

## Development and validation of a Digitized Instructional Material (DIM) in Science 5

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**Abstract:** This study developed and validated Digitized Instructional Materials (DIM) for Science V at Ampayon Central Elementary School. The study employed SAMR model in the development and validation of the materials. A descriptive-developmental research design was used to create DIM that were not only visually engaging and user-friendly but also closely aligned with the Department of Education's (DepEd) Learning Competencies for Grade 5 Science. The materials were intended to enhance the delivery of content in a more interactive and accessible way, fostering a deeper understanding of scientific concepts among students. The experts validate the DIM using the DepEd LRMS Evaluation Rating Sheet. The participants of the study were (4) four experts and (80) eighty Grade 5 pupils. The findings of the study revealed that in the third quarter MPS analysis, the competency "describe the motion of an object by tracing and measuring its change in position (distance traveled) over a period of time" (S5FE-III-a-1) was the least mastered by students. Expert validation confirmed that the DIM met the required standards outlined by the DepEd LRMS, particularly in terms of content accuracy, clarity of presentation, and alignment with learning outcomes. The evaluators highlighted the strengths of the DIM, noting their ability to engage students interactively and enhance conceptual understanding. Furthermore, the use of digital tools was praised for its capacity to make complex scientific concepts more accessible and relatable to the students. Based on the findings, the study recommended the continued development and refinement of DIM, particularly focusing on addressing least-learned competencies. It also suggested that more attention be given to the selection and design of illustrations, ensuring they are contextually relevant and appropriate for the target audience. Additionally, the importance of expert consultation in the development process was emphasized to ensure the highest quality of instructional materials. The study concluded that interactive digital materials have significant potential to address gaps in Science education, enhance student engagement, and ultimately improve learning outcomes in the subject.

Keywords: Digitized instructional materials, SAMR model, Science education, Interactive learning

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## INTRODUCTION

Digitized Instructional Materials (DIM) emerged as a transformative force in science education, offering new opportunities for students and teachers to engage with scientific topics innovatively (Reiser et al., 2024). As technology advanced, the potential for digital learning to improve the quality and accessibility of science education expanded. Recent studies explored the advantages and disadvantages of digital learning in science education, including digital simulations, online resources, collaborative learning, customized learning, and gamification (Mirzaie et al., 2022).

Moreover, research indicated that digital learning could enhance student engagement, motivation, and learning outcomes. However, concerns arose regarding the potential for technology to replace traditional teaching methods and diminish social interaction (Chiu, 2023). Digital learning has the power to reshape how science is taught and learned by creating immersive and interactive learning experiences (Dick, 2021).

Science education aims to provide students with a strong foundation through various learning competencies. These competencies included understanding scientific concepts, conducting scientific inquiries, employing critical thinking to solve problems, and effectively communicating scientific findings. Mastering these competencies fostered a deeper appreciation for science and a lifelong love of learning. However, gaps in the Science V curriculum hindered students' ability to develop these essential skills. Limited resources, outdated materials, and an overemphasis on rote content delivery contributed to these gaps, leaving students deficient in critical inquiry and analytical thinking.

Before the COVID-19 pandemic, Ampayon Central Elementary School consistently achieved an average Science score within the 75 to 80 percent range. However, a notable improvement occurred during the pandemic's challenges, with the average percentage rising to 81 percent. This positive shift resulted from collaborative efforts among learners, who received support from parents or relatives and effectively utilized online resources while completing their modules through the modular distance learning method. Additionally, providing answer keys in self-learning modules was crucial in this improvement.

As classes resumed for the 2022-2023 and 2023-2024 academic years, a marked decline in educational achievement became evident, particularly in Science V. Learning gaps among students widened, decreasing the mean percentage score to 70%. In the Third quarter of Science 5, one of the competencies with which learners struggled the most was describing an object's motion and measuring its change in position (Distance traveled over a period of time). This learning gap highlighted the need to enhance learners' confidence in science.

Furthermore, digitized instructional materials offered a practical solution to bridge existing gaps. These materials, which included interactive simulations, multimedia content, and online activities, provided engaging and dynamic learning experiences. By incorporating these digital resources, Science V teachers could address resource limitations, foster skill development, and help students achieve the competencies outlined in the curriculum.

In Ampayon Central Elementary School, where the researcher assigned, a notable scarcity of instructional materials and references existed, particularly in Science V. This lack of resources hindered effective teaching and learning in the subject. The study emphasized the importance of diverse instructional materials in science education.

Therefore, the study was conceived to address this local need by developing and validating digital resources tailored to the Science V curriculum. These digital materials are aimed to enhance accessibility, increase student engagement, and provide cost-effective alternatives to traditional resources. Ultimately, the study sought to create digitized materials that addressed the specific needs of Science V and improved student learning outcomes. Furthermore, the development of DIM aimed to support mastery of competency-based skills while addressing the instructional challenges and resource scarcity within classrooms, particularly at Ampayon Central Elementary School in the Butuan City Division.

This study was designed to respond to the pressing need for adequate instructional resources in Science V at Ampayon Central Elementary School. By developing and validating digitized instructional materials (DIM), the research aimed to bridge the gap caused by the scarcity of traditional teaching resources. These digitized materials were envisioned to enhance student engagement and learning outcomes and provide a sustainable, cost-effective solution to address the unique challenges faced in the local educational context. Through this initiative, the study underscored the potential of technology to transform science education and foster competency-based learning in under-resourced schools.

### *Statement of the problem*

The study developed and validated a digitized instructional material (DIM) in Science 5 at Ampayon Central Elementary School, Butuan City Division.

The study sought to answer the following questions:

1. What is the least learned competency in Science 5 in the 3rd Quarter?
2. How will a Digitized Instructional Material (DIM) be designed and developed:
3. How did the expert evaluate the DIM??
  - 3.1 Content
  - 3.2 Format
  - 3.3 presentation and organization; and
  - 3.4 accuracy and up-to-datedness?
4. What enhancements to improve the DIM may be done?

## METHODOLOGY

### *Research design*

The study employed a descriptive-developmental research design to a digitized instructional material (DIM). The descriptive component focused on identifying the least-learned competency of Grade 5 learners in Science, determined through the Mean Percentage Scores (MPS) obtained from the item analysis of pretest results during the third quarter. This analysis guided the development of instructional materials tailored to address the identified competency.

The developmental aspect utilized the SAMR Model (substitution (S), augmentation (A), modification (M), and redefinition (R) to systematically create the DIMs. Expert validation of the materials was conducted using the DepEd LRMSD Evaluation Rating Sheet to ensure content quality and alignment with educational standards. Furthermore, learners' levels of appreciation for the DIMs were assessed through survey responses, highlighting the impact and reception of the instructional materials.

### *Respondents and locale of the study*

The study was conducted at Ampayon Central Elementary School of East Butuan District 1. The school is located at Barangay Ampayon, Butuan City. Butuan City is the regional center of the Caraga Region in the Philippines. It is in the Northeastern part of Agusan Valley Mindanao, sprawling across the Agusan River. It is bounded to the north, west, and south by Agusan Del Norte, east by Agusan Del Sur, and Butuan City's Northwest. The East Butuan District I office is located in Barangay Ampayon, one of abundant city of Butuan. It is situated inside Ampayon Central Elementary School. This district is closed to the national highway and easy to locate.

The participants of this study consisted of 80 Grade 5 learners, comprising 48 males and 32 females.

### *Research instrument*

The instrument used in this study is the Expert's Rating Sheet (ERS), which was adapted from the Department of Education, Learning Resources Management and Development System (LRMDS). The experts utilized ERS in validating the developed digitized instructional materials. This instrument is a five-point Likert scale ranging from 5 (Strongly Agree) to 1 (Strongly

Disagree). Some modifications to the item format were made to better align them with the purpose of the study, with revisions validated by the thesis adviser.

The researcher utilized standardized pretest and posttest questionnaires to assess students' understanding before and after the implementation of the developed instructional materials. These questionnaires were previously validated by experts from the Caraga Region, ensuring their reliability and alignment with educational standards.

Additionally, the researcher employed the Kotobee Reader version 1.8.11 as the primary platform for delivering and accessing the interactive digitized materials, providing a user-friendly and engaging medium for students to enhance their learning experience.

#### *Data analyses procedure*

The study employed the following statistical treatments to analyze the data:

**Percentage.** Used to compute the frequency counts and percentages in identifying the least-learned competency in Science V based on the pretest results.

**Weighted Mean.** Applied to calculate the average responses from participants, providing insights into their perceptions of the developed contextualized instructional materials.

**Mean Percentage Score (MPS).** Utilized to represent the learners' performance levels, offering a clear understanding of their achievements in both the pretest and posttest.

**T-test.** Conducted to determine whether there was a significant difference between the learners' pretest and posttest scores, thereby evaluating the effectiveness of the developed instructional materials.

## FINDINGS AND DISCUSSION

### *Least learned competencies in grade 5 science in the third quarter 2023-2024*

This finding underscores the importance of addressing this specific Competency as it serves as a foundation for learning more advanced topics in physics, mathematics, and other sciences. The complexity of the lesson may stem from students' difficulty in visualizing or applying abstract concepts like motion and measurement in real-world contexts.

This challenge is further exacerbated by their limited skills in interpreting numerical data and graphs related to distance and time. Therefore, educators must

implement targeted teaching strategies, such as interactive simulations, hands-on experiments, and step-by-step problem-solving approaches, to enhance students' comprehension and engagement with the topic. Bridging this gap will improve their Science performance and equip them with critical thinking skills applicable to other subject areas.

### *The design and development of the digitized instructional material (DIM)*

Digitized Instructional Material (DIM) are designed and developed to address the least learned competencies in the third quarter in Science 5, focusing on Content, Format, presentation, organization, and Accuracy.

For Content, The DIM was developed based on the MPS results from the pretest in the third quarter of Science 5, which identified the least learned competency: “measuring motion in terms of distance and time”. These results guided the creation of instructional materials specifically designed to address and reinforce this topic.

When it comes to Format, Digitized Instructional Material (DIM) was designed to be highly interactive and engaging, encouraging active learning and exploration. Through Kotobee Software, the e-books were enriched with features such as clickable content, pop-up information boxes, and embedded quizzes that allowed learners to interact with the material in real-time. For instance, students could engage with interactive graphs that allowed them to input different values for distance and time, then see how changes affected the speed of an object in real-time. Additionally, the DIMs included quizzes at the end of each section to test students' understanding and provide immediate feedback. These formative assessments helped students track their progress and identify areas where further review was needed.

Regarding presentation and organization, the researcher paid careful attention to the presentation and organization of content using Kotobee Software. The layout of the e-books was meticulously designed to ensure clarity, ease of navigation, and visual appeal. The content was organized in a clean, structured layout, combining text, images, and interactive features in a cohesive manner. Each section of the material followed a logical progression, ensuring that students could build their knowledge step by step.

To ensure Accuracy, the researcher prioritized verifying the precision of the information in the DIM. Rigorous fact-checking and verification processes were implemented to minimize errors. Additionally, the researcher consulted three experts who evaluated the content using the DepEd LRMSD Evaluation Rating Sheet. Regular reviews and revisions were conducted throughout the development process to maintain high standards of accuracy. The interactive simulations and diagrams embedded within the DIMs were carefully crafted to reflect realistic and scientifically sound data. The accuracy of the material was supported by the students' ability to apply learned concepts to solve real-world problems, such as calculating the speed of an object in a simulation.

*The expert's evaluation and validation on the digitized instructional material in terms of content, format, presentation and organization, and accuracy and up datedness*

Four (4) experts were asked to validate the DIM based on the Content, Format, presentation and organization, accuracy, and up-to-datedness. As mentioned in the previous discussions, these criteria were strictly considered in the design and development of the said DIM.

The experts evaluated the Digitized Instructional Materials (DIMs) based on the DepEd LRMSD Evaluation Rating Sheet, which provides a structured framework for assessing the quality of instructional materials. The evaluation process focused on several key criteria, including

Data shows the quality of DIM in terms of Content as rated by the experts. The most oversized mean rating of 4.00 (perfect mean score) is noted on the indicators "DIM content is consistent with topics/skills found in the DepEd Learning Competencies for the subject and grade/year level it was intended" and "DIM provides clear learning objectives and goals for each lesson or activity, guiding students in their learning process." It further statistically indicates that the experts have affirmed the consistency of the contents included in the DIM relative to the DepEd standards. The DIM has exhibited high clarity of targets indicative of the activities and instructions.

*Quality of the DIM as evaluated by experts in terms of content*

On another important note, table 3 exposes that the other indicators are coupled with mean scores of 3.25, with an equivalent descriptive interpretation of satisfactory. It signifies that the said DIM can still be further enhanced by providing more opportunities for practice exercises for mastery. Consequently, the overall mean rating of 3.55 empirically implies that the developed DIM was very satisfactory, considering the lenses from the experts.

According to Regmi and Jones (2020), clear learning objectives provide the foundation of high-quality digital instructional materials, directing both the Content and the instructional design. These goals must be quantifiable and precise so that students know exactly what is expected. Engaging Content is essential; using a variety of formats, including infographics, videos, and interactive components, can accommodate a range of learning styles and maintain learners' motivation. Furthermore, properly arranging the Content with relevant titles and sections makes navigation easier and makes information more manageable for students to acquire.

Additionally, inclusiveness and accessibility are prioritized in adequate digital resources, guaranteeing that all students—including those with disabilities—can participate entirely in the course. Visual design is important; a professional, uncluttered layout with pertinent images can improve comprehension without drawing attention to itself. Active learning is encouraged by including interactivity, such as conversations and quizzes, and frequent updates guarantee that the information is current and applicable.

#### *Quality of the DIM as evaluated by experts in terms of format*

When it comes to technical quality, it can be observed from the data that the highest mean rating of 4.00 reflects the fact that the developed DIM uses good pictures, videos, and sounds to help learning. Yu et al. (2021) noted that digital educational tools with high-quality images, videos, and audio significantly improve student learning by making the information more exciting and remembered. Complex concepts can be illustrated by visual elements like images and movies, which facilitate understanding and retention.

They support different learning styles and assist in breaking down material into manageable chunks, especially for visual learners. Carefully selected images can also elicit emotional reactions, which can increase motivation and interest in the topic (Parentela, 2021). Moreover, other indicators also obtained mean scores that have verbal descriptions of satisfactory or very satisfactory, which consistently support the remarkable technical quality of the developed DIM.

Regarding the visual quality, the most significant mean of 4.00 lands on the indicator "DIM has features like captions and alternative text." It empirically signifies that the digitized material possesses good features and captions instrumental in better understanding the lessons. Because they improve accessibility and inclusion, features like captions and alternative text are crucial for digital instructional materials. Learners who are deaf or hard of hearing can participate entirely in the course thanks to captions, which offer a textual representation of audio Content (Eviota, 2022). They also help people who prefer to read aloud while listening or who might not be native speakers, which enhances understanding and memory.

As reflected in the mean scores of every indicator, it can be construed that the developed DIM has various areas for continual enhancement. However, statistical ratings established its high technical and visual quality suitable for the learners. Moreover, the overall mean of 3.50 numerically substantiates the very satisfactory quality of the developed DIM in Format. Chen

and Wong (2018) also argued that the Format of digitized instructional materials is crucial because it directly impacts usability, accessibility, and learner engagement. A well-organized format helps learners navigate the Content more efficiently, allowing them to find information quickly and understand the material's structure. Clear headings, bullet points, and consistent layouts contribute to a logical flow, enhancing comprehension and retention.

#### *Quality of the DIM as evaluated by experts in terms of presentation and organization*

Data presents the experts' evaluation results on the quality of the developed DIM in terms of presentation and organization. As to the instructional quality, it can be observed from the given table that the highest mean of 4.00 describes a very satisfactory

rating to the indicator "DIM uses different teaching methods to suit different students' styles." It implies further that students' learning styles are being highly considered in the design and development of the digitized material.

Park and Lee (2021) asserted that it is crucial to consider students' learning styles when creating digital educational materials since this facilitates more individualized and efficient learning. Different learners digest information in different ways. While some learn well with visual assistance, others may do better with auditory materials or hands-on exercises. Teachers can improve student motivation, engagement, and retention by considering these different learning styles.

Regarding organization, experts have rated very satisfactory, as supported by the mean score of 3.75, on the items "DIM is presented in a structured and organized manner" and "DIM allows easy tracking of student progress and performance." These indicators speak of the remarkable features of DIM in terms of its structure, organization, and tendency to track student progress and performance.

Eviota and Boyles (2022) highly noted that learning is facilitated, and clarity is improved by having digital teaching materials that are arranged and well-structured. Learners can browse the information and comprehend the relationships between topics more quickly when presented logically with clear headings and subheadings. By keeping things organized, students' cognitive load is lessened, and they can concentrate on studying instead of figuring out the arrangement (Lana, 2023).

Like the indicators of other criteria, presentation and organization are coupled with areas that can still be enhanced; this is reflected in the overall mean of 3.25, which empirically signifies the satisfactory quality of DIM concerning the organization and presentation of lessons.

#### *Quality of the DIM as evaluated by experts in terms of accuracy and up to datedness*

Data shows the expert's rating on the quality of DIM regarding Accuracy and Up to date. This criterion is further divided into accuracy and up-to-datedness domains. Dealing with accuracy, statistical ratings reveal a most significant mean of 4.00 for the item "DIM helps students distinguish between facts and opinions." This indicates that the developed instructional material has helped students accurately spot differences between facts and opinions.

Other accuracy indicators are described as satisfactory or very satisfactory, which further entails some opportunities to improve the DIM in terms of accuracy. Torio stated that accuracy in digitized instructional materials is crucial because it directly impacts the quality of education and the trustworthiness of the information being presented. When Content is accurate, learners can

rely on it as a valid source of knowledge, which builds confidence and fosters a positive learning environment.

Regarding up-to-datedness, the table shows a mean score of 3.75 for the items "DIM includes issues of the society related to the topic" and "DIM updates quickly to keep content current." It empirically indicates that the developed DIM integrates relevant issues of society and considers the latest trends. Digitized instructional materials must be up to date because current information ensures learners receive the most relevant and accurate knowledge (Kalogiannakis et al., 2021). The overall mean of 3.25 further reveals that the developed DIM has a very satisfactory level of quality in terms of up-to-datedness.

### *The enhancements of the digitized instructional material*

#### *Matrix of recommendations for enhancing the digitized instructional materials*

Regarding the feedback and recommendations provided by validators for improving the e-module based on four key indicators: content, format, presentation and organization, and accuracy and up-to-datedness. These recommendations aim to ensure the e-module is effective, user-friendly, and aligned with educational standards. The corresponding "Action Taken" section indicates the planned or implemented steps to address these recommendations.

For the content, validators emphasized the need for clarity, conciseness, and detail. They recommend avoiding redundancy while ensuring that the information remains comprehensive and insightful. This feedback highlights the importance of balancing depth with accessibility, ensuring that learners can grasp complex concepts without being overwhelmed. The "Action Taken" should focus on refining the content to meet these criteria.

In terms of format, the validators provided several practical suggestions to enhance readability and visual appeal. They advised maintaining consistent font styles, sizes, and color schemes throughout the e-module. Additionally, they stressed the importance of ensuring the material's compatibility across various devices and platforms, recognizing the diverse technological access of learners. Addressing these recommendations would result in a more cohesive and inclusive design.

For presentation and organization, the validators suggested strategies to optimize the learner's experience. These include maintaining a logical structure with balanced content, using consistent layouts, and incorporating design elements to improve engagement.

## CONCLUSIONS AND RECOMMENDATIONS

One major conclusion drawn from the study is that unmastered and least learned competencies in Science 5 are a prevalent issue among Grade 5 learners. This highlights the urgent need for a targeted educational intervention to address these learning gaps effectively and support students' academic progress in science.

Another key conclusion is that the development of Digitized Instructional Materials (DIM) proved to be an effective and innovative approach to bridging the identified competency gaps. The DIM offered an engaging and flexible learning platform that catered to diverse learning styles, encouraging active participation and deeper understanding among learners. By leveraging technological capabilities, the DIM served as an accessible and dynamic supplement

to traditional teaching methods, affirming its relevance and potential in today's educational landscape.

Furthermore, the DIM underwent thorough validation by subject matter experts and master teachers, aligning well with the standards set by the Department of Education (DepEd). It received high ratings in content, format, presentation, and accuracy. Validators noted that the material was comprehensive, curriculum-aligned, and well-structured. The user-friendly format, logical sequencing, and integration of interactive elements significantly contributed to learner engagement and content clarity. Moreover, the material was recognized for its accuracy and currency, incorporating up-to-date information and real-world examples to enhance its educational value.

Despite its overall quality, experts identified areas for improvement. Recommendations for refinement included improving the logical flow of lesson content, integrating more real-life applications to reinforce learning, and providing additional opportunities for student practice. These insights reinforce the DIM's strong foundation while highlighting its potential for continuous development and greater instructional impact in Science 5 education.

To enhance the effectiveness and implementation of the developed DIM, it is recommended that future versions integrate more advanced multimedia elements and interactive features. Adding animations, simulations, and interactive quizzes can cater to various learning preferences, improve learner engagement, and facilitate a deeper understanding of scientific concepts.

Additionally, addressing technical accessibility should be a priority. The DIM must be optimized for seamless use across various devices and operating systems, particularly in schools with limited technological resources. Ensuring broader compatibility will allow more students and educators to benefit from the material without facing technological constraints.

Continuous validation and refinement of the DIM are also crucial. Collecting regular feedback from educators, students, and instructional design experts will help identify any content gaps, usability issues, or areas that require clarification. This iterative process will support the DIM's ongoing improvement and relevance in the educational setting.

Lastly, it is recommended that future studies expand the scope of pilot testing and monitoring. Testing the DIM with a larger and more diverse group of learners can provide more comprehensive insights into its effectiveness. Long-term tracking of its impact on student performance will further validate its educational value and highlight areas that may require future enhancements.

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