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The usage and effectiveness of instructional materials in teaching secondary mathematics

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Abstract

This descriptive study examined the use and effectiveness of instructional materials used by 37 Junior High School Mathematics teachers in the Tiwi District during the 2024-2025 school year. Through a validated questionnaire, it addressed six research questions: materials used, usage levels across print-based, manipulatives, digital, and multimedia categories, effectiveness, their relationship, challenges encountered, and proposed enhancements. Print-based materials dominated (Learning Activity Sheets 94.59%), followed by manipulatives (Coordinate Plane Boards 72.97%), digital (LMS 43.24%), and multimedia (video lessons 67.57%). Usage was enerally sometimes (print-based 3.32, manipulatives 2.81, digital 2.21, multimedia 2.67), with all categories rated moderately effective (overall 3.05). A very strong positive correlation existed ($r=0.93–1.00$, $p<0.05$ via Pearson correlation and t-test), showing that higher usage enhanced outcomes. Challenges included equipment shortages, unstable internet, training gaps, and supply issues—worst for digital/multimedia. Teachers analyzed data using frequency counts and weighted means. Enhancements integrated multimodal worksheets, popsicle stick manipulatives, animated PowerPoints, and Quizlet drills, aligning with MELCs for deeper understanding and engagement. The study benefits administrators, teachers, learners, and researchers by informing improved practices and support, emphasizing infrastructure and training to boost digital/multimedia adoption despite print-based preference.

Keywords: Instructional Materials; Junior High School Mathematics; Print-Based Materials; Manipulatives; Digital Tools; Usage-Effectiveness Correlation; Teaching Challenges; Melcs Alignment

1. Introduction

Mathematics forms a foundational pillar of education, developing logical reasoning, problem-solving, and real-world skills like budgeting and decision-making. In secondary education, it demands abstract thinking, conceptual understanding, and procedural fluency as students connect prior knowledge to complex concepts. Filipino learners face persistent difficulties transitioning from elementary to junior high school, where symbolic representations and problem-solving widen learning gaps, foster math anxiety, and reduce motivation, as evidenced by PISA 2022 (16% basic competency vs. OECD 69%, mean score 355) and TIMSS 2019 low scores (297 Mathematics).

Global SDG 4 (Quality Education by 2030) and Philippine RA 10533 (K-12 Act) mandate quality instruction through relevant resources. DepEd Order No. 010, s. 2024 (MATATAG Curriculum) requires strategic use of instructional materials (IMs)—print-based, manipulatives, digital tools, multimedia—following Bruner's enactive-iconic-symbolic progression from concrete manipulatives (algebra tiles) to abstract formulas. These frameworks emphasize IMs' role in clarifying abstract concepts through multisensory engagement for struggling learners.

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Despite IM availability, researcher observations reveal unsystematic use due to teacher workload, limited training, and preference for traditional methods. Tiwi District Junior High School Mathematics teachers heavily rely on print-based materials (Learning Activity Sheets 94.59%) while underutilizing digital tools (43.24%) and multimedia (67.57%) due to equipment shortages, unstable internet, and supply issues. This limits engagement needed for fundamental concepts, despite moderate effectiveness ratings across categories.

This descriptive study empirically examines IM usage and effectiveness among 37 Tiwi District teachers (SY 2024-2025) through validated questionnaires, Pearson correlation (r=0.93–1.00), frequency counts, and weighted means. It analyzes usage patterns, challenges, and MELC-aligned enhancements (multimodal worksheets, Quizlet drills, animated PowerPoints), providing evidence-based solutions for DepEd learning recovery, teacher support, and improved Mathematics proficiency to address national assessment gaps.

1.1. Statement of the Problem

This study determined the level of usage and effectiveness of Instructional materials in teaching secondary Mathematics in Tiwi District for S.Y. 2024-2025. Specifically, it answered the following questions:

- What instructional materials are used in secondary Mathematics?
- What is the level of usage of the instructional materials along:
  - Print-based;
  - Manipulatives;
  - Digital; and
  - Multimedia?
- What is the level of effectiveness of the instructional materials?
- Is there a significant relationship between the level of usage and the level of effectiveness of the instructional materials?
- What are the challenges encountered by the teachers in using the instructional materials?
- What enhancements to the materials may be proposed to address the challenges?

1.2. Scope and Delimitation

This study focuses on the level of usage and effectiveness of instructional materials in teaching secondary Mathematics in the Tiwi District, Division of Albay. The respondents of the study are junior high school Mathematics teachers from four (4) public secondary schools, namely Tiwi Agro-Industrial School, Naga National High School, Joroan High School, and Misibis Integrated School. The investigation is limited to instructional materials employed by these teachers in mathematics instruction, including print-based, manipulatives, digital, and manipulatives resources.

The scope of the study excludes elementary teachers, senior high school teachers, Mathematics teachers from other districts within the Albay Division, and teachers from private schools. Additionally, the study does not measure students' academic performance directly, as it focuses on teachers' reported usage and perceived effectiveness of instructional materials in secondary mathematics teaching.

2. Research Method

This study used the descriptive method of research utilizing survey questionnaire with the purpose of determining the level of usage and level of effectiveness of instructional materials in teaching secondary Mathematics. It generates quantitative data that describe conditions and characteristics as they exist at a specific point in time. Additionally, it identifies relationship between variables and makes it possible to predict future occurrences based on current knowledge. Based on Salaria (2012), the descriptive research method is defined as a research approach that focuses on describing the existing characteristics, conditions, or phenomena of a population or situation without manipulating variables. It aims to systematically collect and present factual information in order to accurately portray what exists at the time of the study.

2.1. Sources of Data

Both primary and secondary sources were utilized to gather data for analysis and interpretation in this study: the primary source consisted of a researcher-made survey questionnaire completed by thirty-seven (37) Junior High School Mathematics teachers from four secondary schools in Tiwi District, Albay—Tiwi Agro-Industrial School, Naga National High School, Joroan High School, and Misibis Integrated School—providing first-hand information on the usage, effectiveness, and challenges of instructional materials in teaching Mathematics, while secondary sources included

relevant literature from books, journals, online articles, published and unpublished theses and dissertations, other printed materials, and official issuances/guidelines from the Department of Education (DepEd) and other institutions to establish a theoretical and contextual framework for the findings.

2.2. Participants of the Study

The respondents of the study were the thirty-seven (37) secondary Mathematics teachers from the four secondary schools in the Tiwi District, Albay during the School Year (S.Y.) 2024–2025. Total enumeration was employed in selecting the respondents. Specifically, the respondents consisted of nine (9) teachers from Tiwi Agro-Industrial School, sixteen (16) teachers from Naga National High School, ten (10) teachers from Joroan High School, and two (2) teachers from Misibis Integrated School.

2.3. Research Instrument

A researcher-constructed questionnaire-checklist served as the primary data collection tool to gather information on the usage, effectiveness, and challenges of instructional materials in teaching Mathematics, divided into four major parts: the first identified materials used by teachers across print-based, manipulatives, digital, and multimedia categories; the second assessed frequency of usage through three indicators per material on a five-point Likert scale (Never , Seldom , Sometimes , Often , Always); the third evaluated perceived effectiveness via three indicators per material on another five-point scale (Very Low , Low , Moderate , High , Very High) to gauge enhancements in students' understanding, engagement, and mastery; and the fourth identified challenges through a ranked list plus an open-ended question for additional responses, forming the basis for proposing enhanced materials.

2.4. Validation of Research Instrument

After drafting the research instrument, it was presented to the Thesis Committee for comments and suggestions to ensure its accuracy, reliability, and validity. The instrument was validated by two (2) Mathematic's master teachers from Malinao National High Schools, one school head from Estancia National High School, and the adviser of the researcher. This process ensured that the instrument accurately measured what it intended to measure.

2.5. Data Gathering Procedure

Upon thesis proposal approval, the researcher secured permission from the Albay Division Superintendent via formal letter, followed by communications to heads of four Tiwi District secondary schools (Tiwi Agro-Industrial School, Naga National High School, Joroan High School, and Misibis Integrated School) requesting support; questionnaires were then personally distributed to 37 junior high school Mathematics teachers, who had one week to complete them before retrieval, with strict confidentiality maintained throughout, achieving a 100% retrieval rate despite challenges like teachers' seminars, INSETs, and municipal meets; responses were tabulated on a master tally sheet for systematic analysis—with Part 1 ranked for most common instructional materials, Parts 2 and 3 analyzed for usage and effectiveness levels, and Part 4 ranked for key challenges—then statistically interpreted with statistician assistance and third-level validation for accurate conclusions.

3. Results and discussion

3.1. Instructional Materials Used in Secondary Mathematics.

The study revealed that Junior High School Mathematics teachers in the Tiwi District utilized a wide range of instructional materials categorized into print-based, manipulative, digital, and multimedia resources. Print-based materials were most prevalent, led by Learning Activity Sheets at 94.59%, for customizable practice; Visual Display at 83.78%; Flashcards at 70.27%; Drill Cards at 64.86%; Graphic Organizers at 40.54%; Story-based Worksheets at 32.43%; SIMs at 18.92%; and Educational Comics at 2.7%. Manipulatives ranked second with Coordinate Plane Boards at 72.97%; Traditional Learning Games at 64.86%; Algebra Tiles at 62.16%; Integer Counters and 3D Geometric Solids at 40.54%; Fraction Strips and Dice/Domino Sets at 37.84%; Realia at 32.43%; Number Lines (movable) at 29.73%; CRA Approach and Geoboards at 27.03%; Pattern Blocks at 24.32%; and Cuisenaire Rods/Tangrams at 10.81%.

Digital tools placed third; Learning Management Systems (LMS) AT 43.24%; Digital Learning Apps and Digital Textbooks/E-books at 35.13%; Gamified Learning Apps at 32.43%; Interactive Whiteboards/Smartboards at 16.22%; Virtual Classrooms at 10.81%; and AR/VR Math Tools at 8.11%. Multimedia ranked fourth: Recorded Video Lessons at 67.57%; Multimedia Lessons/Interactive Video Tutorials at 62.16%; Audio-Based Math Guides at 18.92%; and Schema-Based Instruction/Cover-Copy-Compare at 13.51%.

Table 1 Instructional Materials Are Used in Teaching Secondary Mathematics

Intervention Material	**Frequency**	**Percentage**
Print-Based		
Drill Cards	24	64.86
SIMs	7	18.92
Flashcards	26	70.27
Graphic Organizers	15	40.54
Learning Activity Sheets	35	94.59
Visual Displays	31	83.78
Educational Comics	1	2.70
Story-based Worksheets	12	32.43
Manipulatives		
Realia	12	32.43
Concrete-Representational Abstract (CRA) Approach	10	27.03
Traditional Learning Games	24	64.86
Geoboards	10	27.03
Algebra Tiles	23	62.16
Cuisenaire Rods	4	10.81
Pattern Blocks	9	24.32
Tangrams	4	10.81
Fraction Strips	14	37.84
Integer Counters	15	40.54
Number Lines (movable)	11	29.73
3D Geometric Solids	15	40.54
Dice and Domino Sets	14	37.84
Coordinate Plane Boards	27	72.97
Digital		
Digital Learning Apps	13	35.14
Interactive Whiteboards / Smartboards	6	16.22
Learning Management Systems (LMS)	16	43.24
Virtual Classrooms	4	10.81
Augmented Reality (AR) Math Tools	3	8.11
Virtual Reality (VR) Math Platforms	3	8.11
Gamified Learning Apps	12	32.43
Digital Textbooks / E-books	13	35.14
Multimedia		
Schema-Based Instruction	5	13.51

Cover-Copy-Compare	5	13.51
Multimedia Lessons / Interactive Video Tutorials	23	62.16
Recorded Video Lessons	25	67.57
Audio-Based Math Guides	7	18.92

3.2. Level of Usage of the Instructional Materials

This study assessed the level of usage of instructional materials in teaching secondary mathematics across four categories, based on weighted means from 37 teachers. Print-based materials (overall mean 3.32, Sometimes) were led by Learning Activity Sheets (4.38, Always), Visual Displays (4.08, Often), Drill Cards (4.04, Often), Flashcards (3.98, Often), and Graphic Organizers (3.41, Often); Lower were Story-based Worksheets (2.56, Seldom), SIMs (2.27, Seldom), and Educational Comics (1.84, Seldom) Manipulatives (Overall 2.81, Sometimes) topped with Traditional Learning games (3.83, Often) and Coordinate Plane Boards (3.59, Often); others included Algebra Tiles (3.34, Sometimes), Realia (3.11, Sometimes) and rates down to Tangrams (2.00, Seldom). Digital tools (overall 2.21, Seldom) were highest for Digital Learning Apps (2.93, Sometimes), and Gamified Learning Apps (2.91, Sometimes); Lowest were VR Math Platforms (1.50, Never) and AR Math Tools (1.63, Never) Multimedia (overall, 2.67, Sometimes) featured Recorded Video Lessons (3.38, Sometimes) Interactive Video Tutorials (2.94, Sometimes); others like Schema-Based Instruction (2.15, Seldom) trailed.

3.3. Level of Effectiveness of the Instructional Materials

Teachers perceived all categories of instructional materials as moderately effective in supporting secondary mathematics instruction, with an overall weighted mean of 3.05 (Moderate), as shown in Table 2. Print-based materials ranked highest ($\bar{x}$=3.39, Moderate), followed by manipulatives ($\bar{x}$=3.13, Moderate), digital ($\bar{x}$=2.86, Moderate), and multimedia ($\bar{x}$=2.81, Moderate). Print-based excelled in structured delivery and remediation (e.g., Learning Activity Sheets), while manipulatives aided visualization of abstract concepts (e.g., Algebra Tiles). Digital and multimedia showed moderate potential despite lower usage due to access barriers, confirming their general supportiveness for diverse learner needs.

Table 2 Level of Effectiveness of the Instructional Materials in Teaching Secondary Mathematics along its Categories

Instructional Materials	Weighted Mean	Adjectival Description
Print-based	3.39	Moderate
Manipulatives	3.13	Moderate
Digital	2.86	Moderate
Multimedia	2.81	Moderate
Average	3.05	Moderate

3.4. Relationship between the Level of Usage and Level of Effectiveness of the Instructional Materials

The study revealed a very strong to perfect positive correlation between the level of usage and effectiveness of instructional materials across all categories (print-based, digital, manipulatives, and multimedia) in teaching secondary mathematics, as tested via Pearson Product-Moment Correlation Coefficient ($r = 0.93–1.00$) with significant t-values exceeding tabular values at the 0.05 level (Table 3). Multimedia exhibited a perfect correlation ($r = 1.00$, $t = 3.182 > 2.447$), while print-based ($r = 0.95$, $t = 7.45 > 2.447$), digital ($r = 0.94$, $t = 6.74 > 2.447$), and manipulatives ($r = 0.93$, $t = 8.75 > 2.179$) showed very high correlations, rejecting the null hypothesis of no significant relationship. Higher usage directly proportional to greater effectiveness, aligning with usage patterns from Table 2.e (e.g., leading print-based at 3.32) and effectiveness rankings in Table 2. Digital materials demonstrated untapped potential despite lower usage (2.21), pending infrastructure improvement.

Table 3 Test of the Relationship between the Level of Usage and Level of Effectiveness of the Instructional Materials in Teaching Secondary Mathematics along its Categories

Instructional Materials	Pearson r	Interpretation	Computed t-value	Tabulated t-value	Remarks
Print-Based	0.95	Very High Positive Correlation	7.45	2.447	Significant
Manipulatives	0.93	Very High Positive Correlation	8.75	2.179	Significant
Digital	0.94	Very High Positive Correlation	6.74	2.447	Significant
Multimedia	1.00	Perfect Positive Correlation	∞	3.182	Significant

3.5. Challenges Encountered by Teachers in Using Instructional Materials

Teachers encountered significant barriers to using instructional materials, ranked by frequency in Table 4, which inversely correlated with usage levels and explained moderate effectiveness. Print-based showed mildest hurdles: differentiation challenges (18, 1st), supply gaps (17, 2nd), and poor quality (15, 3rd). Manipulatives had supply shortages (21, 1st), storage issues (20, 2nd), and integration difficulties (18, 3rd). Multimedia faced the most challenges: limited equipment (laptops, projectors; 30, 1st), technical malfunctions (26, 2nd), and lack of training (25, 3rd). Digital tied at 26 each (all 2nd): device access shortages, unstable internet, and insufficient training. Resource-intensive categories (multimedia/digital) suffered most from infrastructure and training deficits, hindering adoption despite strong usage-effectiveness links.

Table 4 Challenges Encountered by Teachers in Using Instructional Materials in Teaching Secondary Mathematics along its Categories

Category	Indicators	Frequency	Rank
Print-Based	Difficulty differentiating print materials for learners with varied learning paces	18	1st
	Insufficient supply or unavailability of needed print-based materials	17	2nd
	Poor print quality or unclear text/images in printed materials	15	3rd
Manipulative-Based	Insufficient or lack of concrete manipulatives (realia, counters, models)	21	1st
	Challenges in storing, maintaining, or replacing manipulatives	20	2nd
	Difficulty integrating manipulatives meaningfully into abstract lessons	18	3rd
Digital	Limited access to digital devices (phones, tablets, computers)	26	2nd
	Slow or unstable internet connectivity affects the use of digital apps and videos	26	2nd
	Insufficient teacher training in using digital tools and platforms	26	2nd
Multimedia	Limited availability of equipment (laptops, projectors, speakers) for multimedia lessons	30	1st
	Technical issues such as audio/video malfunction during lessons	26	2nd
	Lack of teacher training in designing multimedia-based instruction	25	3rd

3.6. Enhanced Instructional Materials

The enhancement of traditional print-based worksheets into multimodal resources structured print materials with step-by-step procedures, lesson sequences, visuals, real-world applications, and reflection; integer board with two-color popsicle stick manipulatives for tangible integer modeling; interactive PowerPoint presentations with animations and feedback; and Quizlet digital drills for self-paced mastery demonstrates how integrating print, hands-on, visual, and digital elements aligns with Most Essential Learning Competencies (MELCs) while fostering deeper conceptual understanding, engagement, and proficiency in adding signed numbers beyond mere procedural practice.

4. Conclusions

The following conclusions were drawn:

- Teachers utilize a variety of instructional materials with print-based and manipulatives being the commonly used, while digital and multimedia materials are less frequently utilized.
- The level of usage of instructional materials is generally moderate, with print-based resources highly utilized, manipulatives moderately used, and digital/multimedia resources used only occasionally.
- Instructional materials across all categories (print-based, manipulative, digital, and multimedia) are generally moderately effective in supporting mathematics instruction.
- A strong positive and significant relationship exists between usage level and effectiveness of instructional materials, indicating that increased, consistent use enhances teaching outcomes.
- Teachers face challenges in using instructional materials, particularly limited access to digital devices/multimedia equipment, unstable internet, insufficient training, and inadequate supply/maintenance of manipulatives, hindering optimal utilization.
- The proposed enhanced instructional materials are relevant and necessary, focusing on enhancing students understanding, improving access to instructional materials, and securing administrative support for effective Mathematics instruction.

Recommendations

Based on the findings and conclusions, the researcher recommends:

- Increase the utilization of digital and multimedia instructional materials, found highly effective for learner engagement and abstract concepts.
- Provide professional development for teachers in the selection, development, and use of instructional materials.
- Strengthen the integration of d print-based materials and manipulatives for differentiated instruction addressing varied learner needs.
- Ensure adequate provision/accessibility of instructional resources, including digital devices, multimedia tools, and learning materials, for consistent classroom use.
- Establish sustainable mechanisms for managing, maintaining, and storing instructional materials to maximize usability and long-term support.
- Conduct future research on long-term effects of instructional materials on learning outcomes and innovative approaches like technology-enhanced/gamified tools.

Areas for Further Study

Based on the findings and limitations, the following are recommended:

- Studies in other schools/districts to compare usage/effectiveness of instructional materials across contexts.
- Investigate the direct impact of instructional materials along its categories on academic achievement, problem-solving, and conceptual understanding.
- Long-term studies assessing sustained usage, instructional practices, and learner performance over time.

Compliance with ethical standards

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Disclosure of conflict of interest

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Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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