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A Framework for Designing Contextualized and Localized Instructional Materials in Mathematics for Technical Vocational Livelihood Senior High School Students

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ABSTRACT

This study aimed to develop a framework for designing contextualized and localized instructional materials in Mathematics for Technical-Vocational Livelihood (TVL) Senior High School students. The primary goal was to enhance the relevance and effectiveness of mathematics education by aligning instructional content with the needs of students, the business and industry sectors, and both national and international educational standards. This alignment is critical in promoting mathematical literacy and equipping learners with essential 21st-century skills such as critical thinking, problem-solving, and real-world application.

To achieve the study's objectives, a descriptive research design was employed, specifically a descriptive-survey method, to assess the acceptability of the proposed framework. The development process followed the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), ensuring a structured approach aligned with DepEd standards, international large-scale assessments, and industry-specific competencies. Data were collected through surveys and interviews with TVL teachers, curriculum planners, and representatives from the business sector within the Division of City Schools Manila.

The findings highlighted support from various stakeholders for the framework, particularly its emphasis on contextualization, localization, and alignment with real-world industry demands. The framework effectively integrated authentic problem-solving tasks and real-life scenarios designed to enhance students' mathematical literacy and workplace readiness. Statistical analyses, including descriptive statistics, ANOVA, and the Kruskal-Wallis Test, revealed no significant differences among stakeholder responses, indicating high consensus on the framework's relevance, quality, and practical utility.

Based on the results, it is recommended that teachers, curriculum developers, and industry professionals collaborate to implement the framework in TVL mathematics education. A sample prototype instructional material should be developed to support this initiative and demonstrate practical application. Educators are strongly encouraged to adopt the framework as a model for designing instructional content that is responsive to both industry demands and international education frameworks, ultimately fostering globally competitive and mathematically literate graduates. Future research should consider expanding the application of this framework to other academic domains and continuously evaluating its relevance in light of evolving educational and workforce trends.

Keywords: *contextualization and localization, framework, ADDIE Model, descriptive statistics*

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INTRODUCTION

In the fast-paced era of technological advancement, particularly in education, the Philippines continuously evaluates and revises curricula to enhance student interest, skills, and performance. Contextualization is a strategy in creating instructional material, as it helps apply new skills, knowledge and attitudes in presenting essential concepts within specific field. The Department of Education (DepEd) values the importance of contextualization as a method in enhancing student involvement and improving academic performance. According to Sambayon et al. (2023), contextualization enhances students' comprehension and academic performance by relating lessons to students' real-world experiences, interests, and local environment. Contextualization captures students' interest when lessons connect to their personal experiences. Conversely, localization involves adapting educational content to meet local requirements and making it more relevant and suitable for the students' cultural contexts. Jalotjot and Fidelino (2023) describe localization as a method of adapting instructional materials or resources, such as modules and textbooks, to fit local settings, ensuring that the included learning content connects with students' everyday lives and backgrounds.

Statement of the Problem

This study aimed to propose a framework for designing contextualized-localized instructional materials in Mathematics for Technical Vocational Livelihood (TVL) Senior High School students. Specifically, this study sought to answer the following questions:

1. What learning and instructional content should be included in contextualized-localized instructional materials in Mathematics as perceived by the following stakeholders:
    1.1. TVL teachers;
    1.2. TVL supervisors and curriculum developers;
    1.3. Representatives from business sectors and industry?
2. What framework can be designed for creating contextualized-localized instructional materials in Mathematics for TVL senior high school students?
3. How do TVL teachers, TVL supervisors, curriculum planners, and representatives from the business sector assess the proposed framework for designing contextualized-localized instructional materials?
    3.1 Are there differences in the assessments of the proposed framework by the different stakeholders?

Scope and Delimitation

The study was conducted in the Division of City Schools in Manila, including industry partners of each school that offers a TVL program. Participants included TVL teachers, curriculum planners, supervisors, and representatives from the business sector during the academic year 2022-2023, which is dedicated to the development of the framework and its prototype. The development process followed the ADDIE Model, a widely recognized framework used by instructional designers.

The framework will serve as a theoretical model for future researchers interested in designing contextualized-localized instructional materials for TVL students. Assessment of the framework involved feedback from TVL teachers, curriculum planners, supervisors, and relevant stakeholders from industry partners in the City of Manila.

Data collection methods included interviews conducted through both face-to-face and online platforms. An evaluation tool was administered to assess the acceptability of the

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proposed framework for designing contextualized-localized instructional materials in Mathematics specifically tailored for TVL students.

The data and results were limited to insights gathered from interviewed business industry partners who shared relevant experiences and characteristics. The timeframe for this study extended over four semesters, covering the academic years 2022-2023 and 2023-2024.

Review of Related Literature

Contextualization and localization of instructional materials in mathematics is important in developing the conceptual understanding and to increase the Mathematical Literacy of the students. Over the past few decades, different pedagogies and methodologies have been proposed to help students create connections with their world and promote higher-order thinking skills necessary to gain these literacies. Another result of developing this teaching material besides meeting the eligibility criteria is that the teaching materials developed are able to increase mathematical literacy and instill entrepreneurial spirit for students (Adirakasiwi, 2021).

The challenges of PISA according to the PNU report compares the Philippine K to12 Mathematics Curriculum with the PISA Mathematics Literacy Framework revealing the alignment in different areas and also significant in identifying gaps in problem-solving, mathematical reasoning, and real-world tasks (Golla, 2020). The absence of focus in the Kto12 curriculum on higher-order mathematical thinking does not fully address which are critical for real-life applications (OECD, 2021). A mapping study by Golla and Reyes (2020) revealed a high degree of alignment between the PISA Mathematics Literacy framework and the K-12 Mathematics curriculum. However, the study also identified that the Philippine curriculum lacks emphasis on content knowledge, mathematical processes, and contextualization.

The study of Domingo (2023) sought to develop and evaluate contextualized instructional learning materials for Grade 7 Mathematics specifically the areas where students exhibited the most difficulties. The findings from the evaluation of the two groups of participants were *Very Satisfactory* across multiple dimensions including the relevance of content, quality of presentation, structural organization and the accuracy of the information. The statistical analysis revealed no significant difference in the evaluations between the two groups of respondents with a high level of agreement regarding the overall quality of the instructional materials.

A number of current studies have demonstrated how quality instructional materials are an essential factor for enhancing the quality of mathematical education. For example, the research conducted by Sa'dijah et al. (2025) investigated how the integration of TPACK and critical thinking indicators in the development of instructional materials by prospective mathematics teachers could create effective instructional materials. When developing effective materials, Sa'dijah et al. emphasize that integrating tools, pedagogical strategies and relevant mathematics content are all key components in developing student' higher-order thinking skills occurred. In addition, in providing teachers with well-organized instructional materials to present complex mathematical concepts in a manner that develops students' critical thinking skills (analytical, evaluation, solving problems), this study provides additional evidence supporting the development of context-based instructional materials in mathematics that are responsive to students' needs and the local learning environment (Sa'dijah et al., 2025).

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In addition, Arvanitaki and Skoumpourdi (2025) researched how the use of games to teach mathematics, such as indirect measurement of length for both sighted and blind students can also create quality instructional materials. The results from their research indicated that incorporating interactive and inclusive features in instructional materials developed for students can greatly help students get engaged in, and better understand, the concepts they are learning about. Arvanitaki and Skoumpourdi concluded that the use of game-based instructional materials allowed for experiential learning and collaboration when exploring ideas in mathematics. Their findings further support the development of (context-based) instructional materials to meet the diverse needs of learners when studying mathematics (Arvanitaki & Skoumpourdi, 2025).

Finally, Utami et al. (2025)...In their research project, Utami and colleagues (2025) looked into how STEM-based learning through projects influences student scientific literacy while teaching Newton's laws of motion. The researchers found that students who experienced project-based STEM learning had higher levels of understanding conceptual content, analytical thought, and problem solving skills than the students who used traditional instructional methods. The researchers provided evidence supporting the use of contextualized instructional materials that provide real-world application and integrate multiple disciplines in contexts of learning, to promote greater success for students in achieving desired learning outcomes. This information shows that by including contextual and practical aspects in developing instructional materials will make the learning experience more meaningful to the student, especially in the context of vocational and technical education (Utami et al., 2025).

Shittu and Jogymol (2025) explored the relationship between teachers' beliefs and practices in the classroom regarding the application of the 5E model of instructional design from the constructivist perspective within mathematics education. The authors found that the use of instructional materials developed from the 5E model—Engage, Explore, Explain, Elaborate, and Evaluate—encouraged students to engage actively in the learning process and develop a deeper understanding of the conceptual framework. The authors suggested that teachers' use of constructivist-based instructional materials and creating a constructivist-based classroom with a student-centered learning environment would allow students to create their own knowledge through exploration and inquiry. By designing instructional materials that assist teachers in developing interactive, meaningful mathematics instruction, students will be more likely to participate in their learning (Shittu & Jogymol, 2025).

In addition, Berger-Baraban et al. (2025) evaluated the use of data-driven instruction in the mathematics classroom through an adaptive learning (technology-based) learning environment. The students found that using instructional materials designed to use adaptive learning technologies gave teachers the ability to use performance data and learning needs to differentiate instruction. By providing differentiated instruction, learners receive the appropriate level of support to challenge them as they learn to master mathematical concepts. This research highlights the relationship between using data-driven design methodologies and effective instruction and increased student achievement in mathematics (Berger-Baraban et al., 2025).

Wijaya (2025) reported that the integration of digital mathematics textbooks into classroom lessons provide teachers insight into both positive and negative aspects of technology. Digital textbooks provide students with better access to materials for learning, an opportunity to engage in interactive learning experiences and visualize the concepts of mathematics being taught. While the benefits of the integration of digital textbooks are evident,

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teachers also noted obstacles such as lack of relevance to the specific context in which a teacher is working, technical limitations of the digital textbook and the need for the digital textbook to be aligned with the local curriculum. Therefore, teachers should use instructional materials that are not only digitally enhanced but contextualized to meet the needs of students in the teacher's specific educational environment. From this study comes information that aligns with the present study, developing mathematics instructional materials that are contextualized and localized for Technical Vocational Livelihood (TVL) Senior High School students.

A related study conducted by Maria L. Villa (2025) focused on culturally relevant mathematics curricula and the promotion of equity in mathematics achievement for students of color with disabilities in an inclusive classroom environment. Villa concluded that using instructional materials that reflect the culture and social context of the student will lead to increased engagement, enhanced understanding of mathematics, and improved academic performance. Villa also concluded that learners will bring their own life experience to mathematics through the use of culturally relevant instructional materials, thereby gaining a deeper understanding of the mathematics they are learning and becoming more engaged in the process of learning mathematics. Villa's findings support the present research study's focus on contextualization and localization as a methodology for providing meaningful mathematics instruction for a variety of learners.

Additionally, Siti Novita et al.A systematic review and meta-analysis protocol by 2025 regarding the effect of virtual reality-based mathematics education upon student motivation explored how immersive learning technologies (e.g. virtual reality) can be used to increase student interest and motivation within mathematics via creating interactive and engaging immersive learning environments (i.e. using a range of digital tools integrated with well-designed instructional resources). The authors of this study noted that students develop positive attitudes towards mathematics when they use well-designed instructional materials in conjunction with technology. It follows that the experiential, contextualized instructional materials provided by the present research challenge conventional mathematics education methodologies and have the potential to enhance students' mathematics learning experiences.

Another example of how teaching quality, mathematics confidence, and mathematics achievement may relate to primary students' performance was examined using Nordic TIMSS 2019 data by Asp. The findings of this research demonstrated that providing high-quality instruction was a significant factor in primary students' confidence and achievement in mathematics. Furthermore, it was noted that students who were provided with well-structured instructional resources and effective instructional delivery strategies received better support in developing their own mathematical understandings than those who did not. As such, these findings suggest that well-designed instructional materials, particularly those customized or localized for students' learning contexts (e.g., schools), are instrumental in increasing teacher effectiveness as well as increasing student achievement in mathematics.

Wulandari, Mulyati and Rahmalina recently completed a study that evaluated the practicality of applying realistic mathematics education (RME) principles to a realistic mathematics textbook that was written specifically for pre-service teachers of secondary mathematics. The results of their study indicated that realistic mathematics textbooks constructed using RME principles were an excellent resource for assisting students in

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developing their conceptual understanding and problem-solving skills. In addition, RME principles illustrate how to provide authentic contexts for students to make connections between the mathematics concepts learned in class with the world outside of school, ultimately highlighting the importance of contextualized instructional materials in fostering meaningful learning experiences. This study further highlights the importance of establishing localized mathematics instructional materials, specifically RME principles, in meeting the learning needs of Senior High School TVL Students.

The article by Yu and Jiang (2026) investigates instructional support strategies that positively impact the mathematics learning of students with intellectual and developmental disabilities in China. The authors note that contextualized instructional materials and adaptive teaching approaches are essential for meeting learners' needs as they develop cognitively. Their research findings indicate that specially designed instructional materials help simplify abstract mathematical concepts and increase learners' engagement in learning. They also highlight the importance of using tailored instructional materials and providing guided practice and supportive learning environments to help diverse learners develop an understanding of mathematical ideas. These findings emphasize the need to develop contextually and locally relevant instructional materials that will address the unique learning characteristics of senior high school learners (e.g., those within the technical-vocational tracks).

Other studies have investigated the implementation of innovative instructional materials (e.g., 3D printing) across subject areas. Coşkunserçe's (2025) study evaluated the impact of using 3D-printed instructional materials during active-learning opportunities within more traditional science lessons. The results of this study demonstrated that using physical and interactive instructional materials positively affected students' participation, understanding of STEM topics, and motivation when learning abstract STEM concepts. Coşkunserçe's study revealed that learners are better able to conceptualize and visualize abstract concepts when instructional materials are available to them in a tangible form for manipulation. Therefore, Coşkundercerce's findings suggest that developing well-designed instructional materials can provide learners with opportunities to move away from traditional teacher-directed instruction and toward more interactive, learner-directed environments. While the study specifically looked at science education, it has broader implications for teaching mathematics through contextualized learning materials that create opportunities for experiential learning.

The creation of high-quality instructional materials depends on their development within an instructional design framework, such as the Dick and Carey model. For example, whether items created for future teachers using this system can be systematically developed, implemented, and evaluated against existing instructional materials will provide insight into the effectiveness of the developed instructional materials. The research shows that developing instructional materials using an established instructional design framework significantly enhances the quality and effectiveness of the finished materials used in the classroom. In addition, when these materials are created to align with the instructional objectives, it improves the teacher's efficiency and the student's understanding. Therefore, developing a systematic framework for creating contextualized, localized mathematics instructional materials for Technical and Vocational Livelihood (TVL) students is necessary.

Technology-Enriched Learning Environments (TELEs) have been widely studied across numerous educational contexts, with documented success in mathematics. For example, Ayu Puspita Rini and Muhammad Fikrianto (2026) conducted a study that created a STEAM-based interactive learning environment for elementary mathematics students using Articulates

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Storyline 3 software. The results indicated that the use of interactive digital instructional materials through this study improved students' levels of engagement, creativity when developing solutions to problems and problem-solving skills. Furthermore, the use of media and contextualized tasks provided students with connections between the mathematical concepts they were studying and real-life situations. The findings further demonstrated that in addition to improved comprehension of mathematical concepts, interactive instructional materials provided students with the opportunity to develop skillful career paths by engaging in active learning with others.

Finally, multiple researchers continue to investigate the integration of information and communication technologies into mathematics instruction. Tran Duc Huu and colleagues (2025) reviewed the current literature to examine the perceptions and instructional practices of in-service mathematics teachers regarding the use of ICT in their teaching. The findings indicated that teachers' perceptions of technology use had a direct impact on how they use digital technologies and materials in instruction in their classrooms. The review also indicated three points of impact because of using ICT-enriched learning experiences: 1) enhanced understanding of abstract mathematical concepts, 2) inclusion of direct, experiential learning opportunities for students, and 3) the facilitation of student-to-student interactions that will assist in developing their understanding of mathematics. Researchers argue that to ensure the successful integration of technology into mathematics instruction, effective instructional frameworks must be clearly developed to provide teachers with guidance on how to use technology in their teaching practices. Overall, the work of these researchers indicates a need to develop mathematics instructional materials that incorporate existing frameworks for contextualized and localized instruction through the use of appropriate technologies to improve mathematics learning outcomes for senior high school TVL students.

In Oman, educators recognized that elementary instructional methods must be aligned with the particular context of students' learning and national curriculum goals. Providing contextualized mathematics materials to students helps connect mathematical concepts to real-world scenarios, thereby creating a better understanding and engagement in mathematics. In addition, educators noted that instructional materials for mathematics must reflect local learning needs and socio-cultural contexts to provide students with a higher-quality mathematics education (Uthaman et al., 2026).

The transition to modern-day learning environments has brought forth many challenges for mathematics instruction, specifically in distance education and mathematics learning. Research through surveys of mathematics students at public post-secondary institutions found that students experienced issues with conceptual understanding, communication with teachers, and access to learning resources. The study sought to emphasize the value of providing students with well-designed instructional materials that include clear explanations, example problems in context, and structured learning activities that promote independent learning. As a result of these studies, it can be determined that incorporating both contextualized and localized materials into mathematics instruction is a significant benefit for students with learning deficiencies and for enhancing students' understanding of mathematics (Abdulah et al., 2025).

Technology also plays an important role in enhancing mathematics instruction when integrated into instructional design. Research focused on pre-service mathematics teachers' capabilities to use ChatGPT to assist with planning mathematics instructional lessons found

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that utilizing technology in the development of instruction was beneficial to the teachers when creating lessons that were organized and included interaction. The study found that technology could assist instructors in generating contextualized examples, creating problem-solving activities for students, and developing strategies to differentiate instructional materials for all students. However, the authors of the study emphasized that teachers must also ensure that their lesson plans and corresponding instructional materials are aligned with students' learning needs and curriculum standards when developing contextually based instructional materials for lesson delivery (Balıkesir & Demir, 2025).

Design elements of mathematics instructional materials will also contribute to a student's attention level and cognitive processing while learning mathematics. Research conducted on the use of "seductive details" in an online mathematics instructional environment found that although first impressions are important and the visual appeal of a piece of content can initially draw attention, having too much or irrelevant information can actually prevent students from focusing on the key mathematical ideas of the lesson. Therefore, the study stated that when developing instructional materials for mathematics, they must include clear, relevant, and conceptually focused design elements to encourage successful learning at all levels. In conclusion, it is important to design mathematics instructional materials with the primary goal of aiding students' understanding, rather than using phrasing or unnatural grammatical structures to confuse them (Ramirez et al., 2024).

Another strategy that can promote students' learning in mathematics is to use error analysis during instruction. A study examining current in-service and pre-service teachers' thoughts and beliefs regarding the use of error analysis in mathematics instruction demonstrated the value of error analysis in identifying ways to improve students' problem-solving abilities and address misconceptions. Through the use of error analysis as a strategy, teachers who participated in the study reported that students improved critical thinking skills and conceptual understanding. Additionally, by integrating the error analysis strategy into instructional materials to give students an opportunity to reflect on their mistakes, students' capacity to reason within the discipline of mathematics can significantly enhance their skills by giving them practical application in either an applied career area, such as in a Technical-Vocational Livelihood education program, or as a general mathematics student (Ngcobo, 2026).

Theoretical Framework

The primary objective of developing a framework for designing contextualized-localized instructional materials for Technical Vocational Livelihood (TVL) senior high school students is grounded in the definitions and characteristics of contextualization and localization, various learning theories, model theories for instructional material development, and mathematical literacy.

Contextualization can be simply defined as the verbal and conceptual bridge that enables students to learn new information (Lee, 1995). It involves creating relevance and meaning by linking students' everyday experiences with academic knowledge (Tharp & Gallimore, 1988). Meanwhile, Policarpio (2018) characterized localization as a part of contextualization given that instructors utilize local information, material, dialect, and culture in planning educational program instructions.

The instructional framework specifies the interrelationship among different learning theories, including constructivism, behaviorism, and cognitivism. John Dewey's Theory of

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Constructivism, however**,** encourages a learner to come up with his own knowledge based on personal experiences and thoughts. Constructivism is a theory about knowledge and learning and requires collaboration. Cognitivism posits that "learning involves the reorganization of experiences to make sense of stimuli from the environment. Sometimes this understanding comes through flashes of insight" (Merriam & Caffarella, 1999). Behaviorism is an orientation to learning emphasizing methodically time-controlled events and constructed environmental conditions intended to bring about particular behavioral responses. Merriam and CafFarella (1999, p. 251).

Conceptual Framework

The framework of the study is anchored with educational learning theories, instructional design model theory, definition and theories about contextualization and localization and PISA Mathematical literacy necessary in developing a framework in designing a contextualized-localized instructional material for TVL senior high school students.

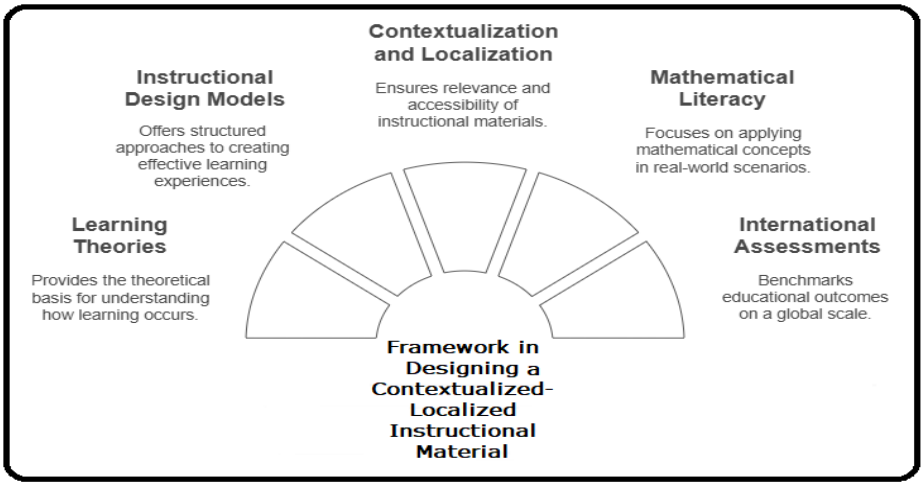

Figure 1. *The Conceptual Framework in Designing Contextualized-Localized Instructional Material*

METHODOLOGY

The primary objective of this study was to develop a framework for designing context-specific, localized materials in mathematics. Descriptive statistics was employed throughout the research. For primary analysis, mean and standard deviation, and ANOVA were used to assess the extent of alignment between current mathematics instructional materials and the TVL curriculum, PISA, LSA, and DepEd standards. The results of the primary analysis about the degree of alignment of the current instructional materials in mathematics found in the market with DepEd standards, large-scale assessments, and the business industry serve as a catalyst for focus group discussions (FGD) among stakeholders. In addition, the Kruskal-Wallis Test a non-parametric test is used to evaluate differences in stakeholder assessments of the newly developed framework.

Research Design

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The study employed a descriptive research design. The descriptive research design was utilized to assess the extent of alignment between the current instructional materials in mathematics used by Grade 11 students and standards set by the Department of Education (DepEd), large-scale assessments, and the needs of the business sector and industry and to evaluate the acceptability of the proposed framework in designing a contextualized-localized instructional materials in mathematics specifically for technical vocational livelihood senior high school students to evaluate the acceptability of the proposed framework in designing a contextualized-localized instructional materials in mathematics specifically for technical vocational livelihood senior high school students.

Research Steps

Following the validation of the research instrument, such as expert validity, pilot testing, and Cronbach's Alpha, the researcher secured a formal communication letter addressed to the authority of the Division of City Schools in Manila, requesting permission to conduct a study involving relevant TVL teachers, curriculum planners, and supervisors. The development of the framework for designing contextualized-localized instructional materials in Mathematics for TVL students adhered to the systematic instructional design process outlined by the ADDIE model. This approach ensures consistency in achieving goals, implementing strategies, and conducting evaluations, thereby enhancing the effectiveness of the resulting instructional materials.

Data Collection and Sample Selection

This study employed a purposive sampling technique, which is commonly used to determine relevant research phenomena. The study's respondents were 20 mathematics teachers, 20 curriculum experts, and 20 representatives from the business sector and industry.

The extensive survey analysis with the scoring rubric in determining the alignment of the existing mathematics books used by grade 11 students in the TVL program to DepEd Standard, Large-Scale Assessments and the needs of business industry.

After the survey, a Focus Group Discussion (FGD) among stakeholders was conducted to determine the learning content needed for the framework's development. In addition, evaluation of the proposed framework among teachers, TVL curriculum planners and representative from the business industry.

Data Analysis Methods

The data analysis employed descriptive statistics and a Likert scale to determine the degree of alignment of the existing mathematics books used by grade 11 TVL students to the standards and needs of the business industry. After the FGD, the interview transcripts were coded using the open-ended questions. The coding process moves to open coding through axial coding to selective coding, where the theory arises from the key themes. The proposed framework was evaluated by the stakeholder group.

Research Hypotheses and Validation

The study aims to test the hypothesis that there are no significant differences in the assessment of the framework across different stakeholders in designing contextualized,

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localized instructional materials in mathematics for Technical Vocational Senior High School Students. The hypothesis was validated using the Kruskal-Wallis Test.

Study Limitations and Ethical Considerations

Approval from the Institutional Ethics Review Board (IERB) of Centro Escolar University was obtained before conducting the study to ensure adherence to ethical standards and guidelines established by the institution. The researcher secured informed consent from participants who were to be interviewed and included in the study. The data and results were limited to insights gathered from interviewed business industry partners who shared relevant experiences and characteristics. The timeframe for this study extended over four semesters, covering the academic years 2022-2023 and 2023-2024.

RESULTS AND DISCUSSION

Sop 1. What learning and instructional content should be included in contextualized-localized instructional materials in Mathematics as perceived by the following stakeholders:

1.1. TVL teachers;

1.2. TVL supervisors and curriculum developers;

1.3. Representatives from business sectors and industry?

The survey results from stakeholders reveal that the learning objectives, content, and assessment of the current mathematics instructional materials are moderately aligned with DepEd standards, large-scale assessments, and the needs of the business industry.

Open and axial codes were used to generate the three themes outlined in the study. For instance, the first theme, Learning Outcome Standard, was derived from the axial codes: Content Standard, Performance Standard, Assessment Standard, and Learning Objectives. The second theme, Learning Content Standard, emerged from the axial codes: Compelling Introduction, Understanding Skills, Enhancing Problem-Solving Skills, Technical and Industry-Specific Skills, and Open Classroom Activities. The final theme, Learning Assessment Standard, was formed from the axial codes: Competency and Standards-Based Assessment, Mathematical Literacy Assessment, Performance-Industry Based Assessment, and Contextual Summative Assessment.

SOP 2. What framework can be designed for creating contextualized-localized instructional materials in Mathematics for TVL senior high school students?

The findings emphasize the need for a contextualized, localized instructional materials framework specifically designed for Technical-Vocational-Livelihood (TVL) senior high school students. The alignment of the learning outcomes, content, and assessments with DepEd standards, large-scale assessments, and industry requirements is important for achieving the objectives of the study. These guarantee that instructional materials are not only relevant to students' needs but also effectively prepare them for real-world applications.

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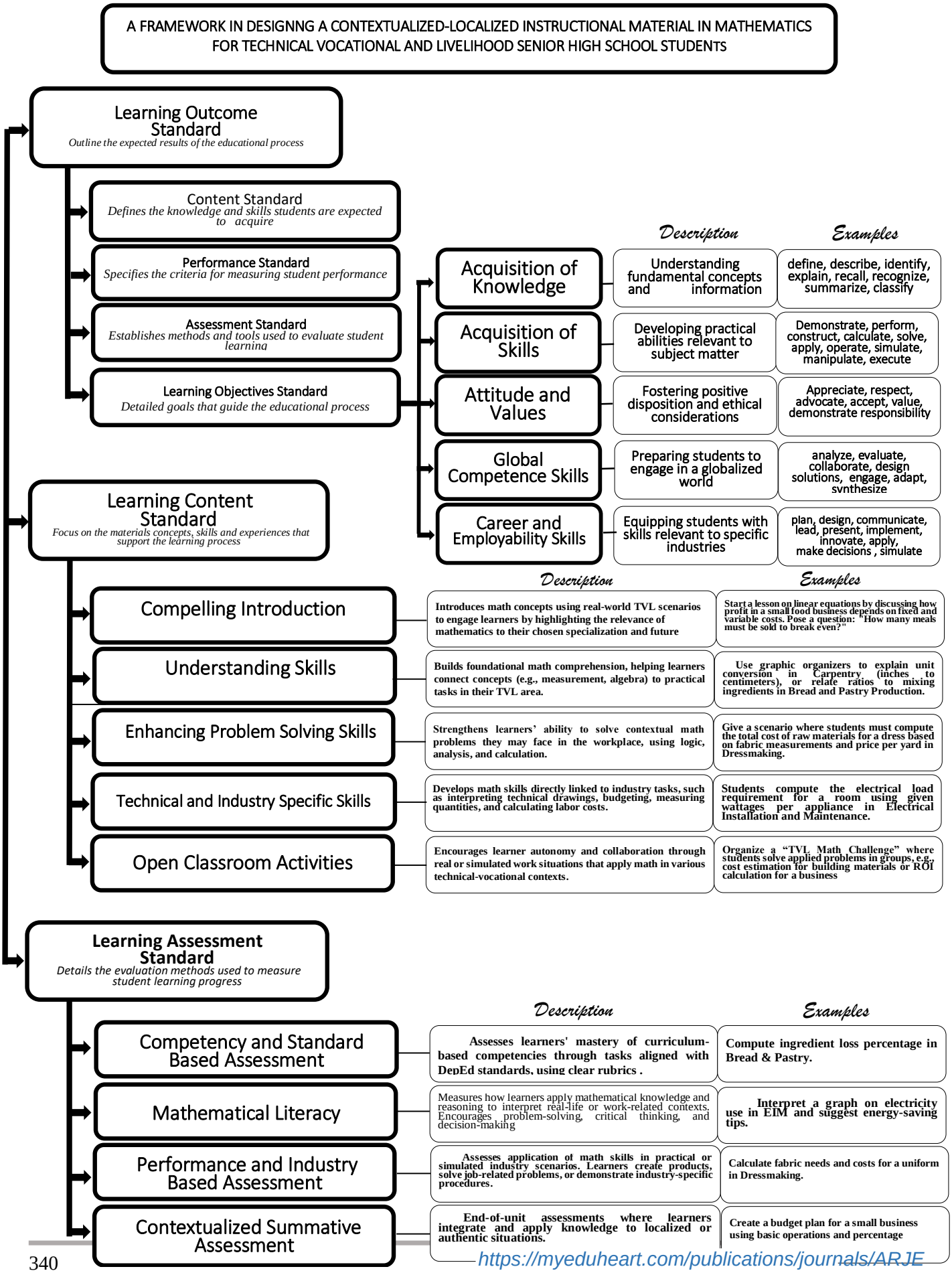

Figure 1: A Framework in Designing a Contextualized-localized Instructional Material in Mathematics for TVL SHS Students

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SOP 3: How do TVL teachers, TVL supervisors, curriculum planners, and representatives from the business sector assess the proposed framework for designing contextualized-localized instructional materials?

Table 1 summarizes the validation criteria for the proposed framework in terms of content and organization, relevance and usability, presentation, and overall alignment. The three groups of respondents strongly agreed, with an overall mean of 3.93, to the proposed framework for designing contextualized, localized instructional materials in mathematics for technical, vocational, and livelihood senior high school students. This suggests not only a high level of agreement but also a uniformity in perceptions across respondents, reflecting a robust endorsement of the framework's key aspects.

Table 1. *Summary of the Overall Result of the Validation of the Proposed Framework*

No.	Criteria	TVL TEACHERS n = 5			CURRICULUM PLANNERS n = 5			BUSINESS INDUSTRY n = 5			Overall $\bar{x}$	Overall sd	VI
		$\bar{x}$	Sd	VI	$\bar{x}$	sd	VI	$\bar{x}$	sd	VI			
1	Content and organization	3.91	0.16	SA	3.91	0.16	SA	4.00	0.00	SA	3.94	0.10	SA
2	Relevance and usability	3.88	0.22	SA	3.90	0.17	`SA	3.95	0.09	SA	3.91	0.12	SA
3	Presentation	3.87	0.21	SA	3.97	0.08	SA	3.97	0.08	SA	3.93	0.11	SA
4	Overall Alignment	3.90	0.20	SA	3.95	0.10	SA	4.00	0.00	SA	3.95	0.10	SA
	Overall Mean	3.89	0.02	SA	3.93	0.03	SA	3.98	0.02	SA	3.93	0.02	SA

Legend: *SA – Strongly Agree* *A – Agree* *D – Disagree* *SD –Strongly Disagree*

In Table 2, the evaluation of the three groups of respondents using the Kruskal-Wallis test to the content and organization of the proposed framework yielded a value of 2.485 and a p-value of 0.289, indicating no significant differences in their assessments. This lack of significant -difference reinforces the strong agreement around the framework's effectiveness, with an overall mean of 3.94 and interpreted as strongly agree. Such a high level of agreement emphasizes that the framework is viewed as comprehensive and relevant, effectively addressing the needs of the Technical-Vocational-Livelihood (TVL) program while providing clear guidance for educators.

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Table 2. *Comparison of Respondents to Content and Organization of the Framework*

Category 1	Respondents	Mean Rank	Kruskal Wallis	p-value	Sig
Content and Organization	Respondent 1	7.00	2.485	p = 0.289 > 0.05	NS
	Respondent 2	7.00			
	Respondent 3	10.00			

***Legend**: p < .05 (Significant); p > .05 (Not Significant)*

Table 3 presents the evaluation under the criteria of comparison of respondents' ratings on relevance and usability of the proposed framework was assessed through the Kruskal-Wallis test yielded a value of 1.655 and a p-value of 0.437 indicating no significant differences among the three groups of respondents. These implies a same perception of the three group of respondents in terms of framework's relevance and usability. The findings shows that the proposed framework has positive effect to the practice of TVL education in our country.

Table 3. *Comparison of Respondents' Ratings on Relevance and Usability of the Framework*

Category 2	Respondents	Mean Rank	Kruskal Wallis	p-value	Sig
Relevance and Usability	Respondents 1	6.40	1.655	p = 0.437> 0.05	NS
	Respondents 2	7.90			
	Respondents 3	9.70			

***Legend**: p < .05 (Significant); p > .05 (Not Significant)*

Table 4 presents the comparison of respondents' ratings on presentation of the proposed framework and assessed through the Kruskal-Wallis test. The results show statistical value of 1.218 with a p-value of 0.544 indicating no significant differences in the insights of the three groups of stakeholders. These three groups of representatives generally agree on the framework's effectiveness in terms of presentation.

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Table 4. *Comparison of Respondents' Ratings on Presentation of the Framework*

Category 3	Respondents	Mean Rank	Kruskal Wallis	p-value	Sig
Presentation	Respondents 1	6.60	1.218	p = 0.544 > 0.05	NS
	Respondents 2	8.70			
	Respondents 3	8.70			

***Legend**: p < .05 (Significant); p > .05 (Not Significant)*

The findings as presented in Table 5 in terms of the comparison of respondents' ratings on alignment, contextualization and localization of the proposed framework. The statistical analysis using Kruskal-Wallis test yielded a result of 2.333 with a p-value of 0.311 showing no significant differences in the perceptions among the three groups of participants the TVL teachers, curriculum experts and planners, and the representatives of the business industry sectors.

The three groups of respondents expressed strong agreement that the proposed framework in designing a contextualized-localized instructional material in mathematics for TVL students aligns with DepEd standards, large-scale assessments, and the needs of the business sector. The findings also demonstrating contextualization and localization with an overall mean score of 3.95.

Table 5. Comparison of Respondents' Ratings on *Alignment and Contextualization of the Framework*

Category 3	Respondents	Mean	Kruskal Wallis	p-value	Sig
Alignment and Contextualization	Respondents 1	6.50	2.333	p = 0.311 > 0.05	NS
	Respondents 2	8.00			
	Respondents 3	9.50			

***Legend**: p < .05 (Significant); p > .05 (Not Significant)*

Based on the findings, the proposed framework in designing a contextualized-localized instructional materials in Mathematics for TVL senior high school students should emphasize

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several key components to enhance alignment with DepEd standards, large-scale assessments, and the needs of the business sector and contextualization and localization. This proposed framework serves as a guide or model in designing a prototype material aimed in producing comprehensive and relevant resources that effectively meet the needs of Technical-Vocational-Livelihood (TVL) curriculum.

SUMMARY

This study primarily focuses on developing a framework for designing contextualized-localized instructional materials in mathematics for TVL senior high school students. Three research questions guided this investigation, providing an overall framework for the study: (1) What learning and instructional content should be included in contextualized-localized instructional materials in Mathematics as perceived by the following stakeholders: (1.1) TVL teachers, (1.2) TVL supervisors and curriculum planners/developers, and (1.3) representatives from business sectors and industry? (2) What framework can be designed for creating contextualized-localized instructional materials in Mathematics for TVL senior high school? (3) How do TVL teachers, supervisors, curriculum planners, and business sector representatives assess the proposed framework for designing contextualized-localized instructional materials? (3.1) Are there differences in the assessments of the proposed framework by the different stakeholders?

The study employs descriptive developmental research to address these questions. Participants included 20 TVL senior high school teachers, 20 TVL supervisors and curriculum planners, master teachers, and 20 representatives from business sectors and industries within the Division of City Schools in Manila that offers Technical Vocational and Livelihood Programs. Participants were selected using a stratified purposive sampling technique. Survey questionnaires and interview guides served as the primary data sources. Interviews were conducted face-to-face, carefully transcribed, and translated to facilitate detailed data collection for framework development. Data were coded according to Strauss and Corbin's proposed scheme (1998): open coding, axial coding, and selective coding. The developed framework was validated by a panel of TVL teachers, curriculum planners, and business industry representatives, leading to the creation of sample prototype instructional materials specifically designed for TVL senior high school students.

CONCLUSIONS

Based on the findings of the study, the following conclusions were formulated:

The perceptions gathered from the group of participants shows the necessity of developing a proposed framework for instructional materials in mathematics that prioritizes contextualization and localization of the learning content. Aligning learning content with the educational standards and demands of the business industry sectors aims to incorporate real-world scenarios and hands-on activities that enhance student engagement and relevance. The proposed framework includes learning outcomes standards, learning content standards, performance standards, and assessment standards in enhancing the effectiveness of instructional materials in Mathematics for TVL students. The focus of the learning objectives includes the acquisition of knowledge, acquisition of skills, attitudes and values, global competence, and career and employability skills highlighting comprehensive approach to TVL education. This

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alignment equipping students with essential learning competencies for the success in both academic and career settings which is significant in improving the quality and relevance of instructional materials for better educational outcomes in the Technical-Vocational-Livelihood (TVL) program. The proposed framework under the learning content standard shows alignment to DepEd standards, large-scale assessments, the needs of the business industry sectors and demonstration on contextualization and localization. It includes compelling introductions, understanding skills, mathematical reasoning and problem-solving, and technical skills and open classroom activities. This approach improves the relevance and effectiveness and contextualization of the instructional materials fostering a better learning outcome among students in the TVL program. Moreover, the proposed framework addresses the gaps with various assessment types including the competency-based assessment, mathematical literacy assessment, industry-based assessment and contextualized summative assessments. The comprehensive approach to the proposed framework makes relevance and improved educational outcomes for students.

RECOMMENDATIONS

Based on the findings and conclusions of this study, the following are recommended:

1. Teachers, curriculum planners and supervisors and business industry sectors should collaborate to create a holistic approach to the proposed framework in designing a contextualized-localized instructional materials in mathematics for TVL senior high school students. This partnership and collaboration can guarantee that the instructional materials are relevant and effective to meet the needs of students in the TVL strand. Support should be provided for the development of prototype instructional materials with the full spectrum of core mathematics subjects, including General Mathematics and Statistics and Probability. These materials must align with the standards set by the proposed framework in contextualizing and localizing instructional content and strategies. Furthermore, our government should consider providing specific instructional materials in mathematics for the TVL strand to enhance educational delivery. Mathematics teachers are encouraged to adopt the validated framework as a model for designing their instructional materials. This framework can guide educators in effectively teaching mathematics concepts to TVL senior high school students, ensuring that lessons are both engaging and aligned with industry standards. Researchers and stakeholders should explore the applicability of the proposed framework in other academic disciplines. Validating the framework across various subjects can help create a comprehensive model for designing instructional materials throughout the educational landscape. Furthermore, future researchers should prioritize the ongoing reassessment and realignment of the learning objectives, content, and assessments within the proposed framework to ensure its continued relevance to DepEd standards, large-scale assessments, the evolving needs of the business sector, and the principles of contextualization and localization. Such adaptability will help maintain the framework's effectiveness in preparing students for both academic success and career readiness.

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