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A Needs Analysis for Developing a Geometry Module to Enhance Higher-Order Thinking Skills in Primary Mathematics Education

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ABSTRACT

Although Higher Order Thinking Skills (HOTS) have been strongly emphasised in the Malaysian mathematics curriculum, many primary school pupils continue to struggle with spatial measurement, particularly when they encounter non-routine geometry problems. Geometry lessons are also still frequently shaped by teacher-centred and procedural approaches, even though the curriculum encourages more meaningful, contextual, and reasoning-oriented learning. This study aimed to identify instructional needs related to HOTS in spatial measurement as an initial step in developing the Geometry City Module (Modul Bandar Geometri, MBG) based on the ADDIE model. A mixed method of needs analysis was conducted in the Analyse phase using questionnaires and follow-up semi-structured interviews. The survey involved 48 primary school mathematics teachers, while interviews were conducted with three selected experienced teachers. The findings showed that pupils had difficulty applying geometry concepts in problem-solving situations beyond routine exercises. Teachers also reported a lack of suitable teaching materials, manipulatives, and contextual learning resources to support HOTS in geometry lessons. Three main issues emerged: weak conceptual understanding, continued reliance on procedural teaching, and the need for more student-centred learning materials. Overall, the findings indicate a clear need for a structured geometry module that integrates HOTS through real-life contexts and supports pupils' progression from concrete experiences to abstract mathematical reasoning.

Keywords: Geometry education, higher order thinking skills, module development, needs analysis, primary mathematics, spatial measurement

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INTRODUCTION

Developing Higher Order Thinking Skills (HOTS) has become a central concern in primary mathematics education. Pupils are no longer expected to remember procedures

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or reproduce familiar examples. They are also expected to analyse relationships, evaluate strategies, justify decisions, and use mathematical ideas in unfamiliar situations. These expectations are particularly important in the early years of schooling because pupils' early conceptual understanding provides a foundation for later mathematical reasoning and problem solving (Anderson & Krathwohl, 2001; Schindler & Bakker, 2022).

Despite this curricular emphasis, many primary pupils still find HOTS-based mathematics difficult, especially in geometry and measurement (Hidayat et al., 2021; Tambunan & Surya, 2023). Geometry requires pupils to visualise, compare, and reason for spatial relationships. However, classroom practice often continues to emphasise memorising formulae and repeating similar exercises. When this happens, pupils have fewer opportunities to observe relationships, explain why a method is appropriate, or consider alternative strategies (Yeh et al., 2022).

These difficulties are especially visible in spatial measurement topics such as perimeters, area, and volume. Pupils may be able to recall a formula yet still struggle to decide which concept is relevant when a problem is presented in a new context. Such difficulty is not merely a matter of weak calculations. It reflects a deeper challenge in connecting geometric concepts, spatial representations, and reasoning processes. Similar concerns have been reported in Malaysian and Southeast Asian mathematics classrooms, where pupils' performance on HOTS-based tasks remains limited when conceptual understanding is weak and instruction is strongly procedural (Kaur et al., 2021; Rahman et al., 2023).

The ADDIE model provides a systematic framework for developing instructional materials that respond to real learning needs. The Analyse phase is particularly important because it identifies learners' difficulties, instructional gaps, and contextual constraints before design and development decisions are made (Branch & Dousay, 2020; Molenda, 2022). When the intended outcome involves complex cognitive processes such as HOTS, a careful needs analysis helps ensure that the module is not only theoretically sound but also usable and relevant in actual classrooms (Almulla, 2021; Sulaiman et al., 2024).

Teachers' perspectives are essential in this process. Teachers observe pupils' misconceptions, learning habits, motivational barriers, and classroom responses in ways that may not be visible from curriculum documents alone. A mixed methods need analysis is therefore useful because it combines broader quantitative patterns with more detailed explanations from teachers' classroom experiences (Creswell & Plano Clark, 2018; Rahimi & Karkami, 2022). This study reports the needs analysis conducted in the Analyse phase of a larger instructional design project to develop the Geometry City Module (MBG), a HOTS-oriented geometry module for Year 5 spatial measurement.

RESEARCH OBJECTIVES

The primary objective of this study was to conduct a systematic needs analysis in the Analyse phase of the ADDIE instructional design model to inform the development of a HOTS-oriented geometry module for primary mathematics.

1. Identify Year 5 mathematics topics, particularly in geometry and measurement, that pose significant challenges to pupils' development of HOTS as perceived by primary school mathematics teachers.
2. Examine teachers' perceptions of pupils' difficulties in engaging with HOTS-based mathematical tasks, including challenges related to conceptual understanding, reasoning, and non-routine problem solving in geometry.
3. Analyse instructional practices and contextual factors that may constrain or support HOTS development in primary mathematics classrooms, with particular attention to teaching approaches and learning resources used in geometry lessons.
4. Explore teachers' perceived needs regarding instructional and pedagogical features required in a HOTS-oriented geometry module, including task design, scaffolding strategies, and contextualisation of learning activities.

LITERATURE REVIEW

Novelty of the Geometry City Module

The Geometry City Module (MBG) is proposed as a structured learning pathway that integrates spatial measurement, contextual geometry tasks, and HOTS-oriented reasoning. Unlike many conventional geometry resources that mainly emphasise procedural mastery or isolated problem-solving exercises, MBG is intended to support reasoning through visualisation, authentic spatial contexts, concrete-to-abstract progression, and carefully scaffolded tasks. Its activities are designed to require pupils to describe, compare, justify, and make decisions about spatial measurement situations. In this sense, MBG is not simply a collection of geometry exercises; it is a module design grounded in teachers' reported classroom needs and organised through the Analyse phase of ADDIE.

Higher Order Thinking Skills in Primary Mathematics

HOTS refer to complex cognitive processes that require pupils to analyse relationships, evaluate possible solutions, and generate ideas or strategies. The revised Bloom's taxonomy is often used to describe these processes, with analysis, evaluation, and creation positioned above recall and routine application (Anderson & Krathwohl, 2001). In mathematics, these processes appear when pupils explain reasoning, compare solution methods, identify patterns, make decisions, and solve unfamiliar problems.

Recent research continues to show that pupils often struggle with non-routine and reasoning-based mathematics tasks, especially when classroom instruction focuses mainly on procedures (Schindler & Bakker, 2022; Yeh et al., 2022).

Higher-order thinking also encompasses critical thinking processes such as interpretation, analysis, evaluation, and inference, which enable learners to make reasoned judgments and justify their decisions when solving mathematical problems (Facione et al., 2021) If learning activities mainly require pupils to apply formulae repeatedly, pupils have limited opportunity to justify their reasoning, connect concepts, or reflect on mathematical relationships. This limits HOTS development because higher-order thinking requires pupils to make sense of ideas, not merely perform steps.

Geometry, Measurement, and Conceptual Understanding

Geometry and measurement provide rich opportunities for HOTS development because pupils must visualise, compare, and reason for spatial relationships. Understanding perimeter, area, and volume requires pupils to coordinate multiple representations and recognise the attributes being measured. Spatial reasoning is also important in early mathematics learning because it supports pupils' ability to visualise, compare, and interpret spatial relationships in geometry. Bates et al. (2023) found that practitioners recognise the importance of spatial reasoning but often need clearer instructional resources to support it effectively in classroom practice. However, primary pupils often struggle to develop deep conceptual understanding of these topics and may rely on memorised formulae instead of meaningful reasoning (Hidayat et al., 2021; Tambunan & Surya, 2023).

A systematic review on area measurement also suggests that many learners do not conceptualise space as a structure formed by iterated units, which limits their ability to analyse composite shapes and solve non-routine problems (Idrus, 2022). Such conceptual weaknesses directly affect HOTS performance because pupils who cannot distinguish mathematical attributes may also struggle to evaluate solution strategies or construct alternative representations. Recent work on primary geometry further shows that creative and reasoning-oriented geometry activities can support more meaningful problem solving when pupils are encouraged to explore relationships rather than merely recall rules (de Vink et al., 2023).

Instructional Design for HOTS-Oriented Mathematics Learning

Because HOTS are complex, they require more than the addition of difficult questions to existing lessons. Instructional materials need to be designed so that pupils are guided to observe, reason, discuss, justify, and reflect. Learning modules can support this process by organising learning sequences, scaffolding cognitive processes, and aligning tasks with intended learning outcomes. However, the usefulness of a HOTS-oriented module depends on how closely its design reflects actual learner needs and classroom realities (Rahimi & Karkami, 2022; Sulaiman et al., 2024).

The ADDIE instructional design model, which consists of Analyse, Design, Develop, Implement, and Evaluate, is widely used because of its systematic and adaptable structure (Branch & Dousay, 2020; Molenda, 2022). The Analyse phase is particularly important because it helps identify instructional problems, learner characteristics, and contextual constraints before module design begins. Without this phase, instructional materials may be conceptually valid but difficult to implement meaningfully in classrooms.

Needs Analysis in ADDIE-Based Module Development

Needs analysis is increasingly conducted using mixed methods because quantitative data can identify priority areas while qualitative data can explain why those needs exist in practice. In mathematics module development, teachers are important informants because they work directly with pupils and understand the practical realities of curriculum implementation. Their perspectives can reveal barriers to HOTS development, such as limited instructional time, examination pressure, lack of suitable learning resources, and uncertainty in facilitating reasoning-based classroom discussions.

In this study, needs analysis served as the empirical basis for aligning the proposed MBG with pupils' difficulties, teachers' instructional practices, and the pedagogical features required to support HOTS in spatial measurement. The purpose was not to evaluate the effectiveness of MBG at this stage, but to ensure that the subsequent design and development phases were grounded in evidence from classroom practice.

METHODOLOGY

Research Design

This study employed a mixed-methods descriptive design embedded in the Analyse phase of the ADDIE instructional design model. The purpose of this phase was to identify instructional gaps, learner difficulties, and contextual factors relevant to the development of a HOTS-oriented geometry module for primary mathematics. Quantitative data provided broad patterns of perceived needs, while qualitative data offered deeper explanations based on teachers' classroom experiences (Creswell & Plano Clark, 2018).

Participants

The participants were primary school mathematics teachers who taught Year 5 mathematics, particularly topics related to geometry and measurement. Purposive sampling was used because the study required teachers with direct experience in implementing the curriculum and observing pupils' engagement with HOTS-based tasks. A total of 48 teachers participated in the questionnaire phase. From this group, three experienced teachers were selected for semi-structured interviews to provide deeper explanatory data.

A sample of 48 teachers was considered appropriate for the needs analysis phase because the purpose of the study was to obtain context-specific information from teachers who were familiar with Year 5 spatial measurement and classroom practices related to HOTS. The study did not aim to generalise to all primary mathematics teachers, but to identify instructional needs that could inform the design of MBG. The use of interviews further strengthened the data by explaining the patterns found in the survey responses. Purposive sampling was employed in the qualitative phase to identify teachers who could provide rich and meaningful information regarding pupils' learning difficulties and instructional needs in geometry. According to Palinkas et al. (2015), purposive sampling is particularly suitable for mixed-methods studies that seek to obtain detailed insights from participants with relevant knowledge and experience.

Needs Analysis Questionnaire

A needs analysis questionnaire was developed to gather quantitative data on teachers' perceptions of pupils' HOTS-related difficulties and instructional needs in primary geometry. The questionnaire consisted of five sections, as shown in Table 1.

Section B used a five-point difficulty scale ranging from Very easy (1) to Very difficult (5). Sections C, D, and E used a five-point agreement scale ranging from Strongly Disagree (1) to Strongly Agree (5). The questionnaire was reviewed by mathematics education experts to ensure content relevance and clarity. A pilot study was conducted to examine reliability. As shown in Table 2, all sections recorded acceptable to high Cronbach's alpha values, with an overall alpha of .924. These values exceed the commonly accepted threshold of .70 and indicate strong internal consistency among the questionnaire items (Taber, 2018). As shown in Table 2, all sections recorded acceptable to high Cronbach's alpha values, with an overall alpha of .924.

Table 1
Components of the needs analysis questionnaire

Section	Component
A	Teacher demographics
B	Information on Year 5 mathematics topics
C	Students' difficulties in learning mathematics
D	Desired characteristics of a learning module
E	Critical thinking elements in mathematics

Source: Authors' own work

Table 2
Cronbach's alpha values for the research instrument

Section	Component	Total Items	Cronbach's Alpha
C	Difficulties in learning mathematics	10	.902
D	Learning module characteristics	7	.816
E	Critical thinking elements in mathematics	5	.920
Total	All analysed sections	22	.924

Source: Authors' own work

Semi-Structured Interview Protocol

Semi-structured interviews were conducted with three selected teachers to support and explain the questionnaire findings. The interview protocol explored teachers' experiences in teaching geometry, pupils' difficulties with HOTS-based tasks, and limitations of existing instructional approaches and resources. Semi-structured interviews were selected because they provide consistency across participants while allowing the researcher to probe important classroom experiences in more depth (Cohen et al., 2018). The use of teachers as key informants is consistent with recent educational research that recognises teachers' perspectives as valuable sources of evidence for understanding instructional needs, classroom challenges, and educational improvement efforts (Yurtseven et al., 2025). All interviews were audio-recorded with participants' consent and transcribed for analysis.

Data Collection Procedures

Data collection was conducted in two phases. First, the needs analysis questionnaire was administered to the participating teachers. The responses were checked for completeness before analysis. Second, semi-structured interviews were conducted with selected teachers to obtain richer explanations of the issues identified in the questionnaire data. This procedure enabled the qualitative findings to elaborate and contextualise the quantitative patterns.

Data Analysis

Quantitative data were analysed using descriptive statistics, including frequencies, percentages, means, and standard deviations. Section A was summarised using frequencies and percentages. Sections B, C, D, and E were analysed using mean scores and standard deviations. Mean scores were interpreted using four levels: low (1.00-2.00), moderately low (2.01-3.00), moderately high (3.01-4.00), and high (4.01-5.00).

Qualitative interview data were analysed using thematic analysis. The researchers first read the transcripts repeatedly to become familiar with the data. Initial codes were then generated from recurring ideas related to pupils' geometry difficulties, teaching practices, and instructional resources. Similar codes were grouped into broader themes. The themes were checked against the original interview excerpts to ensure that they represented teachers' views accurately. To strengthen trustworthiness, the themes were compared with questionnaire findings to identify convergence between quantitative and qualitative evidence (Braun & Clarke, 2021). Member checking was also conducted by returning interview summaries to participants for verification.

Integration of Quantitative and Qualitative Findings

Quantitative and qualitative data were integrated at the interpretation stage. The quantitative findings identified the main areas of instructional need, while the qualitative findings explained why those needs appeared in classroom practice. This integration provided an evidence-based foundation for subsequent ADDIE phases, especially the design and development of MBG.

RESULTS AND DISCUSSION

Demographic Profile of Respondents

A total of 48 teachers completed the questionnaire. Table 3 shows that the respondents included 21 male teachers (43.8%) and 27 female teachers (56.3%). Most respondents were Malay (70.8%), while Chinese and Indian teachers each represented 14.6% of the sample. Most teachers had more than five years of teaching experience (91.7%), suggesting that the responses came largely from teachers with substantial classroom experience.

Table 3
Demographic distribution of respondents (N = 48)

Variable	Category	N (%)
Gender	Male	21 (43.8)
	Female	27 (56.3)
Ethnicity	Malay	34 (70.8)
	Chinese	7 (14.6)
	Indian	7 (14.6)
Teaching experience	< 5 years	4 (8.3)
	≥ 5 years	44 (91.7)

Source: Authors' own work

Year 5 Mathematics Topics Perceived as Difficult

Teachers identified Shape and Space as the most difficult Year 5 mathematics topic, with 54.2% rating it as very difficult (Table 4). Fractions followed, with 45.8% rating as difficult. This pattern suggests that pupils' difficulties increase when mathematics requires spatial reasoning, multi-step thinking, and coordination between two-dimensional and three-dimensional representations.

Table 4
Topics in Year 5 mathematics perceived as difficult by teachers

Difficulty Category	Topic	Learning Area	Main Percentage Reported
Very difficult	Shape and Space	Measurement and Geometry	54.2
Difficult	Fractions	Numbers and Operations	45.8
Moderate	Decimals	Numbers and Operations	83.3 (moderate)
Easy	Whole numbers up to 1,000,000	Numbers and Operations	64.6 (easy)
Very easy	Addition	Numbers and Operations	29.2 (very easy)

Source: Authors' own work

Pupils' Difficulties in Learning Mathematics

Table 5 shows that teachers perceived pupils as facing major learning barriers. The highest mean was recorded for problems understanding concepts (M = 4.56, SD = 0.711), followed by problems recalling concepts (M = 4.50, SD = 0.684), inability to organise solution steps (M = 4.39, SD = 0.609), inability to apply understood concepts (M = 4.37, SD = 0.815), and uncertainty about the next step (M = 4.25, SD = 0.564). These results suggest that pupils' difficulties are not limited to computation. They involve weak conceptual networks and insufficient strategic control during problem solving, both of which are closely linked to HOTS.

Desired Characteristics of a Learning Module

All items in Section D were rated at a high level, indicating strong teacher support for the proposed module features. The highest ratings were for self-assessment (M = 4.60, SD = 0.494) and practice feedback (M = 4.54, SD = 0.503). Teachers also valued module interactivity, end-of-module tests, and technology elements. These findings suggest that MBG should include clear instructional guidance, interactive learning experiences, frequent feedback, self-assessment, and evaluation components. Technology-supported visualisation may also be useful where resources permit. Table 6 shows all the items in Section D were rated at high level, indicating strong teacher support for the proposed module features.

Table 5
Students' difficulties in learning mathematics (Section C)

Item Focus	Mean	SD	Level
Cannot organise solution steps	4.39	0.609	High
Unsure of next step	4.25	0.564	High
Cannot apply understood concepts	4.37	0.815	High
Problems understanding concepts	4.56	0.711	High
Problems recalling concepts	4.50	0.684	High

Source: Authors' own work

Table 6
Desired characteristics of a learning module (Section D)

Feature	Mean	SD	Level
Module interactivity	4.52	0.583	High
Practice feedback	4.54	0.503	High
Self-assessment	4.60	0.494	High
End-of-module test	4.33	0.558	High
Technology element	4.08	0.820	High

Source: Authors' own work

Critical Thinking Elements in Mathematics

Table 7 shows that all critical thinking elements were rated at a moderately high level. Teachers perceived pupils as needing further support in analysing chosen strategies, justifying methods, thinking of multiple approaches, making decisions related to the topic, and drawing conclusions. Although these scores were lower than the difficulty ratings in Section C, they still indicate that pupils' critical thinking in mathematics requires systematic strengthening.

Qualitative Themes and Analytical Mapping

The thematic analysis generated three themes that explained and strengthened the survey findings. These themes were not treated as isolated interview summaries. Instead, they were mapped to HOTS levels and ADDIE design implications to show how teachers' classroom experiences could inform the design of MBG.

Theme 1: Geometry as an Important but Cognitively Demanding Topic

Teachers viewed spatial measurement as important because it is closely connected to daily life. At the same time, they described it as cognitively demanding because pupils must visualise, distinguish, and reason about perimeter, area, and volume. Pupils who cannot interpret spatial contexts tend to remain at formula recall and have difficulty progressing toward analysis and evaluation. Table 8 shows the analytical mapping for Theme 1.

Table 7
Critical thinking elements in mathematics (Section E)

Element	Mean	SD	Level
Analyse chosen strategy	3.66	1.190	Moderately high
Justify chosen strategy	3.56	1.165	Moderately high
Think of multiple methods	3.68	1.094	Moderately high
Make decisions related to topic	3.89	0.994	Moderately high
Make conclusions or summaries	3.62	0.981	Moderately high

Source: Authors' own work

Table 8
Analytical mapping of theme 1: real-life meaning and conceptual understanding

Key Idea	Analytical Meaning	Design Implication
Real-life geometry contexts	Pupils need to connect spatial measurements with meaningful situations.	Include contextualised problems involving perimeter, area, and volume.
Conceptual knowledge	Pupils need to distinguish what is being measured before selecting a method.	Use concept-contrast activities and visual prompts.
Concrete-to-abstract progression	New understanding should be built from prior experience and concrete representation.	Sequence tasks from concrete objects to diagrams and symbolic reasoning.

Source: Authors' own work

Theme 2: Persistent Learning Barriers

Teachers reported that pupils' learning was often dominated by formula memorisation. When faced with HOTS-based tasks, pupils struggled to transfer knowledge because their conceptual understanding was shallow. Misconceptions were especially evident in differentiating perimeters, area, and volume, and in coordinating two-dimensional and three-dimensional representations. Table 9 shows the analytical mapping for Theme 2.

Theme 3: Preferred Teaching Approaches for HOTS-Oriented Geometry

Teachers preferred teaching approaches that use concrete materials, drawing, discussion, inquiry, and project-based learning. They believed these approaches could help pupils explore mathematical ideas, communicate reasoning, compare strategies, and make justified decisions. These practices are closely aligned with analysis, evaluation, and creation in the revised Bloom's taxonomy. Table 10 shows the analytical mapping for Theme 3.

Table 9
Analytical mapping of theme 2: misconceptions and procedural dependence

Key Barrier	HOTS-related Issue	Design Implication
Confusion between perimeter, area, and volume	Pupils struggle at the analysis level because they cannot differentiate attributes.	Include misconception-focused prompts and attribute sorting tasks.
Dependence on formulae	Pupils can recall procedures but cannot explain why a method fits the problem.	Use explanation prompts and work example fading.
Weak motivation and limited prior knowledge	Pupils lose interest when tasks feel abstract or disconnected from experience.	Use real-life contexts, manipulatives, and collaborative activities.

Source: Authors' own work

Table 10
Analytical mapping of theme 3: teaching strategies for reasoning-based geometry learning

Recommended Approach	Reasoning Function	Design Implication
Concrete and semi-concrete materials	Support visualisation and conceptual grounding.	Begin each unit with manipulative and visual models.
Class discussion and peer interaction	Encourage pupils to explain and compare strategies.	Include discussion prompts and pair or group reasoning tasks.
Inquiry and project-based tasks	Encourage decision-making and generation of solutions.	Include open-ended design challenges linked to real contexts.

Source: Authors' own work

Across the three themes, the qualitative findings indicate that pupils' HOTS development is constrained when geometry instruction privileges procedures over conceptual relationships. The mapping of Figures 1 to 3 therefore gives analytical support for the next ADDIE phases by showing how classroom needs should be translated into module design features. Table 11 shows the mapping needs identified in analyse phase.

The qualitative findings were synthesised to identify the broader instructional issues emerging from the interview data. Through thematic analysis, three overarching themes were identified that reflect teachers' perspectives on pupils' difficulties in geometry learning and the instructional support required to enhance HOTS. These themes provide a summary of the key needs identified during the Analyse phase and offer practical directions for the design of the Geometry City Module (MBG). Table 12 presents the themes, their descriptions, and the corresponding implications for module design.

Table 11
Mapping needs identified in the analyse phase to design features (ADDIE)

Qualitative Evidence	**HOTS Level**	**Design Decision for the Next ADDIE Phase**
Weak real-life conceptual links (Figure 1)	Analysis to Evaluation	Contextualised problem scenarios; task prompts requiring comparison and justification
Misconceptions driven by procedural dominance (Figure 2)	Analysis	Concept-contrast activities; misconception-focused prompts; visual attribute sorting
High cognitive load in geometry structures (Figure 3)	Evaluation to Creation	Scaffolded sequences; multiple-solution tasks; design-and-explain activities
Limited transfer to non-routine items (all figures)	Evaluation	Rubrics emphasising reasoning; worked example fading
Few opportunities to generate strategies (all figures)	Creation	Open-ended tasks: design challenges linked to real contexts

Source: Authors' own work

Table 12
Summary of qualitative themes and design implications

Theme	**Description**	**Implications for Module Design**
Geometry complexity	Difficulty visualising and reasoning about spatial measurement	Visualisation activities and concrete-to-abstract progression
Procedural dominance	Weak transfer to HOTS-based tasks	HOTS-oriented problem-solving activities
Resource limitations	Textbook-centred instruction and limited manipulatives	Structured, teacher-friendly module with contextual resources

Source: Authors' own work

Integration of Quantitative and Qualitative Findings

The integration of findings shows that the need for MBG is not simply about the lack of teaching materials. More importantly, it reflects a deeper instructional issue: pupils need learning experiences that help them move from formula recall to reasoning about spatial relationships. Quantitatively, Shape and Space were identified as the most difficult Year 5 topic, and teachers rated pupils' conceptual and strategic difficulties at a high level. Qualitatively, teachers explained that these difficulties were linked to misconceptions, formula dependence, weak 2D and 3D coordination, and limited opportunities for discussion and exploration.

This convergence strengthens the rationale for MBG. The proposed module should not only provide more exercises, but should guide pupils to interpret situations, compare methods, justify decisions, and connect geometry with meaningful contexts. Such features are essential because HOTS in geometry depends on pupils' ability to coordinate conceptual understanding, spatial representation, and reasoning.

Implications for Instructional Design within ADDIE

The findings confirm the importance of the Analyse phase in ADDIE. Needs analysis allows instructional designers to identify specific cognitive gaps, misconceptions, and contextual limitations before developing learning materials. For MBG, the results indicate that the next design phase should include contextualised problem scenarios, scaffolded reasoning activities, concept-contrast tasks, visualisation supports, and explicit prompts for explanation and justification.

The findings also suggest that teacher support should be built into the module. Teachers need guided questioning strategies, examples of reasoning-focused tasks, and assessment criteria that value explanation rather than answers alone. These features can help teachers implement HOTS-oriented geometry learning more confidently and consistently.

Contribution to HOTS-Oriented Mathematics Education

This study contributes to HOTS-oriented mathematics education by positioning teachers' perspectives within a systematic instructional design framework. Previous studies have reported pupils' difficulties in HOTS-based mathematics tasks, but this study extends that discussion by showing how these difficulties are linked to instructional practices and classroom constraints identified through needs analysis. The mixed methods approach also demonstrates how quantitative prioritisation of needs can be strengthened by qualitative explanation from classroom practice.

By grounding MBG in the Analyse phase of ADDIE, this study offers a clear evidence base for later design and development decisions. It shows that instructional materials for HOTS should be responsive to actual classroom needs, especially when the intended learning outcomes involve complex reasoning in geometry.

CONCLUSION

This study shows that a systematic needs analysis is important before developing HOTS-focused instructional materials for primary mathematics. The findings provide consistent quantitative and qualitative evidence that there is a clear need to develop the Geometry City Module for Year 5 Shape and Space. Teachers identified Shape and Space as the most difficult topic, and they reported high levels of pupils' difficulty in understanding concepts, applying ideas, organising solution steps, and recalling relevant concepts.

The interviews further showed that pupils' difficulties are shaped by confusion between perimeter, area, and volume, weak 2D and 3D coordination, heavy reliance on memorised formulae, and limited access to meaningful hands-on activities. Teachers also expressed strong support for module features such as interactivity, feedback, self-assessment, and structured evaluation. Together, these findings support the development of MBG as a structured instructional module that can strengthen conceptual understanding, HOTS, and critical thinking in spatial measurement.

IMPLICATION OF THE STUDY

The findings highlight the importance of intentionally embedding HOTS into primary mathematics instruction through structured and conceptually oriented learning modules. Based on the identified needs, MBG should prioritise conceptual clarity between perimeter, area, and volume using multiple representations, including concrete, visual, and symbolic forms. It should also include concrete, semi-concrete, and abstract progression aligned with classroom practice.

The module should provide practice with immediate feedback, self-assessment, and end-of-module tests to promote monitoring and consolidation. It should also include discussion prompts, inquiry tasks, comparison of methods, and decision-making activities to develop critical thinking. Project-based tasks linked to real-life contexts may further support engagement and meaning-making, while technology-supported visualisation can be included where it is feasible to strengthen 3D reasoning and reduce confusion between 2D and 3D concepts.

LIMITATION AND RECOMMENDATION FOR FUTURE RESEARCH

This study was limited to national primary schools in one district, Raub, Pahang. Therefore, the findings may not be generalisable to other districts, states, or school types. The survey also relied on teachers' perceptions rather than direct measures of pupils' achievement. Future studies should extend the sampling to multiple districts or states, include diagnostic tests on spatial measurement concepts, and evaluate MBG through iterative development cycles with formative feedback and effectiveness testing.

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