics, providing educators with a valuable resource to improve students' foundational skills in integer operations. The findings also guided the planning of extension activities, and recommendations for further refinement and broader use of the SIM were provided. To continue assisting students in overcoming these challenges, the Institution, through its extension program, may offer workshops, seminars, and training sessions on the creation and use of Audio-Visual SIMs.

Keywords: *Audio-Visual Strategic Intervention Material, Least Learned Competency, Operation on Integers, Six Facets of Understanding, Mathematics Education*

INTRODUCTION

Mathematics is a core subject in the school curriculum and plays a vital role in both daily life and the study of other disciplines. Before students can fully understand advanced mathematical concepts, they must first develop a solid foundation in fundamental operations, particularly with integers (Rubin et al., 2014). However, research has shown that students often struggle with integer operations, particularly addition and subtraction, where misunderstanding and misapplication of rules frequently lead to errors (Khalid & Embong, 2019). This challenge is compounded by the abstract nature of integers, making them one of the least mastered skills among students, thus hindering their overall mathematical progress.

Competency-based learning is designed to ensure that students master the skills and knowledge needed to address their least-learned competencies. According to Cordova et al. (2019), competency-based educational techniques vary in their effectiveness, with some methods being more effective than others. The strategic focus of competency-based learning is to bridge learning gaps by providing targeted instruction that allows students to overcome specific academic challenges. In this regard, integer operations represent a critical area where many students struggle, and specialized instructional tools are needed to address these gaps.

To help address these challenges, the Department of Education (DepEd) introduced Strategic Intervention Materials (SIMs) through Memorandum 117, Series of 2005. These materials were developed to help students improve academically by focusing on their least-learned competencies. The DepEd has offered training and workshops to assist teachers in creating effective learning materials tailored to specific subjects and grade levels. SIMs provide an innovative approach to learning by offering students opportunities to master competency-based skills that might not be fully addressed in traditional classroom settings. Villonez (2018) found that SIMs, especially when focused on complex mathematical concepts, help students better understand these ideas, resulting in improved academic performance.

In recent years, the use of multimedia-based tools in education has become increasingly popular due to their potential to enhance student engagement and learning outcomes. Video-based learning, in particular, has been shown to motivate students and improve their understanding of difficult concepts. It combines both auditory and visual elements, which are powerful learning tools that can enhance student engagement and help them grasp complex topics more effectively. This approach is particularly beneficial as it allows students to revisit the material at their own pace, deepening their comprehension and retention of the content (Sablic et al., 2020). Furthermore, Ljubojevic et al. (2013) highlight that using supplementary video materials can capture students' attention, reduce cognitive load, and increase their focus and motivation. The integration of audio-visual

elements into SIMs could therefore provide a powerful tool for teaching integer operations by making abstract concepts more accessible and engaging for students.

At Agusan del Sur State College of Agriculture and Technology (ASSCAT), research on developing Strategic Intervention Materials (SIMs) in Mathematics was still in its early stages. This pioneering study, focused on creating an Audio-Visual SIM to enhance students' understanding of integer operations, represents a significant step toward addressing specific learning gaps. Given the foundational importance of integer operations in Mathematics, this study has the potential to benefit not only ASSCAT but also neighboring schools facing similar challenges. The validated instructional tool developed through this research would serve as a model for future extension activities, including teacher training workshops and classroom implementation in other institutions. By improving student engagement and understanding of basic mathematical operations, this study would contribute to both the academic progress of ASSCAT and the broader educational community in the region.

Research Objectives

This study was designed to develop Strategic Intervention Material for the least learned competencies of Grade 7 students. Specifically, it sought to address the following:

1. To determine the Least Learned Competency of Grade 7 mathematics in the past three years;
2. To determine which of the developed learning activities are most preferred by the student evaluators in terms of 6 Facets of Understanding; and
3. To determine the Quality of the SIM in the Fundamental Operation of Integers in terms of content quality, instructional quality, technical quality, and other findings.

METHODOLOGY

Research Design

This study employed Educational Design Research (EDR), a structured approach to creating, developing, and refining educational interventions aimed at solving complex learning challenges. As outlined by Akker et al. (2007), EDR goes beyond just applying educational tools in practice. It emphasizes understanding the entire design process, which involves repeated cycles of analysis, development, evaluation, and revision. This continuous improvement process ensures that the interventions remain effective and aligned with educational objectives, evolving based on both research and feedback.

For the development of Strategic Intervention Materials (SIMs), the EDR approach provided a clear framework to address specific learning gaps. In this study, EDR was

used to create an audio-visual SIM aimed at teaching Performing Fundamental Operations on Integers, ensuring it meets the Department of Education's learning competencies. Through the involvement of expert validators and student feedback, the SIM was refined to better meet student needs. This process highlighted how multimedia tools like SIMs can enhance student learning, particularly in challenging areas like integer operations, while offering valuable insights into optimizing educational interventions for improved outcomes.

Research Participants

The participants in this study were divided into two key groups: Teacher Validators and Student Evaluators. The Teacher Validators consisted of experienced professionals, including a master teacher from the Department of Education (DepEd), Mathematics instructors with at least three years of teaching experience, and an ICT expert. The math teachers evaluated the content of the Strategic Intervention Material (SIM) to ensure it was relevant and appropriate for Grade 7 learners, while the ICT expert assessed the design and technical quality of the material. Together, this diverse group provided crucial feedback to ensure the SIM was both educationally effective and technically sound. Research supports that having three to five expert validators, particularly from different fields, is sufficient to provide balanced and comprehensive feedback (García-Ceberino et al., 2020; Knox et al., 1999).

The second group, the Student Evaluators, comprised 30 students who actively participated in assessing the SIM activities. They provided feedback on which activities were most engaging and effective, helping the researchers identify the preferred learning activities for each facet. The students were selected using purposive sampling, a method where participants are deliberately chosen based on their experience with instructional materials. This selection process ensured the study gathered valuable and relevant data, as each participant contributed unique insights that were crucial to achieving the study's objectives.

Research Instrument

The researchers utilized a researcher-made checklist to determine which learning activities, corresponding to each facet of understanding, were most preferred by the student evaluators. The student evaluators rated the activities using a scale of 1 to 3, where 3 was for the "most preferred," 2 for "preferred," and 1 for the "least preferred". The activity with the highest weighted mean for each facet was deemed the most preferred by the evaluators. These top-rated activities were then selected to represent each facet of understanding for the final validation of the Strategic Intervention Material (SIM). This step was essential to ensure that the SIM reflected activities that resonated most with students, enhancing its potential for effectiveness and engagement.

In evaluating the quality of the Audio-Visual SIM, the researchers used a rating scale, shown in Table 1, based on the Department of Education's (DepEd) 2009 Guidelines and Processes for Learning Resource Management and Development System (LRMDS)

Assessment and Evaluation of Localized Materials. This evaluation tool was designed to assess the SIM on multiple criteria, including its instructional quality, technical soundness, and any other relevant considerations.

The rating system employed in this study was a 4-point Likert scale, with the following categories:

4 – Very Satisfactory, 3 – Satisfactory, 2 – Poor, and 1 – Not Satisfactory. The evaluators rated the SIM across these dimensions, and the ratings were used to calculate a mean score for each factor. These mean ranges were then interpreted to provide a clear description of the material's overall effectiveness. The tool provided a structured and comprehensive framework for assessing the audio-visual SIM, ensuring that it met the instructional needs of students while also adhering to technical and pedagogical standards.

Table 1. Rating Scale for Evaluating AVSIM

Mean Range	Verbal Description	Qualitative Interpretation
3.25 – 4.00	Very High	This means that the Quality of Audio-Visual SIM in Performing Fundamental Operations on Integers is Very High.
2.50 – 3.24	High	This means that the Quality of Audio-Visual SIM in Performing Fundamental Operations on Integers is High.
1.75 – 2.49	Low	This means that the Quality of Audio-Visual SIM in Performing Fundamental Operations on Integers is Low.
1.00 – 1.74	Very Low	This means that the Quality of Audio-Visual SIM in Performing Fundamental Operations on Integers is Very Low.

Process in the Development of Test Questionnaire

Before the conduct of the study, a letter was submitted to the Dean of the College of Teacher Education to seek approval and ensure compliance with the requirements set forth by the Commission on Higher Education (CHED). Then, a formal letter addressed to the principal of Libertad National High School followed, requesting access to secondary data that outlined the least learned competencies in Grade 7 Mathematics. Upon receiving the data, the researchers carefully selected specific competencies from the identified list to serve as the foundation for developing the Strategic Intervention Material (SIM).

The development process followed the work of Cañeda et al. (2024), which drew inspiration from the foundational works of Luzano (2020) and the early application of the ADDIE (analysis, design, development, implementation, and evaluation) model developed by Florida State University in 1975 (Branson et al.,1975). This comprehensive

model guided the researchers through several key stages: the preparatory phase, audio-visual SIM development, and audio-visual SIM validation.

Preparatory Stage

The preparatory stage is critical, as it establishes the groundwork for all subsequent phases in the instructional design process. This phase encompasses the collection and analysis of the least learned competencies in Grade 7 Mathematics over the past three academic years. From this data, the researchers carefully selected the target competency to focus on. The format of the audio-visual SIM, as well as the materials and applications to be used for video creation and editing, were also determined during this stage.

This phase went beyond simply identifying competencies; it involved a thorough process of conceptualizing and planning the structure and content of the learning material. Key decisions were made about the format of the presentation, including whether to use animation, live-action footage, or other multimedia elements that would enhance understanding and retention. This meticulous planning ensured that the materials were both engaging and pedagogically sound.

To ensure alignment with national educational standards, the learning objectives were based on the Department of Education's K–12 Mathematics Curriculum Guide, specifically targeting the Most Essential Learning Competencies (MELCs). This alignment ensured that the material not only addressed the least learned competencies but also adhered to the broader educational goals of the Department of Education, thereby supporting both students' immediate learning needs and their long-term mathematical proficiency.

By the end of the preparatory stage, the foundation was firmly in place for the design, development, and validation of the audio-visual SIM. This careful preparation ensured that the material was aligned with both the identified competencies and the overall educational framework, providing a solid platform for the subsequent stages of development.

Audio-Visual SIM Development

This phase involved creating a detailed storyboard or outline to ensure that the content of the Audio-Visual SIM was presented clearly and systematically. This step was crucial for maintaining coherence throughout the material, as it provided a structured approach to organizing the information. The design and flow of the audio-visual SIM were carefully aligned with the selected competencies, focusing on addressing the most challenging areas for students in a way that would be both engaging and accessible.

The initial drafts of the audio-visual SIM underwent several rounds of informal validation. During this process, the material was reviewed, rechecked, and modified multiple times, with input from experts sought at various stages. Each SIM was discussed and reviewed in-depth as part of a pre-assessment to identify any areas that required refinement. The feedback from the SIM designers was particularly valuable in highlighting the strengths

and weaknesses of the material. The researchers thoughtfully incorporated comments and suggestions to further improve the SIM, ensuring it was both educationally sound and practically useful for Grade 7 learners.

Validation of Audio-Visual SIM

After the development of the Audio-Visual Strategic Intervention Material (SIM), it underwent a rigorous validation process to ensure its effectiveness and alignment with educational standards. Expert validators, including specialists in both content and instructional design, meticulously reviewed the material, assessing its accuracy, relevance, and pedagogical soundness. Their feedback was invaluable, offering insights into areas where revisions or improvements could enhance the clarity, engagement, and instructional value of the SIM. Each suggestion was carefully considered, and the material was refined accordingly to better meet the needs of the target learners.

The final phase of validation involved a panel of evaluators, comprised of three subject matter experts who assessed the material using a structured rating scale. This evaluation focused on key aspects such as instructional quality, technical execution, and overall effectiveness in achieving the learning objectives. Based on their feedback, the researchers made further revisions to fine-tune the SIM. These modifications were implemented with the goal of ensuring that the material not only addressed the learning gaps but also offered an engaging, accessible, and educationally sound experience for Grade 7 students. By incorporating the evaluators' suggestions, the researchers strengthened the material, ultimately enhancing its potential to support student learning in performing fundamental operations on integers.

RESULT AND DISCUSSION

Least Learned Competencies

Table 1 presents the least learned competencies in Grade 7 Mathematics for the first quarter, covering the academic years 2019-2020, 2020-2021, and 2021-2022 at Libertad National High School. A total of seven competencies were identified as least learned during this period: M7NS-Ia-1, M7NS-Ia-2, M7NS-Ib-2, M7NS-Ic-d-1, M7NS-Id-2, M7NS-Ie-1, and M7NS-If-1. From this list, the researchers selected competency M7NS-Ic-d-1, "Performing Fundamental Operations on Integers," as the focus for developing the audio-visual Strategic Intervention Material (SIM). This competency was chosen due to its recurring difficulty among students, making it a prime target for intervention.

The decision to focus on this competency aligns with the findings of Aguhayon et al. (2023) who observed that Grade 7 students often encounter significant challenges when solving mathematical problems involving integers, as they tend to struggle with the

complexities involved. The research emphasizes that these challenges are exacerbated by gaps in foundational understanding, which can hinder students' ability to progress in mathematics without targeted interventions. Also, students often encounter difficulties in understanding and applying the rules associated with integer operations. The difficulty stems from the complexity of understanding and applying multiple rules associated with integer operations, which can lead to misconceptions and confusion, particularly in operations involving negative numbers. The students tend to mix up rules for addition, subtraction, multiplication, and division when dealing with integers, which results in common errors, such as applying the wrong sign or performing incorrect calculations (Harun et al., 2023).

By developing an Audio-Visual Strategic Intervention Material (SIM) focused on this specific competency, the researchers aimed to offer tailored support that directly addresses the challenges students often face with integer operations. Their goal was not just to create another resource, but to craft a tool that resonates with students' learning needs, bridging gaps in their understanding. Through engaging, visual, and auditory content, the SIM was designed to make abstract concepts more relatable, helping students grasp the fundamental principles of integer operations more easily and confidently. In doing so, the researchers hoped to alleviate common frustrations and boost the students' overall comfort with these key mathematical concepts, laying a stronger foundation for their future success.

Table 1. First Quarter Least Learned Competencies in Grade 7 Mathematics

LLC Code	LLC for S.Y. 2019-2020	LLC for S.Y. 2020-2021	LLC for S.Y. 2021-2022	Frequency
M7NS-Ia-1		1		1
M7NS-Ia-2		1		1
M7NS-Ib-2	1		1	2
M7NS-Ic-d-1	1	1	1	3
M7NS-Id-2			1	1
M7NS-Ie-1	1			1
M7NS-If-1		1		1

Legend:

M7NS-Ia-1	*Illustrates well-defined sets, subsets, universal sets, null sets, the cardinality of sets, union, and intersection of sets, and the difference between two sets*
M7NS-Ia-2	*Illustrates the union and intersection of sets and the difference between two sets.*
M7NS-Ib-2	*Solving problems Involving sets*
M7NS-Ic-d-1	***Performs Fundamental operations on Integers***
M7NS-Id-2	*Illustrates the different properties*
M7NS-Ie-1	*Expresses rational Numbers from Fraction Form to Decimal Form and Vice Versa*
M7NS-If-1	*Performs operations on rational numbers*

Most Preferred Audio-Visual Activities

Table 2 highlights the most preferred activities by student evaluators in each of the six facets of understanding, reflecting their preferences for engaging and effective learning experiences. Under the Explanation facet, the activity titled "Explain Me" received the highest weighted mean of 2.30, showing that students favored this method of clarifying concepts. For Interpretation, the activity "Maze Integer" scored the highest with a weighted mean of 2.26, indicating its appeal in helping students make sense of mathematical concepts. When it came to Application, "Temperature Changes" was the top choice, with a weighted mean of 2.28, emphasizing the students' preference for real-world connections in learning. The activity "Answer Me" stood out in the Perspective facet, earning the highest score of 2.37, suggesting that students appreciated this activity's ability to challenge their viewpoints. In the Empathy category, "Share Your Thoughts" was most favored with a mean of 2.33, pointing to the value of activities that allow students to express themselves. Lastly, under Self-Assessment, "Complete Me" garnered a mean of 2.30, showing the importance students place on reflective activities that help them gauge their understanding.

These findings align with an early study that giving students the ability to choose their learning activities can significantly enhance their engagement and motivation. When students feel that they have some control over their learning process, they tend to be more invested in both the material and the learning experience (Yarborough & Fedesco, 2020). Similarly, Gray and DiLoreto (2016) noted that students who are engaged and enjoy the learning process tend to remain focused and absorb information more effectively. It highlights that active participation in their educational journey leads to a deeper understanding and retention of the material. By incorporating these preferred activities into the audio-visual SIM, the researchers ensured that the material was not only educational but also appealing and engaging for the students.

Table 2. Most Preferred Audio-Visual Activities by the Student Evaluators

6 Facets of Understanding	Mean	Remarks
EXPLANATION		
Explain Me	2.30	**Most Preferred**
Your Understanding	2.25	Preferred
Solve Me	1.47	Least Preferred
INTERPRETATION		
Know me	1.49	Least Preferred
What's My Roles?	2.00	Preferred
Maze Integer	2.26	**Most Preferred**
APPLICATION		
Solving Problems	1.50	Least Preferred
What's My Cost?	2.00	Preferred
Temperature Changes	2.28	**Most Preferred**
SHIFT-PERSPECTIVE		

Solving Tiles	1.93	Preferred
Solving Math Easy	1.44	Least Preferred
Answer Me	2.37	**Most Preferred**
EMPATHY		
Share Your Thoughts	2.33	**Most Preferred**
Share Me	2.20	Preferred
Share Your Ideas	1.47	Least Preferred
SELF-ASSESSMENT		
My Question	2.10	Preferred
Complete Me	2.30	**Most Preferred**
Think To Share	1.50	Least Preferred

The most preferred audio-visual learning activity was identified in each of the 6 facets of understanding. Thus, the total of six (6) most preferred learning activities from each facet of understanding were consolidated as the learning activities of the SIM in Performing Fundamental Operations on Integers.

Validation of Audio-Visual Strategic Intervention Material (AV-SIM)

Table 3 presents the validation results for the Audio-Visual SIM, which achieved an overall weighted mean of 3.63, classified as "very high." This indicates that the audio-visual strategic intervention material (SIM) focused on performing fundamental operations on integers was rated as highly satisfactory. This aligns with Rodrigo's (2015) findings, which suggest that high-quality SIMs provide students with opportunities to explore various concepts, enhancing their understanding and sharpening their competencies.

The highest-rated factor was "other findings," with a weighted mean of 3.80, indicating a "very high" level of satisfaction. This suggests that the SIM was free from conceptual, factual, grammatical, and typographical errors, making the material clear and accurate. This finding is consistent with Dahar's (2012) research, which emphasizes that Strategic Intervention Materials (SIMs), play a crucial role in improving students' academic performance by bridging learning gaps and facilitating the acquisition of new skills. It emphasizes that SIMs help students who struggle with understanding concepts during regular instruction, allowing them to master competencies through targeted interventions.

The lowest-rated factor, "technical quality," still received a strong score of 3.54, which is also classified as "very high." This implies that the material's technical aspects, including its design and functionality, were well-received by the validators. The SIM was found to be engaging, stimulating, and effectively designed, supporting Limbago-Bastida and Bastida’s (2022) conclusion that Strategic Intervention Materials (SIMs) can enhance student learning through visually appealing and straightforward activity presentations. Moreover, the use of well-structured and engaging SIMs can lead to improved learning outcomes by making complex concepts more accessible and easier to understand through effective presentation and design.

Table 3. Result of Evaluation on the Content Validity of the SIM

Criteria	Mean	Verbal Description	Interpretation
Content Quality	3.64	Very High	Very Satisfactory
Instructional Quality	3.55	Very High	Very Satisfactory
Technical Quality	3.54	Very High	Very Satisfactory
Other Findings	3.80	Very High	Very Satisfactory
Overall	3.63	Very High	Very Satisfactory

Conclusions

In conclusion, this study successfully developed and validated an Audio-Visual Strategic Intervention Material (SIM) aimed at improving Grade 7 students' mastery of performing fundamental operations on integers. By addressing one of the least learned competencies, the SIM provided a targeted solution that both engaged students and enhanced their understanding of complex mathematical concepts. The validation process, conducted by expert validators from the fields of mathematics education and ICT, confirmed the SIM's high quality in terms of content, instructional design, and technical execution. Additionally, the student evaluators' feedback highlighted the material's effectiveness and appeal, further supporting its potential for improving student learning outcomes.

The significant contribution of this study lies in its development of an accessible, multimedia-based instructional tool that aligns with the Department of Education's curriculum goals while addressing specific learning gaps in Mathematics. The positive results from both expert and student evaluations suggest that the SIM can serve as a valuable resource not only for students at Libertad National High School but also for other schools facing similar challenges. The findings reinforce the importance of integrating audio-visual tools into classroom instruction, as they can significantly enhance student engagement and comprehension, particularly in subjects that students typically find difficult. Future applications of this SIM could extend beyond its current scope, offering opportunities for refinement, broader implementation, and further research into its impact on student learning.

Recommendations

Based on the findings and conclusions of this study, the following recommendations were made:

1. **Broader Implementation and Testing**: Schools may consider implementing the developed Audio-Visual SIM in other Grade 7 classrooms to further evaluate its effectiveness on a larger scale. Pilot testing in various educational settings would provide additional feedback for refinement and adaptation.
2. **Training for Educators**: It is recommended that higher education institutions (HEIs) like ASSCAT, through its extension program, may conduct workshops and

training sessions for secondary teachers on how to effectively use audio-visual SIMs in their instruction. This will help educators integrate these tools into their teaching practices and maximize their potential to improve student learning outcomes.

3. **Development of Audio-Visual SIMs for Other Competencies**: Schools and educators may explore the development of similar strategic intervention materials for other least-learned competencies in mathematics and other subjects. Expanding the use of Audio-Visual SIMs could address learning gaps across multiple areas.
4. **Further Research**: Future studies may explore the long-term effects of using Audio-Visual SIMs on student performance, particularly in foundational Mathematics. Additionally, researchers may investigate the impact of these materials on different grade levels or other learning difficulties to expand their applicability.
5. **Customization for Diverse Learners**: It is also recommended to adapt the SIM to accommodate diverse learners, including those with learning disabilities or language barriers. By doing so, the material can be more inclusive and cater to the needs of a broader student population.

Compliance with Ethical Standards

This research was carried out with a strong commitment to ethical standards, ensuring full compliance with all institutional guidelines and legal requirements.

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