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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 the SAMR model in the development and validation of the materials. A descriptive-developmental research design was used to create DIMs 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 LRMDS 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 "describes the motion of an object by tracing and measuring its change in position (distance traveled) over some 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 LRMDS, 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

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 some 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 was 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.

METHOD

This chapter presents the research design, research locale, population and participants of the study, sampling design, research instrument, validation, and reliability of the research, data-gathering procedures, and statistical treatment.

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 LRMDS 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.

Research Locale

The study was conducted at Ampayon Central Elementary School of East Butuan District 1. The school is located in 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 the abundant cities of Butuan. It is situated inside Ampayon Central Elementary School. This district is close to the national highway and easy to locate.

Participants of the Study

The participants of this study consisted of 80 Grade 5 learners, comprising 48 males and 32 females. Table 1 presents the detailed distribution of the study's total population, providing a clear demographic profile of the respondents.

Table 1
Distribution of the Participants of the Study

Sex	N	%
Male	48	60
Female	32	40
Total	80	100

Sampling Design

The study used purposive sampling. All Grade 5 learners currently enrolled in the school year 2023-2024 were listed as study participants. As shown in the Table above, the population of the study was classified according to sex.

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 interactive digitized materials, providing a user-friendly and engaging medium for students to enhance their learning experience.

Validation and Reliability of the Instrument

One (1) Master Teacher and three (3) Science teachers, all from the Department of Education, reviewed the Expert's Rating Sheet (ERS). After thorough revisions, the questionnaire was submitted to the research experts of the Agusan Colleges Incorporated thesis evaluation committee for evaluation and approval. Interview questions were conducted with a subset of participants to assess the usability and effectiveness of the research instrument.

Data Gathering Procedure

The study commenced upon the approval of the Thesis Evaluation Committee. The researcher sought permission from the school principal of Ampayon Central Elementary School to conduct the study in the school, where the pretest assessment in the third quarter in Science V was administered among the learners with the aid of the teacher-advisers. After obtaining approval, item analysis was performed in the third quarter and consolidated to identify the least-learned competency of the pupils in Science V based on the results.

The researcher developed digitized instructional materials based on the identified least-learned competency. Then, the developed digitized instructional material was distributed to four experts who validated the DIMs using the DepEd Learning Resources Management and Development System (LRMDS) Evaluation Rating Sheet. The collected data were tallied, tabulated, processed, analyzed, and interpreted to enhance the developed digitized instructional materials.

After using the developed enhanced digitized instructional material, the researcher personally administered the survey questionnaires to the participants, allowing them 10 to 15 minutes to complete them. The participants answered the questionnaires simultaneously in their respective classrooms. Following the administration of the questionnaire, the data were collated, recorded, and analyzed. Subsequently, the data were encoded using a template provided by the study's statistician.

Scoring and Quantification of Data

The following variables were quantified for statistical analysis purposes:

The Criteria of Validator's Rating

Level	Range	Descriptive Rating	Interpretation
1	1.00-1-49	Strongly Disagree	Very low
2	1.50-2.49	Disagree	Low
3	2.50-3.49	Uncertain	Uncertain
4	3.50-4.49	Agree	High
5	4.50-5.00	Strongly Agree	Very High

Pretest/ Posttest Scoring

Mean Percentage Ranges	Verbal Remarks
96% - 100%	Mastered
86% - 95%	Closely Approaching Mastery
66% - 85%	Moving Towards Mastery
35% - 65%	Average Mastery
16% - 34%	Low Mastery
5% - 15%	Very Low Mastery
0% - 4%	Minimal Mastery

Statistical Treatment of Data

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 post-test scores, thereby evaluating the effectiveness of the developed instructional materials.

RESULTS AND DISCUSSIONS

This part presents the results and discussions derived from the data collected during the study. The findings are organized and analyzed in alignment with the sequential order of the stated research problems, providing a clear and comprehensive interpretation of the results.

The Least Learned Competency of the Grade-5 students in their 3rd Quarter Science.

Table 2 shows the least learned competencies of the learners in the third quarter of the school year 2023-2024. As displayed in the Table, the competency "Determine the effects of changing the number or type of components in a circuit (S5FE-IIIg-7)" got the highest Mean Percentage Score (MPS), which is 92%, which means that the majority of the learners had mastered the skill. Looking closely, the competency (Describe the motion of an object by tracing and measuring its change in position (distance traveled) over some time (S5FE-III-a-1)" got the not mastered or lowest MPS, which is 35%, which means that competency is considered least learned of the learners in the third quarter assessment and that they need to use the intervention material.

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.

Table 2

Least Learned Competencies in Grade 5 Science in the Third Quarter 2023-2024

Competencies	MPS	Mastery Level
Describe the motion of an object by tracing and measuring its change in position (distance traveled) over some time (S5FE-III-a-1)	35%	Not mastered
Discuss why some materials are good conductors of heat and electricity (S5FE-IIIc-3)	79%	Nearly Mastered
Relate the ability of the material to block, absorb, or transmit light to its use (S5FE-IIIe-5)	75%	Nearly Mastered
Infer the conditions necessary to make a bulb light up (S5FE-IIIf-6)	62%	Nearly Mastered
Determine the effects of changing the number or type of components in a circuit (S5FE-IIIg-7)	52%	Least Mastered
Determine the effects of changing the number or type of components in a circuit. (S5FE-IIIg-7)	92%	Mastered

Legend: 0-39- (Not Mastered); 40-59-(Least Mastered); 60-79-(Nearly Mastered); 80-100-(Mastered)

The Design and Development of the Digitized Instructional Material (DIM)

Digitized Instructional Materials (DIM) are designed and developed to address the least learned competencies in the third quarter of 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** cohesively. 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 LRMDS 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 student's 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 of the Digitized Instructional Material in terms of content, format, presentation, organization, and accuracy are updated.

Four (4) experts were asked to validate the DIM based on the Content, Format, presentation and organization, accuracy, and up-to-date. 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 LRMDS Evaluation Rating Sheet**, which provides a structured framework for assessing the quality of instructional materials. The evaluation process focused on several key criteria, including

Table 3 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.

Table 3

Quality of the DIM as evaluated by experts in terms of Content

Indicators	Wtd mean	SD	Interpretation
1. Content is consistent with topics/skills found in the DepEd Learning Competencies for the subject and grade/year level it was intended.	4.00	0.000	Very Satisfactory
2. Provide opportunities for students to apply and practice newly acquired knowledge and skills	3.25	0.500	Satisfactory
3. Provide clear learning objectives and goals for each lesson or activity, guiding students in their learning process.	4.00	0.000	Very Satisfactory
4. Objectives are sequenced logically to address the least learned competencies	3.25	0.500	Satisfactory
5. Activities match what students should learn at their grade level.	3.25	0.500	Satisfactory

Legend: 1.00-1.49- Very Unsatisfactory; 1.50-2.49-Unsatisfactory; 2.50-3.49- Satisfactory; 3.50-4.00- Very Satisfactory

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.

In terms of format, table 4 depicts the experts' ratings on technical and visual quality dimensions.

Table 4

Quality of the DIM as Evaluated by Experts in terms of Format

Indicators	Weighted mean	SD	Interpretation
Technical Quality			
1. Uses good pictures, videos, and sounds to help learning.	4.00	0.000	Very Satisfactory
2. Works on many devices, making it easy for everyone to use.	3.50	0.577	Very Satisfactory
3. Is user-friendly so that students can use it easily.	3.25	0.500	Very Satisfactory
4. Can be downloaded easily for quick access.	3.25	0.500	Very Satisfactory
5. Has clear, easy-to-read text in the right size for students.	3.75	0.500	Very Satisfactory
Visual Quality			
1. Text is easy to read on any device.	3.25	0.500	Satisfactory
2. Is easy to navigate, allowing students to locate information efficiently.	3.00	0.000	Satisfactory
3. Has features like captions and alternative text.	4.00	0.000	Very Satisfactory
4. Looks nice and makes students want to use it.	3.25	0.500	Satisfactory
5. Meets the standard for visuals.	3.75	0.500	Very Satisfactory
Overall Weighted Mean	3.50	0.082	Very Satisfactory

Legend: 1.00-1.49- Very Unsatisfactory; 1.50-2.49-Unsatisfactory; 2.50-3.49- Satisfactory; 3.50-4.00- Very Satisfactory

When it comes to technical quality, it can be observed from Table 3 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.

Table 5 presents the evaluation of the Digitized Instructional Material (DIM) by experts, specifically focusing on its quality in terms of presentation and organization.

Table 5

Quality of the DIM as evaluated by experts in terms of Presentation and Organization

Indicators	Weighted mean	SD	Interpretation
Instructional Quality			
1. Uses what students already know in school.	3.25	0.500	Satisfactory
2. Let students collaborate and participate actively, making learning lively.	3.75	0.500	Very Satisfactory
3. Uses different teaching methods to suit different students' styles.	4.00	0.000	Very Satisfactory
4. Shows Content clearly and neatly so students can easily understand it.	3.25	0.500	Satisfactory
5. Shows how what has been learned applies to real life, making it meaningful for students.	3.25	0.500	Satisfactory
Organization			
6. Is presented in a structured and organized manner.	3.75	0.500	Very Satisfactory
7. Provides clear headings, subheadings, and labels to help students easily navigate	3.25	0.500	Satisfactory
8. Allows easy tracking of student progress and performance.	3.75	0.500	Very Satisfactory
9. Integrates multimedia elements (such as videos, simulations, and interactive modules).	3.25	0.500	Satisfactory
10. Incorporates visual aids (e.g., diagrams, charts, graphs)	3.00	0.000	Satisfactory
Overall Weighted Mean	3.25	0.500	Satisfactory

Legend: 1.00-1.49- Very Unsatisfactory; 1.50-2.49-Unsatisfactory; 2.50-3.49- Satisfactory; 3.50-4.00- Very Satisfactory

Table 5 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.

Table 6 provides a detailed assessment of the quality of the Digitized Instructional Material (DIM) as evaluated by experts, with a specific focus on its accuracy and up-to-date. This evaluation ensures that the content is precise, error-free, and aligned with current knowledge and standards, contributing to its effectiveness as a reliable educational resource.

Table 6

Quality of the DIM as Evaluated by Experts in terms of Accuracy and Datedness

Indicators	Weighted mean	SD	Interpretation
Accuracy			
1. Examples and pictures in DIM make sense and are accurate.	3.25	0.500	Satisfactory
2. The creator focuses on getting the information right.	3.75	0.500	Very Satisfactory
3. Helps students distinguish between facts and opinions.	4.00	0.000	Very Satisfactory
4. Helps students discover new ideas in the subject.	3.25	0.500	Satisfactory
5. Gives accurate information with good sources.	3.25	0.500	Satisfactory
Up to datedness			
1. Include issues of the society related to the topic.	3.75	0.500	Very Satisfactory
2. Uses real-life stories to explain ideas.	3.25	0.500	Satisfactory
3. Updates quickly to keep content current.	3.75	0.500	Very Satisfactory
4. The DIM creator listens to feedback to make things better.	3.25	0.500	Satisfactory
5. Content uses new examples.	3.00	0.000	Satisfactory
Overall Weighted Mean	3.25	0.500	Satisfactory

Legend: 1.00-1.49- Very Unsatisfactory; 1.50-2.49-Unsatisfactory; 2.50-3.49- Satisfactory; 3.50-4.00-Very Satisfactory

Table 6 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-dateness 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-date, 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

Table 7 presents a comprehensive summary of the feedback and recommendations provided by validators for the crafted e-module. Its purpose is to highlight key areas for improvement, focusing on four critical indicators: content, format, presentation and organization, and accuracy and up-to-datedness. These recommendations aim to ensure the e-module is not only accurate and relevant but also visually appealing, well-organized, and aligned with the needs of learners.

The "Remarks" column outlines the actions to be taken in response to the feedback, ensuring that the e-module meets high-quality standards and effectively
supports the learning process.

Table 7

Matrix of Recommendations for Enhancing the Digitized Instructional Materials

Indicators	Recommendations	Remarks
Content	• Validators recommend avoiding redundancy by presenting information succinctly while maintaining depth and clarity. • The validators recommend that the content should be detailed.	Action Taken
Format	• Use consistent formatting, including appropriate font styles and sizes, for better readability. • Validators recommend consistent color schemes and themes to improve visual coherence and appeal. • Validators advise ensuring the module's format is compatible across various devices and platforms.	Action Taken
Presentation and Organization	• Validators advise maintaining a balanced presentation to prevent information overload while ensuring completeness. • Validators recommend using consistent layouts and design elements to enhance readability and maintain user engagement. • Validators advise including summaries or key takeaways at the end of each section for better topic recall. • Validators suggest providing clear instructions and guidelines to ensure smooth utilization of the e-module.	Action Taken
Accuracy and Up-to-datedness	• Validators recommend validating all information for factual correctness before finalizing the e-module. • Validators suggest regularly reviewing and updating content to reflect the latest developments in the subject area. • Validators advise citing credible sources to ensure the accuracy and reliability of the material.	Action Taken

In Table 7, the feedback and recommendations provided by validators for improving the e-module are 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.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

FINDING

The results revealed that the least-learned competency among the students was related to describing the motion of an object by tracing and measuring its change in position (distance traveled) over some time. The pretest scores indicated that most students struggled to master key Science 5 lessons, highlighting the need for an innovative instructional approach.

A digitized instructional material using the Kotobee application was developed to address this. This DIM was carefully designed, taking into consideration the students' least-learned competencies and aligning with DepEd criteria such as content, format, presentation and organization, and up-to-date.

The quality of the developed DIM was evaluated by the experts with the following major findings; very satisfactory content and format, satisfactory presentation and organization, and up-to-date.

Ratings from the experts or validator unfold some areas for improvements or enhancement of the developed DIM. Content can be further enhanced by providing students with opportunities to apply and practice newly acquired knowledge and skills. The logical sequence of objectives considering the desired learning competencies is also an area for improvement. When it comes to format, the DIM may be improved by designing it in such a way that it is convenient and easy for students to navigate following the correct and logical sequence of the lessons. As to presentation and organization, the instructional quality of the developed DIM can be improved by including more real-life situations, meaningful examples, and current information. Lastly, up-to-datedness of the DIM may be improved by considering more examples in every lesson. With the presence of more examples, students will be able to understand and master more of the essential competencies.

CONCLUSIONS

Based on the major findings presented, the following conclusions were drawn.

1. Unmastered and least learned competencies in Science 5 is an evident issue among grade 5 learners which needs an intervention.
2. The development of digitized instructional materials (DIM) proved to be an effective and innovative approach to bridging these competency gaps. DIM offered an engaging, flexible learning platform that accommodated diverse learning styles while promoting active participation and deeper understanding. Leveraging the capabilities of technology, the DIM provided an accessible and dynamic supplement to traditional teaching methods, demonstrating its relevance in modern educational contexts.
3. The DIM was validated by experts and master teachers and adhered to the Department of Education (DepEd) standards, receiving high ratings in the areas of content, format, presentation, accuracy, and up-to-datedness. Validators noted that the content was comprehensive, relevant, and aligned with curriculum standards, effectively addressing the identified least-learned competencies. The format was praised for being user-friendly and well-structured, while the presentation and organization demonstrated logical sequencing and interactive elements that engaged learners. Additionally, the DIM was deemed accurate and up to date, incorporating relevant examples and current information to ensure its reliability and practicality.
4. While the DIM's quality was commendable, opportunities for refinement were noted, including enhancing the logical flow of lessons, incorporating more real-life applications, and increasing practice opportunities. Overall, the expert validation highlights the DIM's potential as a valuable tool for addressing instructional challenges and fostering improved learning outcomes in Science 5.

RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations are proposed to enhance the effectiveness and implementation of the developed Digitized Instructional Material (DIM):

Enhance multimedia elements and interactivity. Future iterations of the DIM should incorporate more dynamic multimedia features, such as animations, simulations, and interactive quizzes, to further engage learners and address varying learning styles effectively.

Address technical accessibility. To improve usability, the DIM should be optimized for use on different devices and operating systems, ensuring that technical barriers do not hinder its implementation in schools with limited resources.

Conduct continuous validation and refinement. Regular feedback from educators, learners, and instructional design experts should be gathered to identify and address any weaknesses in the DIM, such as content gaps or unclear instructions, ensuring its continuous improvement.

Expand pilot testing and monitoring. Future researchers may consider testing the DIM with a larger, more diverse student population. Additionally, long-term monitoring of its impact on student performance can provide valuable insights into its sustained effectiveness and areas for further enhancement.

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