# DEVELOPMENT AND VALIDATION OF GEOMETRY CITY STEM MODULE (MBG)

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**Abstract:** The objectives of this paper are to assess the development and content validity of a module developed to assess higher order thinking skills, conceptual knowledge, and critical thinking skills. According to the findings of descriptive statistical, topics Space and Fractions were identified as the most difficult topics to study in Mathematics Year 5 by 48 teachers who taught pupils' elementary school. In this study, a prototype is designed using the ADDIE model. The content validity of the instrument was evaluated using the judgments of eight experts. The item content validity index (I-CVI) and the scale content validity index were used to assess content validity (S-CVI). Six dimensions were identified: interface, picture, text, content, teaching and learning process method, and objective achievement. For interface, picture, text, content, teaching and learning process technique, and objective achievement, the item content validity index (I-CVI) varied from 0.89 to 1, and the scale content validity index (S-CVI/Ave) was 1.00, 1.00, 1.00, 0.93, 0.95, and 0.89, respectively. According to the findings, the module has high content validity and may be utilised to increase HOTS, conceptual and critical thinking skills, and mathematics content understanding among elementary school students.

***Keywords:*** *Content Validity, Face Validity, Module Development, I-CVI, S-CVI*

## INTRODUCTION

Malaysia's Ministry of Education (MOE) and Ministry of Science, Technology and Innovation (MOSTI) have placed a major focus on STEM education to ensure that Malaysian education achieves the aims of the National Innovation and Science Policy and the Malaysia Education Blueprint 2013-2025 (Ministry of Education Malaysia, 2013; MOSTI, 2016). The education and training system must be reformed in order to ensure that everyone has access to good jobs in the future. Malaysia has evolved to embrace higher order thinking skills (HOTS) into official education, beginning with primary school students. The development of HOTS in early learners may lay the groundwork for them to adopt a systematic problem-solving approach and enhance higher-order thinking skills in all subjects, including STEM (MacDonald et al., 2020). HOTS is defined as the capacity to integrate knowledge, skills, and values, as well as generate reasoning and reflection in order to solve issues, make decisions, innovate, and strive to produce something (Anderson & Krathwohl, 2001). HOTS represent the competence to apply, analyse, evaluate, and create, according to Bloom's updated taxonomy (Anderson & Krathwohl, 2001; Ibrahim et al., 2019).

Individuals who grasp the conceptual underpinnings of a process are more likely to effectively generalise into novel contexts and to aid others in choosing which technique is appropriate in a given situation (Barrouillet, 2015; Idrus et al., 2022; Kow & Yeo, 2008). It has also been suggested that conceptual understanding has deeper effects. The Common Core State Standards Initiative, for example, argued that teaching conceptual knowledge in addition to processes is a way to promote broader and more long-lasting mathematics literacy. As a result, many people believe that conceptual knowledge is essential for arithmetic learning. The approach to geometry with young children begins with the students' informal knowledge of conditions, which is then followed by a progressive mathematical reconstruction of these experiences. A greater understanding of conceptual knowledge could improve studies in mathematical thinking, learning, and instruction from a variety of theoretical perspectives.

According to the Trends in International Mathematics and Sciences Study (TIMSS) 2019 report, Malaysian students' average performance in Geometry and Measurement is moderate (achievement score of 466) when compared to Singapore (achievement score is 619) (TIMSS & PIRLS, 2013) (Hooper et al., 2019). This means that Malaysian pupils have just a basic understanding of Geometry and Measurement, and they may be unable to compute the areas, perimeters, and volumes of geometric objects (Huang & Witz, 2011). Although Geometry and Measurement is an amazing topic for children to master at all levels through all types of numbers and numerical operations, it is preferable to learn these in real-world measurement settings naturally. As a result, students must understand that geometry and measurement learned in elementary school will serve as the foundation for further study in secondary school.

In Malaysia, approximately 58 percent of the teaching and learning process is dominated by explaining and performing mathematics; the remainder is spent reviewing homework, re-teaching, taking examinations, and participating in non-lesson-related activities (Ibrahim et al., 2019; Kow & Yeo, 2008; Zabit, 2010). They proposed that shifting away from such a traditional approach and toward a "inquiry" orientation, in which mathematics is viewed as a tool for problem resolution, would be more beneficial (Murphy, 2012). When students learn critical thinking skills through inquiry-based learning rather than traditional teaching methods, their critical thinking abilities improve dramatically. As a result, individuals must be more creative and innovative in order to face daily challenges (Thaiposri & Wannapiroon, 2015).

Pupils were not proficient in converting, calculating perimeter, area and volume (Fujita et al., 2017). In general, these sources did not adequately articulate the conceptual understanding required to support students' efforts to overcome identified learning challenges in perimeter, area, and volume measurement. The presence of area and perimeter in the curriculum was well established for the content domain of area and perimeter. Many academics have reported on lower primary pupils' ideas on area measurement (Battista, 2017; Kow & Yeo, 2008; Naidoo, 2018). Most school curriculum aim to improve pupils' understanding of three-dimensional figures. As a result, developing and measuring strategies to build and measure learners' spatial thinking in 3D geometry is an essential research subject, with one difficult topic being how geometric object representation influences learners' reasoning (Fujita et al., 2017). The concepts area and perimeter were chosen as T&L qualities for a variety of reasons. For starters, educators frequently discovered that students struggled with it. This could be due to misconceptions, mixing area with perimeter, or a complete lack of understanding of the concept. Furthermore, knowing how the concepts of area and perimeter are applied in everyday life can be difficult for students to grasp (Naidoo, 2018).

Therefore, we conducted this research by focusing on a group of Year 5 school students learning 'Measurement and Geometry'. We conducted this study because there is a significant difference in our current understanding of measurement and geometry, specifically combined perimeter, combined area, and combined volume. It is critical to explore how to assist students in "balancing their need to be rigorous with the use of spatial intuition" when solving geometrical challenges with reasoning (Fujita et al., 2017). Geometry teaching provides as both a fundamental means of enhancing learners' spatial vision skills and a platform for developing their deductive reasoning and evidence capabilities (Natalija et al., 2019; Srinivas et al., 2017). As a result, the development and validation of this instrument are crucial for Geometry City STEM Module measurement (MBG).

## RESEARCH OBJECTIVES

The objectives of this research are to develop a Teaching and Learning (T&L) Geometry City STEM Module (MBG) using the ADDIE model and to assess the MBG's validity in the learning of shapes and space with a focus on perimeter, area, and volume.

### *Instrument Development*

The aim of the research was to develop instructional material in the form of a module for 11-year-old pupils. It was designed and developed in accordance with the ADDIE model's procedures, with a focus on the learning of Shapes and Spaces geometry topics. There were five steps involved: Phase I: Needs assessment, Phase II: Design of the Geometry City STEM Module (MBG), Phase III: Development of the Geometry City STEM Module (MBG), Phase IV: Implementation of Geometry City STEM Module (MBG), and Phase V: Evaluation of the effectiveness of the Geometry City STEM Module (MBG). It consisted of four units, namely Unit 1 (Introduction), Unit 2 (Planning of Geometry City), Unit 3 (Development of Geometry City) and Unit 4 (Assessment of Geometry City). As a result, this research will only cover phases I through III.

#### *Phase I*

Performed to discover difficulties in a classroom and see if intervention in education and training was the best line of action to design appropriate change in a learning environment decided on the module's most difficult chapter. A survey of maths teachers was performed to examine their viewpoints. There were five questions on the teacher's survey form: Item A – Demographic respondent Item B – Topics in mathematics that student find difficult to grasp; Item C – Difficulties in earning mathematics; Item D – learning module characteristics; Item E – Elements of critical thinking in mathematics. For item 1 used a five-point Likert scale to indicate their degree of difficulty with each item presented (Very Easy, Easy, Neutral, Difficult, Very Difficult). Meanwhile for item 2,3 & 4 used a five-point Likert scale to indicate their degree of agreement with each item presented (strongly Disagree, Disagree, neither agree or disagree, Agree, Strongly Agree). The topic with the highest percentage for difficulty and mean for item 2,3 & 4 was chosen as the one to develop in the Geometry City STEM Module.

The information gathered from section A, B, C, D and E was evaluated using descriptive statistics such as percentages and means. The questionnaire was also built using a Likert scale from 1 to 5, which was classified and interpreted into four levels, as shown in Table 5.

Table 1
*Mean Score Interpretation (5 Point Likert Scale)*

| Mean Score | Interpretation |
|---|---|
| 1.00 to 2.00 | Low |
| 2.01 to 3.00 | Medium Low |
| 3.01 to 4.00 | Medium High |
| 4.01 to 5.00 | High |

Source Sabilan et, al. (2017)

The results of respondents as a measure of descriptive statistical analysis. According to teachers, 54.2% of respondents identified Space as the most very difficult topic, 45.8% picked Fractions as the difficult topic, 83.3% opted Decimals as the neutral topic, 64.6% identified Whole Number until 1000000 as easy topic and 29.2% named Addition as the very easy topic.

The respondents' impressions of the problems they confront in taking lessons are examined in Section C, which has 10 items. Table 2 shows the frequencies and percentages by item and Table 3 depicts the mean, standard deviation, and interpretation (based on Table 1) of the difficulties they had while studying mathematics.

Findings showed the mean value of item score C1(M=4.39, SD=.609), C2(M=4.25, SD=.564) and C3(M=3.89, SD=1.71) were performing for a high and medium high level. This demonstrates that the participants in the study are having difficulty solving and fine-tuning mathematical problems. The mean value of item score C4(M=4.22, SD=.856), C5(M=4.37, SD=.815) and C6(M=4.22, SD=.691) were putting up a show at a high level. This implies that the study's participants are struggle encountering difficulties in conceptual knowledge in mathematics.

The mean values of the item score C7(M=4.43, SD=.872), C8(M=4.56, SD=.711), C9(M=4.50, SD=.684) and C10(M=4.22, SD=.660) was observed at a high level. This indicates that the participants in the research are facing problems with remembering and recalling the mathematical concepts.

Table 2
*Frequencies and Percentages by Item in Section C*

| Item | Level | | | | | |
|---|---|---|---|---|---|---|
| | Strongly Disagree<br>1 | Disagree<br>2 | Neither agree or Disagree<br>3 | Agree<br>4 | Strongly Agree<br>5 | Total<br>(4&5) |
| | | | N<br>(%) | | | |
| C1 | - | 1<br>2.1 | - | 26<br>54.2 | 21<br>43.8 | 47<br>98.0 |
| C2 | - | 1<br>2.1 | - | 33<br>68.8 | 14<br>29.2 | 47<br>98.0 |
| C3 | 2<br>4.2 | 6<br>12.5 | 5<br>10.4 | 17<br>35.4 | 18<br>37.5 | 35<br>72.9 |
| C4 | - | 3<br>6.3 | 4<br>8.3 | 20<br>41.7 | 21<br>43.8 | 41<br>85.5 |
| C5 | - | 3<br>6.3 | 1<br>2.1 | 19<br>39.6 | 25<br>52.1 | 44<br>91.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| C6 | - | 2<br>4.2 | 1<br>2.1 | 29<br>60.4 | 16<br>33.3 | 45<br>93.7 |
| C7 | 1<br>2.1 | 1<br>2.1 | 3<br>6.3 | 14<br>29.2 | 29<br>60.4 | 43<br>89.6 |
| C8 | - | - | 1<br>2.1 | 17<br>35.4 | 30<br>62.5 | 47<br>97.9 |
| C9 | 1<br>2.1 | 2<br>4.2 | - | 17<br>35.4 | 28<br>58.3 | 45<br>93.7 |
| C10 | 1<br>2.1 | - | 3<br>6.3 | 28<br>58.3 | 16<br>33.3 | 44<br>91.6 |

Table 3
*Analysis of Difficulties in Learning Mathematics*

| | Items | N | Mean | Standard Deviation | Interpretation |
|---|---|---|---|---|---|
| C1 | Students are unable to demonstrate how to solve mathematics problems in a systematic way. | 48 | 4.39 | .609 | High |
| C2 | Students are not sure what the next step is to take when solving mathematics questions | 48 | 4.25 | .564 | High |
| C3 | Students were not confident with every step of the mathematics solution they made. | 48 | 3.89 | 1.71 | Medium High |
| C4 | Students are unable to connect the concepts they have studied in order to solve a mathematics problem. | 48 | 4.22 | .856 | High |
| C5 | Students are unable to apply their knowledge of mathematics concepts to the solution of a mathematical problem. | 48 | 4.37 | .815 | High |
| C6 | Students lack confidence in the concepts that must be applied to solve a mathematics problem. | 48 | 4.22 | .691 | High |
| C7 | Students do not remember mathematical concepts that have been learned quickly. | 48 | 4.43 | .872 | High |
| C8 | Students have difficulty remembering mathematics ideas they have learnt. | 48 | 4.56 | .711 | High |
| C9 | Students have difficulty recalling mathematics ideas that they have learnt. | 48 | 4.50 | .684 | High |
| C10 | Students recall what they have learnt, when mathematics concepts are needed. | 48 | 4.22 | .660 | High |

a. Analysis of learning module characteristics

There are 7 items in section D that explore respondents' impressions of the qualities of the module that they intend to use to keep their conceptual of the year 5 Mathematics topics taught informed. Table 4 shows the frequencies and percentages by item. The mean, standard deviation, and interpretations (based on Table 1) of the module features they wanted are shown in Table 5.

Findings showed the mean value of item score D1(M=4.22, SD=.994), D2(M=4.08, SD=.820), D3(M=4.45, SD=.617), D4(M=4.52, SD=.583), D5(M=4.54, SD=.503), D6(M=4.60, SD=.494) and D7(M=4.33, SD=.558). It is at an all-time high level. All of the qualities as mentioned will be addressed in the development of the learning module later because all of the items mean scores are high.

Table 4
*Frequencies and Percentages by Item in Section D*

| Item | Level | | | | | |
|---|---|---|---|---|---|---|
| | Strongly Disagree 1 | Disagree 2 | Neither agree or Disagree 3 | Agree 4 | Strongly Agree 5 | Total (4&5) |
| | N<br>% | | | | | |
| D1 | 2<br>4.2 | 2<br>4.2 | 1<br>2.1 | 21<br>43.8 | 21<br>45.8 | 42<br>89.6 |
| D2 | 2<br>4.2 | - | 2<br>4.2 | 32<br>66.7 | 12<br>25.0 | 44<br>91.7 |
| D3 | 2<br>4.2 | 6<br>12.5 | 5<br>10.4 | 17<br>35.4 | 18<br>37.5 | 35<br>72.9 |
| D4 | 2<br>4.2 | - | - | 19<br>39.6 | 27<br>56.3 | 46<br>95.9 |
| D5 | - | - | - | 22<br>45.8 | 26<br>54.2 | 48<br>100 |
| D6 | - | - | - | 19<br>39.6 | 29<br>60.4 | 48<br>100 |
| D7 | - | - | 2<br>4.2 | 28<br>58.3 | 18<br>37.5 | 46<br>95.8 |

Table 5
*Analysis of Learning Module Characteristics*

| | Items | N | Mean | Standard Deviation | Interpretation |
|---|---|---|---|---|---|
| D1 | The learning of Mathematics concepts is facilitated by clearly stated learning objectives. | 48 | 4.22 | .994 | High |
| D2 | The inclusion of technology content aspects aids students' learning of mathematics concepts. | 48 | 4.08 | .820 | High |
| D3 | The usage of proper colors assists children in mastering their mathematics skills. | 48 | 4.45 | .617 | High |
| D4 | The module's interactive capabilities help students in mastering their mathematics knowledge. | 48 | 4.52 | .583 | High |
| D5 | Responses from exercise help student’s mastery of Mathematics knowledge | 48 | 4.54 | .503 | High |
| D6 | The module's self-assessment feature encourages students in mastering their mathematics knowledge. | 48 | 4.60 | .494 | High |



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| | | | | | |
|---|---|---|---|---|---|
| D7 | Students' understanding of Mathematics information is assisted through tests at the conclusion of each module. | 48 | 4.33 | .558 | High |

b. Analysis of elements of critical thinking in mathematics

In this section E, there are 5 items that explore in elements of critical thinking skills in mathematics. Table 6 shows the frequencies and percentages by item meanwhile mean, standard deviation, and interpretations (based on Table 1) of the module features they wanted are shown in Table 7. The mean values of the item score were discovered E1(M=3.66, SD=1.190), E2(M=3.56, SD=1.165), E3(M=3.68, SD=1.094), E4(M=3.89, SD=.994) and E5(M=3.62, SD=.981). These have attained as the all medium high. This implies that the study's participants are struggle encountering critical thinking skills in mathematics.

Table 6
*Frequencies and Percentages by Item in Section E*

| Item | Level | | | | | |
|---|---|---|---|---|---|---|
| | Strongly Disagree<br>1 | Disagree<br>2 | Neither agree or Disagree<br>3 | Agree<br>4 | Strongly Agree<br>5 | Total<br>(4&5) |
| | N<br>% | | | | | |
| E1 | - | 11<br>22.9 | 11<br>22.9 | 9<br>18.8 | 17<br>35.4 | 26<br>54.2 |
| E2 | 1<br>2.1 | 11<br>22.9 | 8<br>16.7 | 16<br>33.3 | 12<br>25.0 | 28<br>58.3 |
| E3 | 1<br>2.1 | 8<br>16.7 | 8<br>16.7 | 19<br>39.6 | 12<br>25.0 | 31<br>64.6 |
| E4 | - | 6<br>12.5 | 8<br>16.7 | 19<br>39.6 | 15<br>31.3 | 34<br>70.9 |
| E5 | - | 8<br>16.7 | 11<br>22.9 | 20<br>41.7 | 9<br>18.8 | 29<br>60.5 |

Table 7
*Analysis of Critical Thinking Skills*

| Items | | N | Mean | Standard Deviation | Interpretation |
|---|---|---|---|---|---|
| E1 | Pupils are able to analyze the solution method that has been chosen. | 48 | 3.66 | 1.190 | Medium High |
| E2 | Pupils are able to reason or justify the chosen solution strategy. | 48 | 3.56 | 1.165 | Medium High |
| E3 | Pupils might come up with a variety of solutions to a problem. | 48 | 3.68 | 1.094 | Medium High |
| E4 | Pupils are able to make good decisions related to the topics studied. | 48 | 3.89 | .994 | Medium High |
| E5 | Pupils are able to make good conclusions about what they have learned | 48 | 3.62 | .981 | Medium High |

*Phase II*

The MBG module was designed to give mathematics teachers a step-by-step guide on how to teach a math lesson utilising module activities. The Malay language was used to create the module. Because the module will be deployed in elementary schools, it was written in simple, easy-to-understand format. The beginning of the module focused on the introduction of HOTS, as well as conceptual knowledge and critical thinking skills that had been validated by experts. The activities in the module were structured in accordance with the syllabus's arrangement. A lesson plan, a lesson activity, and a lesson assessment were provided in each activity.

Each of these units included applicable content as well as learning activities. For example, in Unit 2, one activity could be to investigate what is known as combined perimeter. This activity is based on their prior knowledge as fourth-year pupils. Before beginning data collecting, permission was acquired from the Ministry of Education (KPM) and the Pahang State Education Department (JPNP). The study hoped that after the validated Geometry City STEM Module had been proved to be effective in enhancing primary school children's mathematics content understanding, it could be supplied as reference material to elementary school teachers. The Geometry City STEM Module content could be added in the school mathematics textbook to improve understanding of geometry, particularly perimeter, area, and volume.

The perimeter, area, and volume tasks in this study required learners to construct grids and manipulate rectangles, parallelograms, and triangles to determine area and perimeter for the experimental group. As a result, students learned the link between area and perimeter. Figures 1 and 2 show examples from these activities.

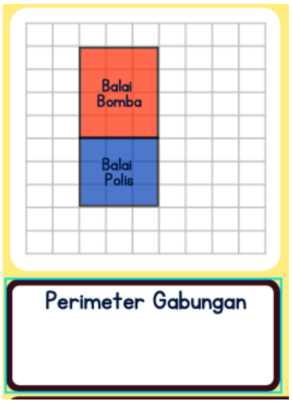


*Figure 1*. Combine Perimeter Activity


*Figure 2*. Combine Area Activity

Furthermore, the difficulty may emerge from a simple misunderstanding of terms or from deeper misunderstandings that lead learners to believe that perimeter and area are simply related in such a way that an increase in one lead to an increase in the other. Next, knowledge of shapes and their sizes is critical to developing the foundations of a child's mathematical reasoning. Spatial thinking is essential for solving issues and representing mathematics in many forms such as diagrams and graphs (Huang & Witz, 2011; Perry & Perry, 1981). Instruction that reproduces the counting of squares on grids leads to better success and may represent the concept of space filling (Murphy, 2012). As a result, the goal of this research is to create an alternate module for measuring Year Five National School children's geometrical measurement skills and to evaluate the module in terms of content validity and face validity.

*Phase III*

The experts made their decision on the development module during this phase. Using an expert panel gives constructive comments on the quality of the newly developed module as well as objective criteria for evaluating each item. This evaluation validates that the items meet the required degree of face and content validity. Although a new instrument's criterion-related and construct validity are critical, information about the measure's content validity is also considered necessary in making judgements about the scale's quality (Baharuddin et al., 2020). The value to which the questions on a measure evaluate the same subject or the extent to which the content material was selected in the measure is referred to as content validity. Face validity and logical validity are two ways to define content validity. Face validity indicates a measure that appeared to be valid "on the surface”. A more rigorous method, such as evaluating the content validity of a measure with a panel of experts, was suggested by logical validity (Rubio et al., 2003). The experts chosen to examine and evaluate data collection instruments are often selected based on their knowledge of the topic to be studied. According to L. Davis (Davis, 1992), Experts should be selected based on their knowledge, professional experiences, and subject matter expertise. As a result, the panel of experts in this study were chosen based on their knowledge in elementary school mathematics education, broad expertise, and adequate training in educational mathematics education.

Consider the item's coherence and difficulty, the grammar employed, sentence structuring, word spelling, font size relevance, and the instrument's structure in its constructions or format when evaluating the item's face validity. As a result, during this step, eight experts were chosen to validate the instrument's face and content validity. Table 1 highlights the domain experts' designations, affiliations, and years of expertise.

Table 1
*Demography of Subject Matter Experts (Smes) for the Content Validation Phase*

| No. | Designation of domain experts | Organization | Years of experiences |
|---|---|---|---|
| 1 | Senior Lecturer, PhD. | Institute of Teacher Training (IPG) Negeri Sembilan | 24 |
| 2 | Senior Lecturer, PhD. | Institute of Teacher Training (IPG) Terengganu | 23 |
| 3 | Senior Lecturer, PhD. | Institute of Teacher Training (IPG) Sarawak | 20 |
| 4 | Senior Lecturer, PhD. | National University of Malaysia (UKM) | 10 |
| 5 | Senior Lecturer, PhD. | Universiti Malaya (UM) | 10 |
| 6 | Excellent Teacher (Grade DG 48) | National Elementary School | 25 |
| 7 | Excellent Teacher (Grade DG 44) | National Elementary School | 10 |
| 8 | Education Officer (Grade DG44) | Pahang Education Department (SISC+) | 18 |

The Content Validity Index is used in this study to represent content validity (CVI). Based on the various recent studies, the CVI is recognised as the best approach for evaluating an instrument's content validity (Baharuddin et al., 2020; Nasser & Lian, 2021; Rubio et al., 2003). According to Lynn (1986), Three experts were recommended as a minimum, but more than ten were probably unnecessary. Eight specialists were asked to review the tools in the context of this research. The content validity index (CVI) was measured on a five-point ordinal scale. According Ghazali [28] The level of agreement was determined using a 5-point scale: 1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, and 5=strongly agree. Scale 1,2 and 3 recode into 0 (not relevant) meanwhile scale 4 and 5 recode as 1 (relevant). The item-level CVI (I-CVI) is then computed when the experts offer rates 4 and 5, which represent the agreement among experts on the importance of the items. Lynn [23] also recommended that a three- or five-point Likert scale be used to obtain agreement.

Lynn (1986) recommends that if there are five or fewer panel experts, the I-CVI acceptance level at this step should be 1.00. A slight variation in opinion is acceptable if additional specialists are involved (If there are eight experts in a single item, the I-CVI must be 0.83) (Lynn, 1986; M. Fuad et al., 2022; Nasser & Lian, 2021).



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*Results and Discussion*

The total content validity of the scale, which contained Universal Agreement (UA) and Ave, was evaluated using the content validity index for scales (S-CVI) (Average). The content validity results are provided in Tables 2 through 7 and are summarised in Table 8. Table 2 to Table 7 show the agreement on interface, image, text, content, T&L process approach and objective achievement.

Table 2
*Agreement On A 5-Item Scale for 'Interface' Dimensions of Geometry City STEM Module (MBG)*

| Experts (E) /Items | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 | Number of Agreement | I-CVI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| Proportion Relevant | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | Mean I-CVI | 1.00 |
| | | | | | | | | | S-CVI/UA | 1.00 |
| | | | | | | | | | S-CVI/AVE | 1.00 |

Note: 1 indicates that the item is important; items ranked 4 or 5 on a 5-point scale are relevant. S-CVI (Average) (accepted)

The S-CVI/UA refers for scale content validity index/universal Agreement Proportion, whereas the I-CVI stands for item content validity index. The minimal I-CVI and S-CVI/AVE for 8 experts are 0.83 and 0.90, respectively.

**Table 3**.
*Agreement on a 5-item scale for 'image' dimensions of Geometry City STEM Module (MBG)*

| Experts (E) /Items | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 | Number of Agreement | I-CVI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| Proportion Relevant | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | Mean I-CVI | 1.00 |
| | | | | | | | | | S-CVI/UA | 1.00 |
| | | | | | | | | | S-CVI/AVE | 1.00 |

Note: 1 indicates that the item is important; items ranked 4 or 5 on a 5-point scale are relevant. S-CVI (Average) (accepted)

The S-CVI/UA refers for scale content validity index/universal Agreement Proportion, whereas the I-CVI stands for item content validity index. The minimal I-CVI and S-CVI/AVE for 8 experts are 0.83 and 0.90, respectively.

Table 4
*Agreement On A 5-Item Scale for 'Text' Dimensions of Geometry City STEM Module (MBG)*

| Experts (E) /Items | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 | Number of Agreement | I-CVI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| Proportion Relevant | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | Mean I-CVI | 1.00 |

| | |
|---|---|
| S-CVI/UA | 1.00 |
| S-CVI/AVE | 1.00 |

Note: 1 indicates that the item is important; items ranked 4 or 5 on a 5-point scale are relevant. S-CVI (Average) (accepted)

The S-CVI/UA refers for scale content validity index/universal Agreement Proportion, whereas the I-CVI stands for item content validity index. The minimal I-CVI and S-CVI/AVE for 8 experts are 0.83 and 0.90, respectively.

Table 5

*Agreement On A 5-Item Scale for 'Content' Dimensions of Geometry City STEM Module (MBG)*

| Expert (E) /Items | E1 | E2 | E3 | E 4 | E5 | E6 | E7 | E8 | Number of Agreement | I-CVI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 9 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 7 | 0.87 |
| 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 11 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 13 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 14 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 15 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| Proportion Relevant | 1.00 | 1.00 | 1.00 | 1.00 | 0.93 | 1.00 | 1.00 | 1.00 | Mean I-CVI | 0.99 |
| | | | | | | | | | S-CVI/UA | 0.93 |
| | | | | | | | | | S-CVI/AVE | 0.99 |

Note: 1 indicates that the item is important; items ranked 4 or 5 on a 5-point scale are relevant. S-CVI (Average) (accepted)

The S-CVI/UA refers for scale content validity index/universal Agreement Proportion, whereas the I-CVI stands for item content validity index. The minimal I-CVI and S-CVI/AVE for 8 experts are 0.83 and 0.90, respectively.

Table 6

*Agreement on a 5-item scale for 'T&L process approach' dimensions of Geometry City STEM Module (MBG)*

| Experts (E) /Items | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 | Number of Agreement | I-CVI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 | 0.88 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 7 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 0.88 |
| 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 9 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 7 | 0.88 |
| 10 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 0.88 |
| 11 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| Proportion Relevant | 0.81 | 1.00 | 0.90 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | Mean I-CVI | 0.95 |
| | | | | | | | | | S-CVI/UA | 0.63 |
| | | | | | | | | | S-CVI/AVE | 0.95 |

Note: 1 indicates that the item is important; items ranked 4 or 5 on a 5-point scale are relevant. S-CVI (Average) (accepted)
The S-CVI/UA refers for scale content validity index/universal Agreement Proportion, whereas the I-CVI stands for item content validity index. The minimal I-CVI and S-CVI/AVE for 8 experts are 0.83 and 0.90, respectively.

Table 7
*Agreement On A 5-Item Scale for 'Objective Achievement' Dimensions of Geometry City STEM Module (MBG)*

| Experts (E) /Items | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 | Number of Agreement | I-CVI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 6 | 0.75 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 3 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 6 | 0.75 |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 | 1.00 |
| 6 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 | 0.87 |
| Proportion Relevant | 0.83 | 0.83 | 0.83 | 1.00 | 0.66 | 1.00 | 1.00 | 1.00 | Mean I-CVI | 0.89 |
| | | | | | | | | | S-CVI/UA | 0.50 |
| | | | | | | | | | S-CVI/AVE | 0.89 |

Note: 1 indicates that the item is important; items ranked 4 or 5 on a 5-point scale are relevant. S-CVI (Average) (accepted)
The S-CVI/UA refers for scale content validity index/universal Agreement Proportion, whereas the I-CVI stands for item content validity index. The minimal I-CVI and S-CVI/AVE for 8 experts are 0.83 and 0.90, respectively.

Table 8
*Validity of Content Summary*

| Dimensions | No. of items | I-CVI (> 0.83) | S-CVI/Ave (0.90) |
|---|---|---|---|
| Interface | 5 | 1.00 | 1.00 |
| Image | 5 | 1.00 | 1.00 |
| Text | 5 | 1.00 | 1.00 |
| Content | 15 | 0.99 | 0.99 |
| Teaching and learning process approach | 11 | 0.95 | 0.95 |
| Objective achievement | 6 | 0.89 | 0.89 |

To verify that the items created assess the components of geometrical measuring skills, content validity and face validity evaluations were performed. Overall, these six module validation dimensions, namely: interface; image; text; content; teaching and learning process method; and objective achievement, are consistent with previous research (Hutkemri, 2013; Nor Tutiaini, 2019). The MBG module has good content validity, according to all eight experts who were assigned to validate it. This is demonstrated by the fact that all questions in the questionnaire have an I-CVI greater than 0.80, and the S-CVI achieved is 0.971, both of which exceed the minimal I-CVI (0.83) and S-CVI (0.83) values recommended by Lynn (Lynn, 1986; Polit & Beck, 2005).

Numbers and Operations, Measurement and Geometry, and Algebra Relevance are three areas of studying Mathematics Year 5 based on DSKP. The level agreement of very difficult the topic of Space is 54.2%, followed by the level agreement of medium difficult the topic of Fractions 45.8%. Based on the National Curriculum, these are two topics come from the field of study in Measurements and Geometry.

Furthermore, the results of the study demonstrate that the respondents' views of students' challenges in learning mathematics include challenges with conceptual knowledge, word problem solving and critical thinking skills being at a high level. The findings of this investigation are consistent with those of a previous research from (Arti & Ikhsan, 2020) who stated to teach a course using the approach of critical thinking, the course must be conceptualized as a way of thinking that applies to solving issues generated in particular disciplines, rather than a set of topic domains. Students must understand not just the current terminology and concepts in a discipline, but also the manner of thinking associated with problem-solving in the subject of study (Celuch & Slama, 1999). In the mathematics concept, students' critical thinking abilities and conceptual knowledge have a positive correlation with their learning outcome (Wulandari, 2018). Conceptual knowledge is the act of acting to correctly grasp an abstract design or idea that allows one to categorise things or activities, and it is acquired via the learning process



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(Alatas, 2014). In development studies and education, understanding the process of knowledge change is a significant objective. Modules for HOTS, conceptual knowledge and critical thinking skills were developed.

The findings from the study of respondents' perspectives on the qualities of the module that they plan to take HOTS, conceptual knowledge and critical thinking skills of the themes learned in Mathematics Year 5 will be highlighted by the researcherMBG was developed to assess Year Five students' geometrical measurement skills. In addition to measuring students' measurement skills, this instrument supports students in developing conceptual understanding in geometrical measurement by adding HOTS and critical thinking skills. This is related to previous research indicating that spatial and numerical abilities influence geometrical measurement abilities. (Nasser & Lian, 2021). Furthermore, by integrating spatial and numerical skills, students and teachers can discover which components contribute to geometrical measurement issues, allowing them to improve teaching and learning centred on perimeter, area, and volume. Even if designing an ideal instrument is extremely difficult, there are various factors that must be addressed in order to produce a good instrument.

## CONCLUSION

The findings of a descriptive analysis based on the mean of students' challenges in learning mathematics revealed that mastery of conceptual knowledge and critical thinking skills are all at a high level. Results for the development module's qualities show learners want to keep their conceptual knowledge and critical thinking skills for all the qualities of the proposed module. Hence, as a consequence of this survey study, researcher will take the results of the questionnaire while develop a learning module to increase their conceptual knowledge and critical thinking skills.

The next process in the research process is to validate the research instrument, which involves content validity. The instrument in this context is a questionnaire. Instrument development revealed 47 items, which were a combination of items used in previous research, responses from preliminary studies, and items developed specifically for this study that were adapted and derived from an existing questionnaire, and six domain experts were then asked to rate the items on the basis of their relevance and requirement.

The development of the MBG module will serve as the foundation for a longer-term learning progression aimed at integrating HOTS into the math curriculum. The curriculum was created primarily for use in primary five math T&L to improve HOTS, conceptual knowledge, and critical thinking. The module has been content validated and may be utilised as a resource by math teachers to diversify their instructional strategies for enhancing systematic thinking abilities in children in an active and collaborative learning environment. The module's material has the potential to be incorporated into math instruction textbooks, so benefiting more children. The module was designed to provide pupils with core CT skills for the twenty-first century in a dynamic and collaborative atmosphere.

## SUGGESTION FOR FUTURE RESEARCH

Based on the most crucial factors that have been identified in this study, future research may determine that the instrument is validated for both reliability and many types of validity, such as face, construct, and criterion validity, for enhanced assessment instrument effectiveness.

## CO-AUTHOR CONTRIBUTION

All authors contributed to the article's concept, design, data collecting, interpretation, writing, and critical revision. The final version of the essay has been approved by all authors.

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