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From stories to numbers: development of folktale-based instructional materials in mathematics

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ABSTRACT

Persistent learning gaps and the scarcity of culturally anchored resources continue to challenge Grade 7 mathematics instruction in rural public schools in the Philippines, particularly under the MATATAG curriculum. This study developed and evaluated a folktale-based instructional material that integrates local Panay folktales with target Grade 7 competencies in measurement and geometry and number and algebra to support meaningful, context-rich learning. Using a Type I developmental research design guided by analysis, design, development, implementation, and evaluation (ADDIE) model and anchored on social constructivism and attention, relevance, confidence, and satisfaction (ARCS) motivational framework, the material was produced through competency mapping, story-task scripting, iterative expert review, and pilot implementation. Participants included 25 Grade 7 mathematics teachers who identified suitable competencies, 10 content and pedagogy experts who validated the material, and 66 Grade 7 learners from four public secondary schools who evaluated usability and learning support. Acceptability was measured using adapted expert and learner evaluation forms with a 5-point scale and summarized using descriptive statistics. Results indicated an overall rating of highly acceptable. Format and design received the highest evaluation, followed by organization and presentation and learning objectives; content and assessment were rated acceptable, highlighting specific areas for refinement. These findings suggest that embedding mathematical concepts in culturally familiar narratives can improve perceived clarity, engagement, and task coherence while maintaining alignment with curriculum standards. The study contributes a replicable, culturally responsive development process and a ready-to-adapt set of story-based math tasks for teachers in similar contexts. Future work may examine learning gains through quasi-experimental implementation and explore digital adaptations to broaden access and interactivity.

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1. INTRODUCTION

The K to 12 basic education programs in the Philippines was established to align national education with global standards while strengthening Filipino identity, values, and community resilience. Beyond extending schooling years, it sought to cultivate 21st-century skills such as critical thinking, communication, collaboration, and creativity were anchored in civic responsibility and cultural awareness [1], [2]. However,

despite these aspirations, a persistent gap remains between educational access and actual learning outcomes. National and international assessments consistently highlight Filipino learners' weak performance in literacy and numeracy, revealing the need for deeper, culturally grounded reform. This troubling result emphasizes the urgency to enhance instructional quality rather than merely increase access [3]–[5].

In response, the Department of Education (DepEd), in collaboration with the Assessment, Curriculum and Technology Research Centre (ACTRC), recalibrated the curriculum, resulting in the MATATAG curriculum an acronym representing a learner-centered vision that prioritizes foundational skills, well-being, teacher support, and contextual relevance. It redefines quality education through inclusivity, localization, and values formation [6]. One of its key goals is to revive home-based learning cultures and promote community collaboration in developing literacy and numeracy. Within this initiative, mathematics becomes a vital area to operationalizing such reforms, as it serves as a foundation for problem-solving and reasoning yet remains one of the most challenging subjects for Filipino learners [7], [8].

Mathematics instruction in many schools remains abstract and heavily dependent on rote procedures. Learners often struggle to connect mathematical ideas with their lived experiences, leading to low engagement and achievement. As Luecke [9] argues, teaching mathematics as a universal and culture-free discipline can distance learners from its meaning. In contrast, integrating cultural context and everyday experiences fosters a sense of belonging and enhances comprehension. Culturally relevant education (CRE) responds to this challenge by validating students' cultural identities and integrating local contexts into teaching and learning. It treats culture as a dynamic resource for academic success rather than an obstacle [10]. This challenge becomes more pronounced in rural public secondary schools, where limited access to contextualized learning resources and heavy teacher workloads can constrain differentiated instruction and make curriculum shifts more difficult to implement. Under these conditions, teachers need ready-to-use materials that connect mathematical ideas to learners' local experiences while remaining aligned with curriculum standards [11].

In the Philippine context, the call for contextualized and culturally responsive instruction is supported not only by pedagogy but also by policy. Section 10 of the Implementing Rules and Regulations (IRR) of Republic Act No. 10533 mandates curriculum flexibility for localization and indigenization. This direction also aligns with UNESCO's sustainable development goal (SDG) 11, particularly target 11.4, which emphasizes protecting and promoting cultural heritage. Hence, culturally responsive mathematics teaching can strengthen academic learning while contributing to the preservation of intangible cultural traditions, ensuring that education remains relevant, inclusive, and empowering [12].

Within CRE, stories and folktales offer a particularly promising pathway for contextualization because they are familiar cultural forms through which communities transmit values, practices, and problem-solving strategies. Folktales serve as vessels of cultural memory, embodying meanings recognizable to learners [13]. When mathematical ideas are embedded in these narratives such as patterns in weaving, proportions in cooking, or measurements in farming concepts become more concrete and relatable. Learners can visualize and interpret numbers through the lens of their community's lived experiences.

Supporting this view, studies affirm that storytelling enhances engagement, comprehension, and retention. Abdalla and Moussa [14] emphasize that culturally responsive instruction addresses social barriers to achievement by grounding learning in familiar contexts. Similarly, Mendez and Es [15] identify stories as effective tools in mathematics education because they "provide a meaningful context that attracts learners' interest." Thus, integrating local folktales into the classroom can unite culture and cognition, making learning both intellectually rigorous and emotionally resonant.

Alongside story-based contextualization, recent studies also highlight technology and inquiry-driven innovations in mathematics instruction. For instance, augmented reality can improve elementary learners' critical thinking [16], digitally supported frameworks can strengthen pre-service teachers' learning design competencies and research based learning-science, technology, engineering, and mathematics (RBL-STEM) approaches can enhance students' conjecturing skills [17]. However, such approaches may be difficult to sustain in low-resource settings and rarely position locally shared narratives as the primary context for mathematical sense-making. Therefore, a clear gap remains in developing and empirically evaluating culturally anchored, story-based mathematics materials aligned with the MATATAG curriculum for rural Grade 7 learners. Addressing this gap constitutes the novelty of the study, it systematically converts Panay folktales into curriculum-aligned Grade 7 mathematics tasks using the analysis, design, development, implementation, and evaluation (ADDIE) development process enriched by Keller's attention, relevance, confidence, and satisfaction (ARCS) principles, and validates the resulting material through a multi-perspective evaluation involving teachers, experts, and learners offering a replicable pathway for culturally responsive mathematics instruction within the MATATAG context.

To explain how this development effort can enhance learner engagement and mastery, the theoretical foundation integrates social constructivism, the instructional design theory (ADDIE), and the ARCS model. Social constructivism, inspired by Vygotsky, posits that knowledge is co-constructed through

interaction, culture, and language; learning is a social activity where meaning emerges from dialogue, negotiation, and shared experience [18]–[20]. Applied to mathematics teaching through folktales, this perspective assumes that learners collaboratively build understanding as they analyze narrative situations, pose problems, and derive solutions. Folktales function as mediational tools that connect learners' cultural schema with mathematical reasoning, while activities such as group discussion, dramatization, and storytelling support internalization of both cultural narratives and mathematical structures and cultivate critical thinking, communication, and collaboration [21].

Building on this constructivist lens, the ADDIE model provides a systematic process for transforming local folktales into effective instructional materials [22]. In the analysis phase, teachers identify learners' needs, least-mastered competencies, and cultural resources that can illuminate key mathematical ideas. During design and development, storylines are aligned with learning objectives and converted into modules, visuals, and interactive tasks that encourage learners to explore, represent, and justify solutions collaboratively. Implementation then focuses on teacher-facilitated use of the materials in class, while evaluation both formative and summative feedback into earlier phases to refine stories, activities, and assessments. In this way, ADDIE operationalizes social constructivism by ensuring that each stage of material development intentionally supports social interaction, cultural relevance, and concept-building.

To strengthen motivation alongside learning design, Keller's ARCS model is embedded within the ADDIE cycle [23]. During analysis and design, folktales and tasks are selected to capture attention through vivid plots and characters and to ensure relevance by linking mathematical ideas to familiar community practices such as farming, handicraft, and trading [24]. Development and Implementation support confidence by structuring scaffolded, cooperative activities such as guided questioning, peer explanation, and group problem-solving that allow learners to experience incremental success in a supportive social environment. Finally, evaluation and reflective discussions foster Satisfaction as learners recognize that they can master mathematics through stories rooted in their own heritage. Thus, ARCS and social constructivism work as mutually reinforcing lenses that guide motivational decisions at each ADDIE phase rather than functioning as separate add-ons.

Anchored in these three frameworks, culturally relevant mathematics education aligns with DepEd's MATATAG vision of producing Batang Makabansa learners who are academically competent, values-driven, and culturally rooted [25]. Localized stories can position mathematics as a vehicle for both analytical and moral reasoning, helping learners recognize that numbers and patterns are embedded in their everyday environment while positioning teachers as cultural mediators who connect abstract concepts to lived realities [26]. Yet many classrooms remain textbook-dependent and dominated by Western examples, and empirical research on systematically designed, culturally integrated mathematics instruction in the Philippine context remains limited [27]. Hence, this study seeks to design, develop, and evaluate a folktale-based instructional material in mathematics grounded in social constructivism, structured by ADDIE, and motivated by ARCS, demonstrating how cultural relevance, cognitive construction, and motivational design can work together to improve learners' conceptual understanding, engagement, and motivation.

Ultimately, this research frames education not merely as the transmission of mathematical knowledge but also as an act of cultural preservation and transformation. Through the strategic use of folktales, learners are invited to rediscover mathematics as part of their heritage, embedded in stories of wisdom, problem-solving, and community cooperation so that concepts become both meaningful and usable in their daily lives. Accordingly, this study links curriculum demands, rural implementation constraints, and recent scholarship to a concrete development effort: designing and evaluating folktale-based instructional materials that can be adopted and adapted by Grade 7 mathematics teachers to support the MATATAG goal of developing numerate, values-driven, and culturally rooted learners. In light of the foregoing context, this study endeavored to respond to the following inquiries:

i) Which mathematics competencies do teachers perceive as suitable for integration with local folktales?
ii) What instructional material can be designed and developed integrating local folktales from the identified competencies, and what are its distinctive features?
iii) What are the students and experts' evaluation of the acceptability of the developed folktale-based instructional material in terms of the: learning objectives; content; organization and presentation; format and design; and assessment?

2. METHOD

This section of the paper presents the research design, the respondents, the data collection instruments and procedures, as well as the ethical considerations observed in the conduct of the study, detailing how the investigation was structured, who participated, what tools were used to gather data, and the safeguards implemented to ensure ethical compliance.

2.1. Research design

This investigation adopted a Type I developmental research design guided by the ADDIE model to conceptualize, construct, and evaluate a folktale-based instructional material in mathematics 7 contextualized through local folktales. Developmental research serves as a rigorous methodological framework for generating, refining, and empirically validating instructional innovations that advance pedagogical practice and learner engagement [28]. It entails a systematic inquiry into the processes of design, development, and evaluation either as an integrated system or through the examination of distinct procedural phases. As articulated by Al-Khiami *et al*. [29], developmental research constitutes a systematic study of design, development, and evaluation processes to establish an empirical foundation for the creation of instructional and non-instructional products and the refinement of models guiding their production.

The study employed the Type I developmental research design, which emphasizes the description, analysis, and appraisal of a product development process within a defined educational context. This approach was deemed appropriate given the study's objective of designing and validating a culturally responsive folktale-based instructional material that integrates mathematical concepts with indigenous narrative traditions. The developmental process was systematically guided by the ADDIE model, comprising the phases of ADDIE to ensure methodological rigor, theoretical grounding, and iterative refinement of the instructional product.

Moreover, the overall structure of the research was framed through the input–process–output (IPO) model, which delineated the logical progression of activities from identifying instructional needs to producing and validating the final material. The synthesis of the developmental research framework, ADDIE instructional model, and IPO conceptual structure provided an empirically grounded and theoretically coherent pathway for creating an innovative educational resource [30]. This integrative approach ensured that the resulting folktale-based instructional material was not only pedagogically sound and empirically validated but also contextually meaningful, thereby contributing to a more culturally attuned and engaging mathematics learning experience for Grade 7 learners.

2.2. Respondents

The respondents of this study consisted of twenty-five (25) Grade 7 teachers, 66 learners from four public secondary schools in the municipality of Maayon, Province of Capiz. The teachers, specializing in mathematics, English, and social sciences, were purposively selected to provide critical inputs for the design and development of the folktale-based instructional material, integrating local folktales into mathematics instruction. Their expertise and familiarity with the local educational context were deemed vital in identifying the most suitable learning competencies for integration, ensuring that the material reflected both cultural authenticity and pedagogical soundness. In addition, Grade 7 learners officially enrolled in the first semester of the school year 2024–2025 participated in the implementation and evaluation of the developed folktale-based instructional material. These learners also served as respondents in assessing the acceptability and relevance of the developed folktale-based instructional materials. The inclusion criteria for learner-respondents: i) current enrollment in Grade 7 during the specified academic term and ii) voluntary participation in the study. Their feedback provided empirical evidence on the folktale-based instructional material's effectiveness in enhancing engagement and learning motivation within the mathematics classroom.

2.2.1. Evaluator

The study included 10 content and pedagogy experts' evaluators who assessed the developed folktale-based instructional materials in terms of content validity, functionality, and pedagogical appropriateness. The evaluators were purposively selected based on their professional qualifications, which included: i) possession of a master's or doctorate degree in education or a related field; ii) a minimum of 5 years of teaching experience; and iii) active involvement in teaching mathematics or English, or in curriculum and instructional materials development. The panel of evaluators was composed of mathematics and English teachers, curriculum specialists, and a DepEd education program supervisor in mathematics. Their expert judgments and recommendations were thoroughly considered and integrated into the refinement of the folktale-based instructional material to ensure its academic rigor, cultural alignment, and instructional efficacy.

2.3. Data gathering instruments

To facilitate systematic data collection and ensure methodological rigor, three research instruments were utilized in this study: i) learning competency checklist; ii) experts' evaluation form; and iii) learners' evaluation form. Each instrument underwent content and face validation by five field experts to ascertain its appropriateness and relevance to the study's objectives.

2.3.1. Learning competency checklist

A researcher-developed checklist was employed to identify the five most appropriate Grade 7 mathematics learning competencies that could be effectively integrated with local folktales. The checklist contained first-quarter learning competencies under the MATATAG curriculum and was rated using a 4-point Likert scale: 4=strongly agree, 3=agree, 2=disagree, and 1=strongly disagree. Teachers were instructed to indicate the degree to which they deemed each competency suitable for folktale integration. This instrument served as the foundation for selecting and designing the folktale-based instructional material aligned with identified key competencies.

2.3.2. Experts' and learners' evaluation forms

To determine the acceptability and pedagogical soundness of the developed folktale-based instructional material, evaluation checklists adapted from Nabayra [31] and Banerjee and Bhat [32] were utilized. The forms consisted of items clustered under five criteria: objectives, content, organization and presentation, format and design, and assessment. A 5-point rating scale was used: 5=strongly agree, 4=agree, 3=neutral, 2=disagree, and 1=strongly disagree. Minor revisions were made to tailor the instruments to the study's framework. The acceptability of the folktale-based instructional material was interpreted using the scale as: 4.51–5.00 (highly acceptable), 3.51–4.50 (acceptable), 2.51–3.50 (moderately acceptable), 1.51–2.50 (fairly acceptable), and 1.00–1.50 (not acceptable). This evaluative process ensured that both expert validators and student respondents provided feedback grounded in established pedagogical standards.

2.4. Data collection procedure

This study adopted the ADDIE instructional design model as the guiding framework for the systematic development of a culturally contextualized folktale-based instructional material in Grade 7 mathematics. The model, consisting of the five interrelated phases of ADDIE, served as the structural backbone of the research process. Each phase was carefully executed to ensure that the resulting folktale-based instructional material achieved both pedagogical soundness and cultural relevance.

2.4.1. Analysis phase

The analysis phase involved an extensive review of the Grade 7 mathematics learning competencies outlined in the MATATAG curriculum for the first quarter of the school year 2024–2025. A detailed checklist was formulated to identify which competencies could be effectively integrated with local folktales, thereby creating a meaningful intersection between mathematics and culture. Subject matter experts in mathematics, English, and social studies collaboratively examined, ranked, and selected the top five competencies using statistical measures such as mean and standard deviation. In addition, practical aspects such as instructional environment, production logistics, and cost considerations were evaluated to ensure the project's viability and sustainability. This phase established the pedagogical and logistical groundwork for the succeeding stages of material development.

2.4.2. Design phase

In the design phase, the researcher analyzed learner characteristics and content requirements to ensure that the material addressed both cognitive and affective learning needs. Drawing from Panaysayon: Tales from Panay Island, authentic Panaysanon folktales were chosen to serve as the narrative framework for embedding mathematical concepts such as geometry, measurement, and basic algebra. The instructional blueprint was structured to include lesson discussions, interactive activities, and reflective questions that fostered analytical and problem-solving skills. The design phase emphasized the integration of local culture with formal mathematics instruction, allowing learners to appreciate mathematical ideas within familiar and meaningful contexts. This stage ensured that the material aligned with curriculum standards while also reflecting the lived experiences and cultural heritage of the learners.

2.4.3. Development phase

The development phase involved the production of the folktale-based instructional material based on the finalized design blueprint. Lessons were written in clear, engaging language, complemented by culturally inspired illustrations created by a commissioned artist to enhance aesthetic quality and contextual accuracy. The preliminary version of the material was subjected to expert validation by specialists in curriculum development and mathematics education. They assessed the material for clarity, content accuracy, relevance, and overall instructional coherence. Constructive feedback was analyzed and integrated into successive revisions, resulting in a refined material that was visually appealing, culturally sensitive, and pedagogically robust. This phase ensured that the developed material effectively balanced academic rigor with cultural expression.

2.4.4. Implementation phase

The implementation phase consisted of the pilot testing of the developed folktale-based instructional material among selected Grade 7 learners within the Maayon District. Prior to the implementation, formal approval was secured from educational authorities, and parental consent was obtained to ensure adherence to ethical standards. The researcher and the teacher-implementer collaboratively facilitated the lessons using the folktale-based instructional material in an authentic classroom setting. Throughout the process, the research and coresearchers conducted on-site observations to ensure fidelity and consistency of instruction. Video documentation of the sessions was provided to the expert panel for additional evaluation. Conducted from the last week of August to the third week of September 2024, the implementation period allowed ample time for monitoring student performance, assessing instructional flow, and identifying areas for refinement.

2.4.5. Evaluation phase

The evaluation phase focused on assessing the acceptability and of the developed instructional material. Standardized evaluation forms were distributed to both learners and expert evaluators to gather quantitative data. The evaluation criteria included content accuracy, cultural relevance, instructional clarity, layout, and engagement value. Descriptive statistics such as mean, standard deviation, and rank were employed to interpret the collected data. Overall, the evaluation revealed strong positive responses from both groups, indicating that the material was not only educationally sound but also culturally meaningful. The insights and recommendations gathered were systematically incorporated into the final version of the material, ensuring continuous improvement and alignment with pedagogical standards. The overall procedure is summarized in Figure 1.

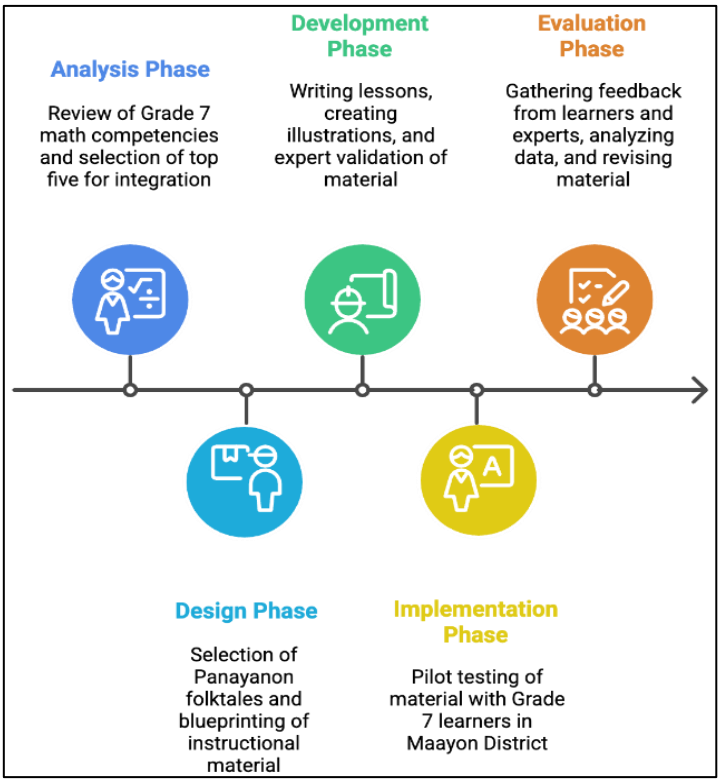

Figure 1. Flowchart of the study procedures from beginning to end

2.5. Ethical consideration

This study was conducted in adherence to the data privacy act of 2012 (republic act no. 10173). These frameworks emphasize respect for persons, beneficence, and justice, which are principles that guided the researcher in safeguarding the rights, dignity, and welfare of all participants throughout the study. Prior to data collection, formal approval was obtained from the schools' division office of Capiz and the administrators of the participating secondary schools. An orientation was conducted to inform participants about the study's objectives, procedures, benefits, and minimal risks. Participation was strictly voluntary and respondents were assured of their right to withdraw from the study at any point without consequence.

Informed consent was obtained from all teachers and learners as respondents, while parental or guardian consent was secured for minors. The consent process ensured transparency and understanding of the study's scope, purpose, and data use. All collected information was treated with strict confidentiality and anonymity, where identifiable data were excluded, securely stored, and reported only in aggregated form. By upholding these ethical and legal standards, the researcher ensured that the study was conducted with integrity, transparency, and full respect for human participants, thereby maintaining both the moral soundness and the scholarly rigor of the research.

3. RESULTS AND DISCUSSION

To improve clarity and avoid redundancy, the discussion synthesizes findings around: i) competency selection; ii) material features; and iii) evaluation results, while explicitly linking each table and figure to the corresponding claims in the text. The results and discussion are presented on the learning competencies in Grade 7 mathematics that are best integrated with local folktales, the development of the folktale-based instructional materials, and the evaluation of these materials conducted by experts and students.

3.1. Learning competencies in Grade 7 mathematics best integrated with local folktales

The integration of local folktales into mathematics instruction necessitates the identification of learning competencies that align conceptually and contextually with cultural narratives. In this study, a competency checklist was administered to 25 Grade 7 teachers handling mathematics, English, and social sciences across four public secondary schools in the municipality of Maayon, Province of Capiz, during the first semester of S.Y. 2024–2025. The purpose of the instrument was to ascertain which learning competencies in Grade 7 mathematics were most suitable for integration with local folktales. Data gathered were analyzed using mean, standard deviation, and rank to determine the competencies perceived as most appropriate for integration. The results were then used as the foundational framework in the design and development of a culturally relevant instructional material.

The results in Table 1 revealed that competencies under measurement and geometry, and number and algebra were perceived as more adaptable to cultural storytelling. This finding suggests that teachers value the contextual potential of folktales to illustrate mathematical ideas that involve problem-solving, trade, and real-life applications [33], [34]. Under measurement and geometry, one competency was identified: "draw triangles, quadrilaterals, and regular polygons (5, 6, 8, or 10 sides) with given angle measures" (M=3.00, SD=0.76, rank=4). This competency was considered suitable because of its connection to symmetrical and geometric patterns found in indigenous art, weaving, and architectural motifs. By associating geometric figures with cultural artifacts, learners can better understand abstract mathematical forms through familiar cultural representations [35].

Table 1. Learning competencies in Grade 7 mathematics best integrated with local folktales

Topic	SD	M	Rank
Measurement and geometry:			
Draw triangles, quadrilaterals, and regular polygons (5, 6, 8, or 10 sides) with given angle measures	0.76	3.00	4
Number and algebra:			
Solve problems involving: percentage increase, and percentage decrease	0.69	3.16	2.5
Solve money problems involving percentages (discount, commission, sales tax, and simple interest)	0.80	3.16	2.5
Identify and explain the uses of rates	0.79	2.96	5
Solve problems involving rates (speed)	0.65	3.20	1

Correspondingly, in number and algebra, four competencies with higher mean scores were identified, reflecting teachers' perception of their stronger narrative adaptability. The highest-ranked competency was "solve problems involving rates (speed)" (M=3.20, SD=0.65, rank=1), which aligns naturally with folktales featuring journeys, movement, and time-related challenges. The competencies "solve problems involving: a. percentage increase, and b. percentage decrease" (M=3.16, SD=0.69, rank=2.5) and "solve money problems involving percentages (discount, commission, sales tax, and simple interest)" (M=3.16, SD=0.80, rank=2.5) were also rated highly, as teachers recognized that stories involving commerce, trade, and moral decision-making can contextualize these abstract concepts. Lastly, "identify and explain the uses of rates" was obtained (M=2.96, SD=0.79, rank=5), suggesting that while conceptually relevant, it may require more concrete narrative examples for effective integration.

Overall, the findings indicate that mathematical competencies rooted in computation and real-world problem-solving, particularly those related to rates and percentages, are most compatible with the narrative and moral dimensions of local folktales. Integrating these competencies into culturally familiar stories not

only strengthens students' mathematical comprehension but also fosters cultural appreciation and engagement. This culturally responsive approach aligns with the DepEd's advocacy for contextualized instruction that promotes meaningful and inclusive learning experiences [36].

3.2. Development of a folktale-based instructional material in mathematics

The development of the culturally relevant folktale-based instructional material was grounded in the integration of mathematical concepts with indigenous folktales from Panay Island. Following an extensive analysis of the Grade 7 learning competencies outlined in the MATATAG curriculum, the researcher identified specific competencies suitable for contextual integration with local narratives. In collaboration with a local layout artist, the researcher designed and illustrated visual elements that authentically represented the characters, settings, and cultural motifs of Panayanon folklore, while simultaneously embedding mathematical ideas within the narrative structure. The stories utilized in the material were adapted from Acevedo *et al.* [37].

Upon completion of the layout and design, the material underwent preliminary production and was subjected to rigorous face and content validation by subject matter experts, educators, and cultural consultants. Subsequent revisions were implemented based on evaluative feedback to enhance both pedagogical soundness and cultural integrity. The final version of the material was then reproduced for classroom implementation and evaluation.

Distinct from commercially available instructional storybooks, the developed material is characterized by three defining features that underscore its cultural and educational relevance. First, the incorporation of Panay Island folktales serves as an avenue for promoting cultural awareness and heritage appreciation among learners. As noted by Mohyeddin [38], local folklore functions as a vessel of cultural identity, offering profound insight into community values, traditions, and worldviews. Second, to reinforce linguistic and cultural authenticity, the stories were narrated in Hiligaynon, the regional dialect of Capiz, thereby establishing a deeper emotional and cultural resonance with learners. Complementary English translations were provided to ensure accessibility and conceptual clarity, especially for mathematical ideas that may lack direct linguistic equivalence in Hiligaynon. According to Shukla [39], translation often fails to fully capture semantic nuance; thus, engaging with a culture through its native language provides a more authentic understanding of meaning and context. Finally, the material concluded with an assessment component designed to evaluate learners' comprehension of both the story and the embedded mathematical concept, fostering not only academic mastery but also interpretative and reflective engagement.

3.2.1. Structural components of the folktale-based instructional material

- Cover page: the cover page was meticulously designed to encapsulate the material's thematic core through culturally inspired visual representations. The interplay of imagery, color, and symbolism introduces readers to the narrative's tone, setting, and mathematical focus, thereby stimulating curiosity and cognitive engagement even before textual interaction. This visual framing aims to establish an anticipatory connection, inviting readers to explore the story and its conceptual depth.
- Copyright page: this section formally establishes the material's intellectual property rights, ensuring legal and ethical use. It attributes the cultural origins of the incorporated folktales and acknowledges the collaborative efforts of the development team, including researchers, educators, and artists. This transparency underscores respect for cultural ownership and affirms the material's academic legitimacy.
- Learning competencies covered: each story was purposefully aligned with designated Grade 7 mathematics competencies to maintain curricular coherence and instructional focus. These competencies are explicitly listed in the material and serve as the basis for the lesson objectives, content flow, and assessment tasks.
- Content: the content section presents the selected Panay Island folktales alongside the corresponding mathematical lessons and activities. Each story is organized to introduce the narrative, highlight the embedded mathematical idea, and provide guided exercises that connect the events of the folktale to the target competency.
- Assessment: the concluding section of each lesson comprises questions and tasks directly linked to the story and the mathematical concept it illustrates. These items check learners' understanding of both the narrative and the computation or reasoning required, and they provide immediate feedback on the attainment of the stated competency. As Baddane and Ennam [40] posits, assessment not only measures learning but also deepens engagement with literature by prompting learners to interpret, evaluate, and internalize textual meaning.

3.2.2. The unique features of the instructional material

The development of the folktale-based instructional material was guided by the intent to create a pedagogical resource that merges mathematical proficiency with cultural literacy. Its design embodies distinct features that differentiate it from conventional mathematics workbooks, integrating local identity, contextual understanding, and learner engagement within a single educational framework. Each element of the material was deliberately structured to cultivate cognitive growth, cultural awareness, and meaningful learning experiences among students.

a. Contextualized, story-based framework

At the heart of the material lies the integration of Panay Island folktales as narrative anchors for mathematical concepts. This design not only contextualizes abstract ideas within familiar cultural settings but also nurtures a sense of pride and identity among learners. By embedding mathematical principles into local stories, the material transforms traditional problem-solving into a culturally resonant learning experience, allowing learners to see mathematics as both a universal language and a reflection of their community's worldview.

b. Linguistically inclusive and bilingual approach

The material employs Hiligaynon as the primary medium of narration, supported by English translations. This bilingual structure enhances accessibility for a diverse range of learners and ensures that mathematical concepts are communicated with precision and cultural authenticity. The use of the local dialect bridges cognitive and cultural understanding, reinforcing the value of linguistic diversity in academic contexts. This feature not only preserves local heritage but also encourages students to appreciate the interplay between language and knowledge, a principle underscored by Tazhitova *et al*. [41].

c. Visually and culturally engaging design

Every page of the material is enriched with illustrations that mirror the cultural motifs, characters, and settings of Panay's folklore. These visuals serve as semiotic resources, conveying meaning beyond text and inviting learners to interpret mathematics through visual, narrative, and cultural dimensions. The material's design draws on multimodal learning principles, where imagery and text collaborate to deepen comprehension, enhance recall, and sustain engagement. This approach positions visual literacy as a crucial tool in mathematics education, especially in culturally grounded pedagogy.

d. Competency-aligned and task-oriented structure

Each story is deliberately mapped to specific Grade 7 mathematics competencies derived from the MATATAG curriculum, ensuring alignment with national standards. The tasks within each lesson are sequenced to progress from comprehension of the story to application of mathematical concepts, culminating in reflective exercises that integrate both domains. This design ensures a spiral progression of learning development, not only mathematical understanding but also critical thinking, problem-solving, and cultural interpretation skills.

e. Reflective and integrative assessment

The concluding sections of each story feature assessments that blend literary appreciation with mathematical reasoning. These assessments are designed to measure both cognitive mastery and interpretive understanding, allowing learners to demonstrate how cultural narratives can illuminate mathematical ideas. Well-designed assessments not only evaluate comprehension but also foster deeper engagement and appreciation of content [42]. Through this integrative approach, learners are encouraged to think critically, make connections, and apply their knowledge in culturally meaningful contexts.

f. Final output

The final output of the study was a validated and refined folktale-based instructional material titled Panaysayon: Tales from Panay Island in mathematics, designed specifically for Grade 7 learners. The material successfully integrated selected Panayanon folktales with core mathematical competencies, allowing students to engage with mathematical ideas through culturally grounded narratives. Evaluation results confirmed that the folktale-based instructional material met high standards of content accuracy, instructional effectiveness, and aesthetic appeal. Learners demonstrated increased motivation, deeper conceptual understanding, and improved participation during evident during the implementation. Expert validators affirmed that the material promoted contextual learning by connecting abstract mathematical concepts to familiar cultural contexts, thereby enhancing comprehension and retention.

To visually represent these features, Figure 2 shows a sample cover page of the developed material, offering a preview of the story's themes, tone, and content through illustrations that suggest its structure, characters, and setting; this cohesive design aims to capture readers' attention, spark curiosity, and encourage deeper engagement with the story. Building on this visual introduction, Figure 3 presents a sample Panaysayon lesson, where a local folktale is used to contextualize the targeted mathematics competency. The main text is in Hiligaynon, with an English translation to enable bilingual instruction and access for

non-Hiligaynon speakers. This bilingual, culturally responsive design promotes linguistic inclusivity and supports a comprehensive, rigorous framework for mathematics education.

Figure 2. The cover design of Panaysayon

Figure 3. Sample of Panaysayon lesson

3.2.3. Sample story-based mathematics tasks

To help readers visualize how learning unfolds, the developed material includes story-anchored tasks that progress from comprehension of the folktale to mathematical modeling and solution checking. All stories are anchored on the competencies identified as least mastered as shown in Table 1. Examples (abridged) include:

- Shapes and figures (Panasayon book 1): on a quiet morning by the river, a boatman sketches a new boat meant to glide smoothly through strong currents: he plans a rectangular deck measuring 4 m×1.5 m, a pointed isosceles triangular bow with sides 1.2 m, 1.2 m, and 1.5 m, and trapezoid side panels (top base 4 m, bottom base 3.4 m, height 0.6 m) that slant inward for balance. As you read his plan, identify the shapes he used, classify the bow triangle (by sides and angles), and determine the missing acute angle of a right-triangle support brace inside the boat with legs 0.6 m and 0.8 m.
- Percentage (Panaysayon book 2): in the forest, the monkeys found a small raft that could carry only 500 kg, and they first loaded 350 kg of cargo onto it; later, even though the butterfly warned them not to add more, they kept stacking sacks until the load reached 560 kg, going beyond the safe limit. What is the percentage increase in the cargo weight (from 350 kg to 560 kg) with respect to the raft's 500 kg carrying capacity?
- Simple interest (Panasayon book 3): in the town ledger, dog the lender, cat the shopkeeper, and mouse the collector reviewed cat's records: cat had ₱72,000 in assets and ₱32,500 in liabilities. If cat plans to use 40% of her assets to pay her debts, how much money will she pay, will it be enough to cover the ₱32,500 liability, and how much debt (if any) will remain?
- Speed–rate–time (motion) (Panasayon book 4): on a 600-meter forest trail, the deer dashed at 12 m/s while the tiny snail inched forward at only 0.06 m/s, how long will each take to reach the finish line, and when the deer arrives, how many meters has the snail already traveled?

3.3. Evaluation of the folktale-based mathematics instructional material

The evaluation of the developed culturally relevant folktale-based instructional material in mathematics determined its level of acceptability based on five core dimensions: learning objectives, content, organization and presentation, format and design, and assessment as seen in Table 2. A total of 76 respondents, comprising 66 Grade 7 students and 10 content and pedagogy experts, participated using a validated and modified version of the university's evaluation form for printed instructional materials. The results revealed that the material obtained an overall mean rating of M=4.56, SD=0.21, which corresponds to a "highly acceptable" description. This indicates that the material met expected pedagogical, linguistic, and aesthetic standards, validating its suitability for instructional use in mathematics classrooms with minimal revisions required.

Format and design achieved the highest overall mean (M=4.85, SD=0.23), signifying that the material's layout, consistency, and illustrations were exceptionally well-executed. The use of culturally inspired visuals, coherent color schemes, and legible typography made the material engaging, user-friendly,

and pedagogically supportive. These findings echo Maier [43], who emphasized that effective visual design in print materials enhances learner comprehension, particularly when graphics are contextually relevant. Similarly, Chisunum *et al*. [44] highlighted that aesthetic coherence in instructional materials promotes learner motivation and cognitive engagement are key to improving conceptual understanding in mathematics.

The organization and presentation component received a highly acceptable rating (M=4.63, SD=0.21), reflecting logical sequencing and structural coherence. Topics were systematically arranged from simple to complex, allowing learners to build understanding while relating mathematical concepts to the narrative folktales. This aligns with Kikechi [45] who noted that well-sequenced lessons sustain learner interest and aid comprehension, whose cognitive theory of multimedia learning supports that organized presentation facilitates information integration and retention.

The learning objectives component was rated highly acceptable (M=4.58, SD=0.30), affirming that objectives were clear, measurable, and aligned with competencies in the MATATAG curriculum. Explicit objectives helped teachers and learners focus on targeted outcomes. As Nouri [46] emphasized, well-defined objectives provide a foundation for effective instructional alignment between teaching and assessment.

The content component was rated acceptable (M=4.32, SD=0.27), indicating that while the material met academic and curricular standards, experts observed that several lessons offered only a few worked examples and limited opportunities for independent practice. They specifically recommended increasing the number and variety of contextualized problems per competency such as additional story-based word problems, guided examples, and spiral review items to better scaffold concept mastery and application. These concrete suggestions help explain the acceptable rating for content and point to clear directions for revising and enriching the material in future iterations. The integration of local folktales contextualized mathematics, making abstract ideas culturally meaningful. This supports Lau and Shea [47] who asserted that culturally responsive materials improve learner engagement and achievement. In addition, teacher-tailored student evaluation of teaching can serve as a formative lens for reflection and iterative refinement of contextualized materials [48].

The assessment component received an acceptable rating (M=4.44, SD=0.33), indicating that the tasks were generally workable, clearly stated, and aligned with the learning objectives. However, expert validators pointed out that some items assessed only a narrow portion of the targeted competencies and relied heavily on lower-order recall, leaving limited room to gauge problem-solving and reasoning skills. They recommended refining the assessments by adding more varied and contextualized items per competency, including open-ended and performance-based tasks that directly draw from the folktales, and ensuring a more balanced distribution of easy, moderate, and challenging questions. These suggestions not only justify the moderate rating for assessment but also provide concrete directions for improving future versions of the material and for subsequent research on its impact on learner achievement.

To enhance clarity and potential learning outcomes, the assessment items were revised to: i) increase the number of worked and guided examples before independent practice; ii) diversify item formats (short response, multi-step problems, and rubric-guided explanations); and iii) strengthen alignment between each assessment prompt and the stated learning objective. These refinements improve the instructional scaffolding of the material and reduce cognitive ambiguity during task completion, which supports more consistent learner performance during classroom use.

Evaluator feedback on both the content and assessment components was fully integrated into the refined version of Panaysayon, exemplifying the iterative nature of the ADDIE model. For content, the material was revised to include more and varied contextualized examples and practice activities such as additional story-based word problems, guided examples, and spiral review tasks to provide stronger scaffolding and richer opportunities for independent practice. For assessment, expert comments led to the redesign of several tasks so they would cover the full range of targeted competencies and move beyond simple recall. The revised assessments now include more varied, contextualized items per competency, with added open-ended and performance-based tasks and a more deliberate balance of easy, moderate, and challenging questions. These systematic revisions show how evaluation informed a return to the design and development phases, resulting in a more coherent and instructionally sound material.

Compared with recent studies on innovations that strengthen higher-order mathematical thinking through technology-intensive or laboratory-based designs such as augmented reality for critical thinking and RBL-STEM activities for conjecturing [49] the present work contributes a culturally anchored, low-resource pathway that is feasible for rural classrooms while still targeting reasoning-oriented competencies. The high overall acceptability (M=4.56) indicates that teachers, experts, and learners view narrative-contextualized tasks as coherent, engaging, and curriculum-aligned, supporting the broader claim that well-designed contextual materials can enhance motivation and meaning-making in mathematics learning. Thus, the study's contribution to the research community is twofold: i) a replicable development-and-validation procedure

using ADDIE, ARCS, and local folktales for culturally responsive mathematics materials and ii) a concrete set of adaptable story-based tasks aligned with MATATAG competencies for immediate classroom use.

Table 2. Acceptability of the material

Evaluation criteria	Students		Experts		SD	Mean	Description
	M	SD	M	SD			
Learning objectives	4.61	0.3	4.38	0.2	0.3	4.58	Highly acceptable
Content	4.34	0.26	4.14	0.25	0.27	4.32	Acceptable
Organization and presentation	4.65	0.21	4.52	0.24	0.21	4.63	Highly acceptable
Format and design	4.87	0.22	4.72	0.27	0.23	4.85	Highly acceptable
Assessment	4.46	0.32	4.28	0.37	0.33	4.44	Acceptable
Overall rating	4.59	0.21	4.41	0.17	0.21	4.56	Highly acceptable

Note: 4.51-5.0 (highly acceptable), 3.51-4.50 (acceptable), 2.51-3.50 (moderately acceptable), 1.51-2.50 (fairly acceptable), 1.0-1.50 (not acceptable).

4. CONCLUSION

This study developed and validated a culturally relevant, folktale-based instructional material for Grade 7 mathematics aligned with MATATAG competencies and anchored in social constructivism, the ADDIE instructional design process, and Keller's ARCS motivational model. Overall acceptability was rated highly acceptable, with the highest ratings in format and design and organization and presentation, suggesting that the material meets quality standards for classroom use and is feasible for implementation in rural public secondary school contexts.

Beyond its immediate product, the study contributes to the literature in three ways. First, it demonstrates a replicable development pathway for translating local folktales into curriculum-aligned mathematical tasks through an ADDIE process deliberately strengthened by ARCS-based motivational design. Second, it provides bilingual (Hiligaynon–English) story-based lessons that foreground learners' cultural experiences as a resource for conceptual understanding and engagement. Third, it documents a multi-perspective validation involving teachers, experts, and learners, generating evidence-informed revisions particularly in contextual examples and assessment alignment that improved the instructional coherence and usability of the material.

To strengthen evidence of impact, future studies should move beyond acceptability and examine instructional effectiveness through quasi-experimental or experimental designs that assess achievement gains, retention, and transfer of learning. Wider field trials across additional municipalities, diverse school contexts, and other grade levels are also recommended to test scalability and contextual robustness. Finally, research should isolate which narrative and task-design features such as cultural familiarity, character-driven problem contexts, scaffolding density most strongly predict motivation and problem-solving outcomes, and explore low-bandwidth digital or hybrid extensions like interactive worksheets or lightweight mobile supplements that improve access while safeguarding cultural authenticity.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
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Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
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Vi : **Vi**sualization
Su : **Su**pervision
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CONFLICT OF INTEREST STATEMENT

The authors affirm that no potential conflicts of interest exist with respect to the research, authorship, or publication of this paper. All stages of the study were conducted independently and without any influence, financial or otherwise, that could compromise the objectivity and integrity of the work.

ETHICAL APPROVAL

The study strictly followed the data privacy act of 2012 (RA 10173) and the ethical principles of respect for persons, beneficence, and justice by protecting the rights, dignity, and welfare of all participants. Permission was secured from the Capiz schools division office and the participating school administrators. Participation was voluntary, with the right to withdraw at any time, and informed consent was obtained from all teacher and learner respondents, along with parental or guardian consent for minors.

DATA AVAILABILITY

The data utilized in this study were obtained from West Visayas State University and are subject to institutional access regulations. Due to confidentiality and data-sharing agreements, these datasets are not publicly available. Nonetheless, access to the data may be granted upon reasonable request and with prior authorization from West Visayas State University. Requests for access may be directed through the following repository link: https://bit.ly/49tVe8z.

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