

ASSESSING HIGHER ORDER THINKING SKILLS TEACHERS

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ABSTRACT

This phenomenological inquiry explored the experiences of teachers in assessing higher order thinking skills of secondary students in mathematics lessons at Banaybanay District, Division of Davao Oriental. In exploring the experiences of the ten participants, I employed the qualitative primary instrument of data gathering was through in-depth interview. Major findings phenomenological study of which revealed that on the experiences of teachers, the following were the emergent themes namely challenges in designing appropriate assessment tools, strategies for encouraging higher-order thinking, and balancing standardized testing and higher- order thinking assessment. In addition, on their coping mechanisms from the challenges encountered, the following three themes emerged namely adaptation of instructional approaches, collaborative professional development, and effective feedback and communication. Lastly, on the teachers' insights, the following three themes emerged specifically nuances in student progress and understanding, impact on teaching pedagogy and curriculum design, and strategies for continuous improvement. Findings can inform the development of teacher training programs that specifically target the design and implementation of assessments aimed at evaluating higher-order cognitive processes. Professional development initiatives should focus on equipping educators with the skills and strategies necessary to effectively assess critical thinking, problem-solving, and analytical abilities. Additionally, the research may shed light on the need for curricular adjustments, emphasizing the integration of activities that foster higher-order thinking throughout the mathematics curriculum. The research may have implications for the adoption of innovative instructional technologies that facilitate the assessment of HOTS in a more dynamic and engaging manner.

Keywords: Higher order thinking skills, secondary students, mathematics, phenomenology

1. INTRODUCTION

Education plays a critical role in equipping students with the skills necessary to navigate an increasingly complex and interconnected world. Among these essential skills, higher-order thinking skills (HOTS)—which encompass analysis, evaluation, and creation—are widely recognized as fundamental to academic success and workforce readiness (Anderson & Krathwohl, 2020). In mathematics education, fostering HOTS enables students to develop logical reasoning, problem-solving abilities, and decision-making skills that are crucial for addressing real-world challenges (Brookhart, 2021). However, despite its significance, the assessment of HOTS remains a persistent challenge in secondary education, as many traditional testing methods focus on lower-order thinking skills such as recall and comprehension (Zohar & Barzilai, 2021).

Globally, several educational challenges highlight the importance of HOTS in mathematics assessment. First, the rise of artificial intelligence (AI) and automation is reshaping the workforce, requiring individuals to develop strong analytical and problem-solving abilities rather than rely on routine cognitive tasks (World Economic Forum, 2020). Countries such as Finland, Singapore, and Canada have reformed their curricula to emphasize HOTS assessment, leading to improved student outcomes (OECD, 2022). Second, the impact of the COVID-19 pandemic on education has exposed significant gaps in how students' cognitive skills are assessed. The sudden shift to remote learning revealed that many assessment methods failed to capture students' ability to analyze and synthesize information critically, emphasizing the need for innovative assessment strategies even in online or hybrid learning environments (UNESCO, 2021). Third, the declining mathematical proficiency in international assessments, as reflected in the 2022 Programme for International Student Assessment (PISA) results, indicates that students worldwide are struggling with complex mathematical reasoning. Even countries that traditionally performed well, such as the United States and Australia, have shown a decline in students' ability to apply mathematical concepts in real-world scenarios (OECD, 2023). These trends suggest that assessment methods need to be restructured to emphasize critical thinking rather than rote memorization.

At the national level, the Philippine education system faces significant challenges in fostering HOTS among students. Filipino students have consistently ranked among the lowest in international assessments of mathematics proficiency, with results from PISA (2018) and the Trends in International Mathematics and Science Study (TIMSS, 2019) showing poor performance in mathematical reasoning and problem-solving. A major reason for this underperformance is the overreliance on rote memorization instead of conceptual understanding and analytical problem-solving (Bernardo & Mendoza, 2021). Additionally, many mathematics teachers in the country struggle to implement HOTS-based assessments due to a lack of specialized training and professional development programs (DepEd, 2021). Studies indicate that without proper support, educators tend to revert to traditional assessment methods that emphasize factual

recall over deep cognitive engagement (Ganal & Guiab, 2022). Another issue is the misalignment between the K–12 Basic Education Curriculum and actual classroom assessment strategies. While the curriculum aims to enhance Filipino students' critical thinking and problem-solving skills, assessment practices remain largely content-focused, evaluating knowledge retention rather than higher-order reasoning (DepEd, 2023).

Locally, teachers in Banaybanay District, Davao Oriental, face unique challenges in assessing HOTS in secondary mathematics education. Many schools in rural areas lack the necessary instructional materials and technological tools to develop and administer HOTS-based assessments, making it difficult for teachers to design assessments that go beyond multiple-choice questions and simple computational problems (Salvador, 2022). Moreover, public school teachers often manage large class sizes and excessive administrative responsibilities, which limit their ability to develop innovative assessments that promote higher-order thinking (Cruz, 2021). Another challenge is the variability in students' learning readiness, as socio-economic disparities impact their ability to engage with higher-order thinking tasks. In Banaybanay District, some students lack foundational skills in mathematics, making it difficult for teachers to design assessments that accommodate diverse learning levels (Reyes, 2023).

Despite widespread recognition of the importance of HOTS, assessing these skills in secondary mathematics remains a challenge. Teachers struggle to design assessment tools that effectively measure students' ability to analyze, evaluate, and create. This study investigates the lived experiences of mathematics teachers in assessing HOTS, focusing on their challenges, coping mechanisms, and insights for improving assessment practices. Specifically, it aims to identify the challenges faced by teachers in assessing HOTS in secondary mathematics, examine the strategies used to promote and evaluate HOTS, explore teachers' coping mechanisms in overcoming assessment-related difficulties, and determine the implications of HOTS assessment for teaching pedagogy and curriculum design.

This study is significant as it contributes to the ongoing discourse on effective assessment practices in mathematics education. It provides empirical insights that can inform teacher training programs focused on designing and implementing assessments that evaluate higher-order cognitive processes. Professional development initiatives should equip educators with the necessary skills and strategies to assess critical thinking, problem-solving, and analytical abilities effectively. Additionally, this research may highlight the need for curricular adjustments, emphasizing the integration of activities that foster higher-order thinking throughout the mathematics curriculum. Lastly, the study may have implications for the adoption of innovative instructional technologies that facilitate the assessment of HOTS in a more dynamic and engaging manner. By addressing these issues, this research seeks to enhance mathematics education and improve students' ability to think critically and solve complex problems.

2. LITERATURE REVIEW

Assessing higher-order thinking skills (HOTS) in mathematics education is crucial for developing students' critical thinking, problem-solving, and analytical abilities. Various global educational frameworks emphasize the importance of HOTS in mathematics, yet challenges persist in integrating them effectively into curricula and assessments. This literature review examines recent studies (2019–present) from the Association of Southeast Asian Nations (ASEAN), Europe, Africa, and Australia to provide a comprehensive understanding of current practices, challenges, and gaps in assessing HOTS in mathematics.

Higher-Order Thinking Skills in Mathematics Education

Higher-order thinking skills involve cognitive processes that go beyond basic memorization and recall, encompassing analysis, evaluation, and creation (Brookhart, 2020). In mathematics education, HOTS enable students to apply mathematical concepts to novel situations, engage in abstract reasoning, and develop solutions to complex problems (Anderson & Krathwohl, 2020). The integration of HOTS in assessments aims to prepare students for real-world challenges and promotes a deeper understanding of mathematical principles (Zohar & Barzilai, 2021).

In the ASEAN region, several studies have explored the incorporation of HOTS in mathematics assessments. Azid et al. (2020) investigated the effect of integrating HOTS into school-based assessments (SBA) on students' mathematics achievement in Malaysia. Their study found that incorporating HOTS in SBA positively influenced students' performance and encouraged teachers to adopt innovative teaching strategies. Similarly, a study conducted in Indonesia examined the effectiveness of HOTS assessments in enhancing high school students' critical thinking skills in mathematics, finding that such assessments significantly improved students' problem-solving abilities (Sulaiman et al., 2021).

However, challenges persist in the ASEAN region. Hamzah (2019) highlighted difficulties students faced in solving HOTS-oriented mathematical problems in Malaysia's Form-3 assessment. The study emphasized the need for targeted interventions to improve students' problem-solving skills and better prepare them for HOTS assessments. Additionally, research in the Philippines has shown that while the Department of Education has advocated for the inclusion of HOTS

in assessments, implementation remains inconsistent due to a lack of teacher training and insufficient assessment materials (Francisco et al., 2022).

In Europe, there has been a strong emphasis on developing students' HOTS in mathematics through educational reforms. A study by the Royal Society (2024) in the United Kingdom called for a comprehensive revamp of the mathematics curriculum to better equip students with the skills necessary for computing and data analysis. The report highlighted that a significant percentage of UK adults possess numeracy skills equivalent to an 11-year-old, underscoring the need for curriculum enhancements to foster HOTS (Overton, 2024).

Additionally, a study by Reiss and Mujtaba (2022) explored the impact of technology-enhanced assessments on evaluating students' higher-order thinking abilities. The research suggested that incorporating digital tools in assessments can make them more engaging and provide deeper insights into students' cognitive processes. However, challenges such as digital literacy gaps and technological accessibility need to be addressed (Strand & Granlund, 2021). Research on HOTS in mathematics education within the African context is relatively limited. However, existing studies indicate a growing recognition of the importance of HOTS. Mupa and Chinooneka (2019) examined teachers' perceptions of HOTS in mathematics instruction in Zimbabwe, revealing that while teachers acknowledged the importance of HOTS, they faced challenges in implementing appropriate assessment strategies due to limited resources and professional development opportunities.

In Nigeria, Adeyemi (2020) investigated the impact of HOTS-based assessments on secondary school students' performance in mathematics. The results indicated that students exposed to HOTS-oriented assessments demonstrated improved problem-solving skills and a deeper understanding of mathematical concepts. However, the study also pointed out that many Nigerian schools lack the necessary infrastructure to support the widespread implementation of such assessments (Okonkwo, 2021).

In Australia, there has been a concerted effort to incorporate HOTS into mathematics education. Sullivan et al. (2020) explored the effectiveness of challenging mathematical tasks designed to promote HOTS among primary and secondary students. Their findings suggested that such tasks encouraged students to engage in deep thinking and develop a robust understanding of mathematical principles.

Furthermore, a report by the Australian Council for Educational Research (ACER) emphasized the need for professional development programs to equip teachers with the skills necessary to design and implement HOTS-oriented assessments (Thompson et al., 2021). The report highlighted that ongoing support and training are crucial for the successful integration of HOTS in mathematics curricula. However, there remains a gap in addressing how educators can assess HOTS in remote and rural areas with limited technological access (De Silva et al., 2022).

Identified Gaps and Discussion

Despite the global recognition of the importance of higher-order thinking skills (HOTS) in mathematics education, several gaps persist in the current literature that need to be addressed. One key gap is the lack of comprehensive studies examining the long-term impact of HOTS-oriented assessments on students' academic and professional success. While there is substantial evidence supporting the benefits of fostering HOTS in mathematics education, there is limited research on how these assessments translate into real-world outcomes for students. Longitudinal research is necessary to understand how the development of HOTS in mathematics influences students' success in higher education, their careers, and their overall problem-solving abilities in professional environments (Mason, 2020). Such studies would provide valuable insights into the enduring effects of HOTS assessments, allowing educators and policymakers to gauge the true impact of these assessment methods over time and refine their approaches accordingly.

Secondly, while numerous studies have explored the effectiveness of HOTS assessments in improving student outcomes, there remains a significant gap in the literature concerning the challenges teachers face when implementing these assessments, especially in resource-constrained settings. Teachers in underfunded schools or rural areas often struggle to access the tools, training, and support needed to assess HOTS effectively (Chen et al., 2021). The challenges include insufficient time for assessment preparation, lack of appropriate resources, and limited professional development opportunities focused on HOTS assessment methods. Understanding these barriers is critical for developing interventions and support mechanisms that can help teachers overcome these challenges and successfully integrate HOTS assessments into their classrooms. This research could lead to the creation of more equitable educational practices, where teachers in diverse settings receive the support needed to foster higher-order thinking in their students. Lastly, there is a growing need for more culturally responsive research that takes into account the diverse educational contexts across different regions. Current research often focuses on Western educational systems, overlooking the unique cultural, social, and economic factors that influence education in other regions, such as ASEAN countries, Africa, and parts of Europe. Studies that explore how cultural factors shape the implementation and effectiveness of HOTS

assessments can provide valuable insights for educators and policymakers (Ndlovu, 2022). For example, cultural attitudes towards education, teaching styles, and learning approaches may impact how HOTS assessments are perceived and applied in different contexts. Culturally responsive research would help ensure that assessment strategies are tailored to the specific needs and challenges of students in diverse regions, leading to more effective and inclusive educational practices.

The assessment of higher-order thinking skills in mathematics education is critical for preparing students to navigate complex, real-world challenges. Although significant progress has been made globally, particularly in the ASEAN region, Europe, Africa, and Australia, there are still challenges and gaps that need to be addressed. By targeting these gaps through focused research and interventions, educators and policymakers can enhance the effectiveness of HOTS assessments, ultimately contributing to the development of students' critical thinking, problem-solving abilities, and preparedness for future academic and professional success. Addressing these gaps will also ensure that HOTS assessments are equitable, culturally relevant, and accessible to all students, regardless of their background or resources.

3. METHODOLOGY

Research Design

This study adopts a phenomenological research design, which is appropriate for exploring and understanding the lived experiences of teachers in assessing higher-order thinking skills (HOTS) in mathematics lessons. Phenomenology allows for an in-depth understanding of participants' perspectives and how they interpret their experiences within a specific context (Creswell & Poth, 2020). This approach was chosen to uncover the nuanced challenges, coping mechanisms, and insights of teachers, offering rich and descriptive data that can inform future educational practices and policy.

Phenomenology is particularly valuable in this context as it helps to uncover underlying themes and meanings that may not be immediately apparent through other methods, allowing the researcher to delve into the complexities of educational assessment in mathematics (Moustakas, 2021). The qualitative approach, grounded in the phenomenological tradition, is ideal for examining how teachers experience and make sense of assessing HOTS in the classroom, particularly in the diverse educational setting of the Banaybanay District in Davao Oriental.

Participants

The study involved 10 secondary mathematics teachers from Banaybanay District, Division of Davao Oriental. These participants were selected using purposive sampling, a non-probability sampling method that targets individuals who have direct experience with the phenomenon being studied (Palinkas et al., 2021). The selection criteria included: (a) teachers who have at least three years of experience in teaching mathematics, (b) teachers who regularly assess students' higher-order thinking skills in mathematics, and (c) teachers who are willing to participate in an in-depth interview process. This ensures that the data gathered will be rich, focused, and relevant to the research questions.

Data Collection Methods

Data were collected through in-depth, semi-structured interviews. Semi-structured interviews provide flexibility for participants to express their experiences in their own words, while also ensuring that the key topics relevant to the research are addressed (Kallio et al., 2020). The interview protocol was designed to elicit detailed descriptions of participants' experiences with assessing HOTS in mathematics, including challenges, strategies, coping mechanisms, and insights. Interviews were conducted in a face-to-face setting, adhering to ethical standards such as informed consent, confidentiality, and voluntary participation (Flick, 2022).

To ensure validity, the interview questions were pilot-tested with a small group of mathematics teachers from a neighboring district to refine the wording and ensure clarity. The final interview protocol included open-ended questions aimed at gaining an in-depth understanding of the teachers' practices and perceptions regarding HOTS assessment in mathematics.

Data Analysis

The data were analyzed using thematic analysis, a widely used qualitative analysis method that involves identifying, analyzing, and reporting patterns (themes) within the data (Braun & Clarke, 2021). The analysis process involved several stages:

- 1. Familiarization with the Data:** The researcher transcribed the interviews verbatim and read through the transcripts multiple times to become familiar with the data.
- 2. Initial Coding:** Meaningful segments of data were coded using NVivo software, which helps manage and organize qualitative data (QSR International, 2022). Codes were generated based on the content of the responses.
- 3. Theme Development:** The researcher identified recurring patterns or themes from the initial codes and grouped similar codes together to form broader themes related to the research questions.

4. **Reviewing Themes:** The themes were reviewed to ensure they accurately represented the data. This process involved comparing the themes to the original data to ensure consistency and accuracy.
5. **Finalization of Themes:** After refining the themes, the researcher organized the data into major themes and subthemes that best captured the participants' experiences.

This thematic analysis allowed for the emergence of key themes related to the challenges faced by teachers in assessing HOTS, the strategies they employ, and their coping mechanisms. Themes were also organized into categories to address the research objectives effectively.

Ethical Considerations

Ethical considerations were paramount in this study. The researcher adhered to the ethical guidelines set forth by the institution's ethics review board. The key ethical principles followed include informed consent, confidentiality, and participant voluntary participation. Before data collection, all participants were provided with an information sheet explaining the purpose of the study, their rights as participants, and the voluntary nature of their participation. Consent forms were signed by each participant before the interviews took place.

To maintain confidentiality, all personal identifiers were removed from the data, and the information was stored in a secure, password-protected database. The findings of the study will be reported in aggregate form, ensuring that individual identities are not disclosed.

Justification of Chosen Methods

The phenomenological approach was chosen to explore the lived experiences of teachers assessing HOTS because it enables a deep, personal understanding of the phenomenon. Interviews were the most suitable method of data collection, as they allowed for the exploration of teachers' personal reflections and the complexities of their experiences in assessing HOTS in mathematics (Van Manen, 2022). Semi-structured interviews were specifically chosen for their flexibility, allowing participants to provide rich and diverse responses, while still ensuring that key areas of the study were covered. Thematic analysis was selected as the method of data analysis because of its ability to identify recurring themes that align with the research questions (Clarke & Braun, 2021). The method's flexibility and rigor make it suitable for analyzing qualitative data from semi-structured interviews, allowing the researcher to uncover meaningful insights that are directly related to the challenges and strategies associated with HOTS assessment in mathematics.

4. RESULTS

The research revealed key themes that emerged from the teachers' experiences regarding the assessment of higher-order thinking skills (HOTS) in secondary mathematics lessons. Data were organized into major themes and subthemes, providing insights into the challenges faced by teachers, their coping mechanisms, and their reflections on the assessment process. These findings were derived from in-depth interviews with 10 secondary mathematics teachers from Banaybanay District, Davao Oriental.

Theme 1: Challenges in Designing Appropriate Assessment Tools

One of the most significant challenges faced by the teachers was designing appropriate assessment tools that effectively evaluate HOTS. Several participants highlighted that existing assessment tools were often insufficient for measuring higher-order thinking processes, such as critical thinking, problem-solving, and analysis. Teachers reported the lack of comprehensive rubrics or guidelines for assessing HOTS in mathematics, leading to ambiguity in evaluation criteria.

For example, Teacher 1 stated, "Most of the time, we use multiple-choice tests, which cannot capture the depth of students' thinking" (Participant 1, Interview, 2023). Similarly, Teacher 4 mentioned, "There are no clear standards on how to assess critical thinking in mathematical problems" (Participant 4, Interview, 2023). These findings align with studies indicating the gap between assessment tools and the ability to measure higher-order cognitive skills (Lai, 2020; Afacan, 2021).

Theme 2: Strategies for Encouraging Higher-Order Thinking

Teachers reported using various strategies to encourage HOTS among their students. Common strategies included problem-based learning (PBL), inquiry-based learning, and the integration of real-world applications into lessons. PBL was frequently cited as an effective strategy, as it encourages students to engage with complex problems that require critical thinking and analysis.

For instance, Teacher 3 explained, "We implement project-based activities where students must research and apply mathematical concepts to solve real-world problems" (Participant 3, Interview, 2023). Teacher 5 added, "By using inquiry-based methods, students are pushed to ask questions, seek solutions, and justify their reasoning" (Participant 5, Interview, 2023).

These findings support the literature that emphasizes the importance of active learning strategies like PBL and inquiry-based learning in fostering higher-order thinking skills in mathematics (Finkelstein et al., 2020; Dabbagh, 2021). Furthermore, it echoes studies suggesting that incorporating real-life applications into mathematics lessons enhances students' engagement and cognitive development (Soni & Sharma, 2021).

Theme 3: Balancing Standardized Testing and HOTS Assessment

Teachers also discussed the tension between standardized testing, which often focuses on rote memorization and lower-level thinking, and the assessment of HOTS. Many teachers expressed frustration with the pressure to focus on preparing students for standardized exams that do not adequately assess higher-order cognitive skills.

Teacher 7 noted, "Our curriculum emphasizes passing the standardized tests, but these exams are more about recalling formulas rather than solving complex problems" (Participant 7, Interview, 2023). Teacher 9 shared a similar sentiment, "We need to balance preparing students for standardized tests and fostering their higher-order thinking abilities" (Participant 9, Interview, 2023).

These findings are consistent with research indicating that standardized tests often fail to capture the full spectrum of students' cognitive abilities and that balancing both forms of assessment is essential for fostering comprehensive skill development (Guskey, 2019; Sahin, 2022).

Theme 4: Coping Mechanisms – Adaptation of Instructional Approaches

In response to the challenges they faced, teachers developed several coping mechanisms. One common adaptation was modifying instructional approaches to better align with the needs of their students and the demands of assessing HOTS. Teachers reported implementing more student-centered teaching methods, such as flipped classrooms and collaborative learning, to create opportunities for deeper engagement and critical thinking.

Teacher 6 noted, "We have started using flipped classroom models where students engage with the material before class, allowing more time for discussion and problem-solving" (Participant 6, Interview, 2023). Teacher 2 emphasized the importance of peer collaboration: "We use group activities where students explain their thought processes, which helps to develop their critical thinking skills" (Participant 2, Interview, 2023).

These adaptations align with recent findings suggesting that student-centered approaches, such as flipped classrooms and collaborative learning, support the development of higher-order thinking skills (Soh & Choy, 2020; Mohammed & Ali, 2021).

Theme 5: Coping Mechanisms – Collaborative Professional Development

Another coping mechanism reported by teachers was participating in collaborative professional development programs. Teachers expressed that engaging with peers in workshops, seminars, and online communities of practice helped them gain new insights into effective assessment strategies for HOTS.

Teacher 10 shared, "We regularly attend workshops on innovative assessment strategies, which have helped us understand how to design more effective assessments for HOTS" (Participant 10, Interview, 2023). Teacher 8 further emphasized the role of professional development, stating, "Collaborating with colleagues in professional learning communities has been essential in refining our teaching and assessment practices" (Participant 8, Interview, 2023).

These responses reflect findings from the literature that highlight the importance of continuous professional development in enhancing teachers' instructional practices and assessment capabilities (Ponte et al., 2020; Santos, 2021).

Theme 6: Teachers' Insights – Impact on Teaching Pedagogy and Curriculum Design

The teachers also shared their reflections on how their experiences with assessing HOTS impacted their teaching pedagogy and curriculum design. Many teachers indicated that they had begun integrating more problem-solving activities and critical thinking exercises into their curriculum to align with the goal of fostering higher-order thinking skills.

Teacher 4 explained, "I now design my lessons with more emphasis on problem-solving tasks, which require students to analyze and think critically" (Participant 4, Interview, 2023). Teacher 5 added, "The process of assessing HOTS has made me rethink how I approach curriculum design and teaching strategies" (Participant 5, Interview, 2023).

These findings are consistent with studies suggesting that teachers' involvement in higher-order thinking assessments leads to changes in their instructional practices and curriculum design, promoting a more active, student-centered learning environment (Parker et al., 2020; Edwards et al., 2021).

The key findings of this study highlight several critical insights into the challenges and strategies related to assessing higher-order thinking skills (HOTS) in mathematics education. One of the primary challenges identified by teachers is the difficulty in designing assessment tools that effectively measure HOTS. Many teachers struggle to create assessments that go beyond rote memorization and truly assess students' critical thinking, problem-solving, and analytical skills. To

foster HOTS among their students, teachers employ strategies such as problem-based learning and inquiry-based learning, which encourage students to engage deeply with the material and develop their higher-order thinking abilities. However, teachers also face the challenge of balancing the need to assess HOTS with the pressure to focus on standardized testing, which often emphasizes memorization and recall over critical thinking. In response to these challenges, teachers adapt their teaching methods, incorporating more interactive and student-centered approaches, and they engage in professional development programs to improve their assessment practices. These coping mechanisms help teachers navigate the difficulties of HOTS assessment and support their efforts to enhance students' cognitive skills. Finally, the study found that teachers modify their teaching strategies and curriculum design to better incorporate HOTS, recognizing the importance of preparing students for real-world problem-solving and analytical tasks. These findings underscore the need for ongoing professional development and curriculum reforms that prioritize the assessment and development of higher-order thinking skills in students.

These results provide a comprehensive understanding of the teachers' experiences and the challenges they face in assessing higher-order thinking skills in mathematics, offering valuable insights that can inform future teacher training programs and curricular reforms.

5. DISCUSSION

The findings of this study reveal important insights into the challenges and strategies employed by secondary mathematics teachers in assessing higher-order thinking skills (HOTS) among students. The key challenges identified include difficulties in designing appropriate assessment tools, the tension between standardized testing and HOTS assessments, and the pressure to focus on rote memorization. These results align with previous studies, which have highlighted the gap between traditional assessment methods and the need to assess higher-order cognitive skills, especially in complex subjects like mathematics (Lai, 2020; Guskey, 2019). Teachers in the study reported that conventional assessment methods, such as multiple-choice tests, are inadequate for measuring critical thinking, problem-solving, and analysis (Finkelstein et al., 2020; Afacan, 2021). This limitation reflects a broader issue in education systems worldwide, where assessments often focus on memorization rather than critical thinking and application (Santos, 2021).

The strategies for fostering HOTS identified by teachers, such as problem-based learning (PBL) and inquiry-based learning, are consistent with best practices in modern educational theory, which emphasize active, student-centered learning (Parker et al., 2020; Soh & Choy, 2020). These strategies have been shown to engage students more deeply and encourage critical thinking and problem-solving, which are essential skills for success in mathematics and beyond. The emphasis on these strategies suggests a growing awareness among teachers of the need to shift away from traditional rote learning methods in favor of more interactive and thought-provoking approaches (Soni & Sharma, 2021).

Teachers' coping mechanisms, including adapting instructional approaches and engaging in collaborative professional development, were also highlighted as key factors in overcoming challenges related to HOTS assessment. Professional development programs that focus on HOTS assessment and instructional innovation have been shown to enhance teachers' ability to foster critical thinking and apply effective assessment strategies (Dabbagh, 2021; Ponte et al., 2020). The teachers' reflections on how HOTS assessment has influenced their teaching pedagogy and curriculum design further emphasize the need for continuous professional growth and curriculum innovation to keep pace with evolving educational demands.

However, the study also has limitations. The sample size of 10 teachers, though representative of the district in question, is relatively small and may not fully capture the diversity of experiences and practices across different contexts or regions. Additionally, the study focused solely on secondary mathematics teachers in a single district in Davao Oriental, which limits the generalizability of the findings to other geographical locations or subjects. Future research could expand the sample size and include teachers from different regions or countries to provide a more comprehensive understanding of HOTS assessment across diverse educational settings.

6. CONCLUSION

This study contributes valuable insights into the challenges and strategies related to assessing higher-order thinking skills in secondary mathematics education. The findings underscore the need for better assessment tools that align with the complexities of HOTS, as well as the importance of professional development in equipping teachers with the skills necessary to design and implement effective assessments. By examining the teachers' experiences, this study highlights the gap between traditional assessment methods and the evolving needs of modern education systems. It also emphasizes the role of instructional strategies like PBL and inquiry-based learning in fostering HOTS and improving student outcomes.

The study's findings are consistent with existing research, which advocates for a shift toward more dynamic, student-centered teaching and assessment methods that foster critical thinking and problem-solving (Finkelstein et al., 2020; Soh & Choy, 2020). By exploring the experiences of teachers, this research sheds light on the need for curricular reforms that prioritize HOTS and the integration of innovative instructional technologies that facilitate more engaging and dynamic assessments (Dabbagh, 2021; Santos, 2021).

Future research could focus on exploring the long-term impact of HOTS assessments on student outcomes, as well as examining the experiences of teachers in different educational contexts. Additionally, studies that investigate the role of technology in enhancing the assessment of HOTS could offer valuable insights for educators and policymakers seeking to modernize assessment practices.

7. RECOMMENDATIONS

To the Department of Education

To address the gaps in assessing higher-order thinking skills (HOTS) in mathematics education, it is essential to develop and promote professional development programs focused on the design and implementation of assessments aimed at evaluating HOTS. These programs should equip teachers with the necessary tools, resources, and strategies to effectively assess critical thinking, problem-solving, and analytical skills. Professional development initiatives can provide educators with the knowledge to design assessments that challenge students to apply their learning in complex and meaningful ways, moving beyond rote memorization to engage higher-order cognitive processes (Lai, 2020; Dabbagh, 2021). By prioritizing these training programs, schools can enhance teachers' capacity to evaluate HOTS, ensuring that they can foster students' critical thinking and reasoning abilities in the classroom.

In addition to professional development, advocating for curriculum reforms that emphasize HOTS is crucial for aligning assessments with the broader educational goal of developing higher-order cognitive skills in students. Curriculum reforms should integrate activities and assessments that encourage critical thinking, problem-solving, and creativity, ensuring that students are not only prepared for exams but also equipped to tackle real-world challenges. By aligning the curriculum with HOTS-focused assessments, educators can create learning environments that prioritize depth of understanding over memorization. These reforms can help students build skills that are essential for academic success and professional achievement, fostering a generation of learners who are adept at analyzing, synthesizing, and solving complex problems (Guskey, 2019; Finkelstein et al., 2020).

Moreover, the integration of innovative instructional technologies can greatly enhance the assessment of HOTS. By encouraging the use of dynamic and engaging platforms such as interactive simulations, digital tools, and real-time assessment technologies, educators can offer more immersive and effective ways to evaluate students' higher-order thinking. These technologies provide students with the opportunity to engage with content in interactive ways, facilitating instant feedback and offering diverse methods of assessment that can better capture critical thinking skills. Furthermore, instructional technologies can make assessments more engaging, motivating students to take an active role in their learning and encouraging them to demonstrate their problem-solving abilities in real-time (Soni & Sharma, 2021; Parker et al., 2020). The adoption of such tools ensures that HOTS assessments are not only more accessible and relevant to the digital age but also more effective in evaluating the cognitive skills necessary for success in an increasingly complex world.

To School Heads

To promote the effective assessment of higher-order thinking skills (HOTS), it is vital to provide teachers with strong support in adopting student-centered teaching strategies, such as problem-based learning (PBL) and inquiry-based learning (IBL). These strategies have been shown to be highly effective in fostering HOTS, as they encourage students to engage actively with the material, solve real-world problems, and develop their critical thinking and problem-solving abilities. By shifting the focus from traditional teacher-centered instruction to a more student-driven approach, teachers can create an environment where students take ownership of their learning and engage in deeper cognitive processes. Supporting teachers in adopting these methodologies ensures that students have opportunities to develop essential skills such as analysis, evaluation, and creative thinking (Soh & Choy, 2020; Edwards et al., 2021). Providing ongoing training and resources in these teaching strategies can help educators effectively incorporate them into their classrooms, thus enhancing students' higher-order thinking.

In addition to supporting student-centered teaching methods, it is crucial to ensure that teachers have access to continuous professional development opportunities that focus specifically on innovative assessment strategies for HOTS. As education evolves, so too must the methods of assessing students' cognitive abilities. Ongoing professional development ensures that teachers stay up-to-date with the latest advancements in assessment practices, enabling them to design and implement assessments that effectively measure higher-order thinking. These opportunities should be

targeted towards equipping educators with the skills to create assessments that go beyond rote memorization and address the complexities of critical thinking and problem-solving. Teachers can benefit from training in the use of formative and summative assessments that emphasize higher-level cognitive skills, as well as technology-based assessment tools that offer more dynamic ways to evaluate HOTS (Ponte et al., 2020; Mohammed & Ali, 2021). This will ultimately lead to more robust and accurate assessments of students' cognitive development.

Furthermore, fostering a collaborative school culture where teachers can share best practices and insights is essential for the effective assessment of HOTS. Collaboration allows teachers to learn from one another, exchange strategies, and discuss challenges they encounter in assessing HOTS in mathematics and other subjects. By creating a supportive and open environment where educators can collaborate, schools can ensure that teachers are continuously improving their assessment practices. Sharing successful approaches and resources can also provide teachers with practical solutions to common challenges in assessing higher-order thinking. This collaborative culture not only enhances the individual teaching practices of educators but also contributes to a collective improvement in assessment quality across the school or district. A school-wide commitment to collaboration can lead to more consistent and effective implementation of HOTS assessments, benefiting students across various subjects (Parker et al., 2020).

To Teachers

To foster the development of higher-order thinking skills (HOTS) among students, it is essential for educators to embrace innovative teaching strategies such as problem-based learning (PBL) and inquiry-based learning (IBL). These student-centered approaches encourage active engagement, critical thinking, and problem-solving, which are crucial for developing HOTS. PBL and IBL allow students to explore real-world problems, ask questions, and seek solutions collaboratively, all while enhancing their ability to think critically and analytically. By incorporating these strategies into their teaching practices, educators can create environments where students are encouraged to think beyond memorization, engaging in higher-level cognitive processes that are essential for academic and professional success (Finkelstein et al., 2020; Dabbagh, 2021). This shift in teaching methodologies is not only beneficial for students' intellectual growth but also helps them develop the skills necessary to navigate complex challenges in various contexts. In addition to embracing innovative teaching strategies, it is important for teachers to collaborate with colleagues and engage in professional development opportunities. Collaborative teaching allows educators to share best practices, discuss challenges, and exchange ideas on how to refine their assessment strategies and teaching practices. Continuous professional development provides teachers with the tools and knowledge necessary to stay abreast of new approaches to teaching and assessment, particularly in relation to HOTS. Such development can focus on enhancing teachers' abilities to assess critical thinking, problem-solving, and analytical skills effectively, ensuring that their assessments are aligned with the goal of fostering HOTS. By collaborating with colleagues and engaging in ongoing professional development, educators can refine their teaching methods and provide more meaningful learning experiences for students (Santos, 2021; Mohammed & Ali, 2021).

Finally, advocating for curriculum changes that better align with the goal of assessing HOTS is essential. Curricula should be designed in a way that provides students with frequent opportunities to engage in critical thinking, problem-solving, and analysis. These opportunities should be embedded in both the content and the assessments, ensuring that students develop and demonstrate their higher-order thinking abilities throughout their academic journey. Educators and policymakers must work together to advocate for these curriculum reforms, ensuring that assessments are designed to evaluate HOTS and that students are given the tools and opportunities to develop these critical skills. By aligning the curriculum with the goal of fostering HOTS, educational systems can better prepare students to tackle the complexities of the modern world (Lai, 2020; Guskey, 2019). This alignment not only benefits students' academic growth but also equips them with the cognitive tools necessary for lifelong learning and problem-solving.

To Future Researchers

Future research should focus on conducting studies with larger and more diverse samples to explore the experiences of teachers in different regions and across various subjects. By broadening the scope of these studies, researchers can better understand how teachers from diverse backgrounds approach the assessment of higher-order thinking skills (HOTS) and identify the effectiveness of various assessment strategies in different contexts. Larger and more varied samples will provide valuable insights into the challenges and successes of implementing HOTS assessments in different educational settings, enabling the development of more comprehensive recommendations for educators and policymakers (Santos, 2021; Afacan, 2021). Additionally, these studies could help identify any regional or subject-specific barriers and differences in teaching approaches, which could be instrumental in tailoring effective HOTS assessment strategies across diverse classrooms.

Another area of research should examine the role of technology in enhancing the assessment of HOTS. As digital tools and platforms become increasingly integrated into education, it is crucial to explore how these technologies can be utilized to assess critical thinking, problem-solving, and other higher-order cognitive processes in real-time. Digital tools offer the potential to create dynamic, interactive assessments that provide instant feedback, allowing both teachers and students to engage with the learning process more actively. By investigating how technology can be incorporated into HOTS assessments, future research can shed light on best practices for using these tools to assess critical thinking and provide a more accurate representation of students' cognitive abilities. This line of inquiry will be essential as educational systems continue to integrate technology into classrooms, ensuring that digital assessments are both effective and engaging (Soh & Choy, 2020; Finkelstein et al., 2020).

Lastly, future studies should investigate the long-term impact of HOTS assessments on student outcomes, specifically how well these skills are transferred to real-world contexts and future academic pursuits. It is essential to determine whether the development of higher-order thinking skills through assessments has lasting effects on students' ability to navigate complex problems outside the classroom, as well as their success in higher education and professional environments. By conducting longitudinal research, scholars can assess how well students retain and apply HOTS in various contexts, providing valuable insights into the practical significance of HOTS assessments. This research would help highlight the broader implications of HOTS development, demonstrating its relevance not only for academic achievement but also for lifelong learning and career success (Edwards et al., 2021; Lai, 2020). Understanding the long-term effects of HOTS assessments will further inform the design of more effective assessment strategies and educational practices aimed at preparing students for the challenges of the future.

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