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EXPLORING FACTORS AFFECTING STUDENTS' MATHEMATICS ACADEMIC COMPETENCY TEST ACHIEVEMENT: A CASE STUDY AT SMA ISLAM ASSAFIIYAH BEKASI

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Abstract

The Mathematics Academic Competency Test is designed to assess students' mastery of conceptual understanding, mathematical reasoning, problem solving, and higher order thinking skills (HOTS). However, previous studies have mainly focused on assessment development and instructional effectiveness, with limited attention to the factors influencing students' TKA achievement from a qualitative perspective. This study aimed to explore the factors influencing students' Mathematics Academic Competency Test achievement at SMA Islam Assafiiyah Bekasi. A qualitative case study was conducted involving the school principal, vice principal for curriculum affairs, mathematics teachers, and Grade XII students. Data were collected through classroom observations, semi-structured interviews, document analysis, and TKA documentation, and analyzed using the interactive model of Miles, Huberman, and Saldaña. Trustworthiness was established through triangulation, member checking, dependability, and confirmability. The findings revealed that students' TKA achievement was influenced by internal factors, including limited conceptual understanding, low learning motivation, inadequate problem-solving skills, and weak learning independence, as well as external factors, including insufficient HOTS oriented instruction, limited TKA based practice, and suboptimal use of learning resources. These findings highlight the importance of strengthening conceptual learning, HOTS oriented instruction, and authentic assessment to improve students' readiness for competency-based mathematics assessment.

Keywords: academic competency test, mathematics learning, higher-order thinking skills

Abstrak

Tes Kompetensi Akademik (TKA) Matematika dirancang untuk mengukur penguasaan peserta didik terhadap pemahaman konsep, penalaran matematis, kemampuan pemecahan masalah, dan kemampuan berpikir tingkat tinggi. Namun, penelitian terdahulu lebih banyak berfokus pada pengembangan instrumen asesmen dan efektivitas pembelajaran, sedangkan kajian mengenai faktor-faktor yang memengaruhi capaian TKA Matematika melalui pendekatan kualitatif masih terbatas. Penelitian ini bertujuan mengeksplorasi faktor-faktor yang memengaruhi capaian TKA Matematika siswa di SMA Islam Assafiiyah Bekasi. Penelitian menggunakan pendekatan kualitatif dengan desain studi kasus yang melibatkan kepala sekolah, wakil kepala sekolah bidang kurikulum, guru matematika, dan siswa kelas XII. Data dikumpulkan melalui observasi, wawancara semi-terstruktur, analisis dokumen, dan dokumentasi hasil TKA, kemudian dianalisis menggunakan model interaktif Miles, Huberman, dan Saldaña. Keabsahan data dijaga melalui triangulasi, *member checking*, dependabilitas, dan konfirmabilitas. Hasil penelitian menunjukkan bahwa capaian TKA dipengaruhi oleh faktor internal, yaitu rendahnya pemahaman konsep, motivasi belajar, kemampuan pemecahan masalah, dan kemandirian belajar, serta faktor eksternal berupa pembelajaran yang belum berorientasi HOTS, terbatasnya latihan berbasis TKA, dan belum optimalnya pemanfaatan sumber belajar. Temuan ini menegaskan pentingnya penguatan pembelajaran konseptual, pembelajaran berorientasi HOTS, dan asesmen autentik untuk meningkatkan kesiapan siswa menghadapi TKA.

Kata kunci: tes kemampuan akademik, pembelajaran matematika, berpikir tingkat tinggi

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INTRODUCTION

Mathematics is one of the fundamental subjects that plays an essential role in developing students' logical, analytical, critical, creative, and problem solving abilities. In the context of 21st-century education, mathematics learning is expected to facilitate students in constructing conceptual understanding and applying mathematical knowledge to solve authentic real-world problems rather than merely mastering computational procedures. Consequently, mathematics instruction should foster mathematical reasoning, communication, problem-solving, and higher order thinking skills (HOTS), which are recognized as essential competencies for lifelong learning and active participation in an increasingly complex society. The OECD PISA 2022 Mathematics Framework emphasizes that mathematical literacy involves students' ability to formulate, employ, and interpret mathematics in various real world contexts through reasoning, problem solving, and critical thinking (OECD, 2023). Likewise, mathematics education should provide meaningful learning experiences that promote conceptual understanding and mathematical proficiency as the foundation for students' successful mathematical performance (NCTM, 2014). Recent empirical studies have further demonstrated that the implementation of HOTS oriented mathematics instruction significantly improves students' conceptual understanding, reasoning, and problem solving abilities, although its classroom implementation remains inconsistent because of instructional, pedagogical, and assessment challenges (Al Ayyubi et al., 2024; Gradini et al., 2025; Zana et al., 2024).

The Academic Competency Test was developed to assess students' mastery of essential competencies acquired throughout their learning process rather than their ability to memorize subject matter. In mathematics, TKA is designed to evaluate students' conceptual understanding, mathematical reasoning, problem solving skills, and the application of mathematical concepts in various contexts. Consequently, mathematics items in the TKA predominantly measure higher order thinking skills (HOTS), requiring students to analyze information, evaluate alternative solution strategies, and justify their mathematical reasoning. Such an assessment paradigm is consistent with current trends in mathematics education that emphasize competency based assessment as an integral component of improving learning quality and preparing students for complex real world challenges (Kasneci et al., 2023; Purnomo et al., 2022; Zana et al., 2024).

Despite these educational reforms, mathematics achievement among Indonesian students remains a significant concern. Results from national and international assessments indicate that many students continue to experience difficulties in solving contextual mathematical problems that require reasoning, mathematical modelling, and higher order thinking skills. Research has shown that these difficulties are closely related to classroom learning practices that still emphasize procedural fluency rather than conceptual understanding and mathematical reasoning (Zana et al., 2024). In addition, the limited implementation of higher order thinking skills (HOTS) oriented assessment in mathematics classrooms has reduced students' opportunities to develop analytical and problem-solving competencies. Consequently, students tend to perform poorly when confronted with competency based mathematics assessments that require analysis, evaluation, and justification of mathematical solutions (Arriza et al., 2025; Ryandi & Santri, 2024).

Several studies have identified that these difficulties are closely related to classroom learning practices. Mathematics instruction in many schools continues to emphasize teacher centered approaches, routine exercises, and assessments targeting lower order thinking skills (LOTS). Consequently, students have limited opportunities to develop reasoning, mathematical communication, and problem solving abilities. Research has shown that the alignment between curriculum, instructional practices, and assessment is essential for fostering higher order thinking skills (Purnomo et al., 2022; Zana et al., 2024). Likewise, (Ainie et al., 2026) reported that mathematics learning environments emphasizing students' active exploration, collaborative discussion, and reflective learning contribute positively to the development of conceptual understanding and mathematical reasoning, thereby supporting students' readiness to solve higher-order thinking problems.

Previous studies have mainly focused on developing HOTS based assessment instruments, examining the effectiveness of mathematics learning models, and measuring students' mathematical abilities using quantitative approaches (Maarif et al., 2026; Nurhayati et al., 2024). Although these studies have contributed to improving mathematics education, they provide limited insight into the underlying factors influencing students' achievement in the Mathematics Academic Competency Test. In particular, few studies have explored how students' learning experiences, instructional practices, assessment implementation, and school learning environments collectively shape students' readiness and achievement in

competency-based mathematics assessments. Therefore, a qualitative investigation is needed to provide a more comprehensive understanding of these factors from the perspectives of school leaders, teachers, and students.

Therefore, this study aims to explore the internal and external factors influencing students' Mathematics Academic Competency Test achievement at SMA Islam Assafiiyah Bekasi through a qualitative case study. The study focuses on identifying how students' conceptual understanding, learning motivation, problem-solving skills, and learning independence, together with instructional practices, HOTS oriented learning, assessment implementation, and the utilization of learning resources, contribute to students' achievement in the Mathematics TKA. The novelty of this study lies in providing a comprehensive qualitative explanation of Mathematics TKA achievement by integrating classroom observations, semi-structured interviews, and document analysis to capture multiple perspectives from school leaders, teachers, and students.

METHODS

This study employed a qualitative case study design to explore the internal and external factors influencing students' achievement in the Mathematics Academic Competency Test at SMA Islam Assafiiyah Bekasi. A qualitative case study was considered appropriate because it enables an in depth investigation of a contemporary educational phenomenon within its real life context and facilitates a comprehensive understanding of participants' experiences, perceptions, and instructional practices (Yin, 2018).

The research was conducted during the implementation and evaluation of the 2025 Mathematics Academic Competency Test. Participants were selected using purposive sampling to obtain rich and relevant information regarding mathematics learning and the implementation of the Mathematics Academic Competency Test. The participants consisted of the vice principal for curriculum affairs, mathematics teachers, and Grade XII students who had completed the Mathematics Academic Competency Test. The selection criteria included direct involvement in mathematics instruction, curriculum implementation, school academic support, assessment practices, or participation in the Mathematics Academic Competency Test. The vice principal contributed information related to curriculum implementation, school academic support, and Mathematics Academic Competency Test policies, while mathematics

teachers and students provided insights into classroom learning, assessment practices, and experiences related to Mathematics Academic Competency Test preparation and achievement.

Data were collected through classroom observations, semi structured interviews, document analysis, and documentation. Classroom observations were conducted to examine mathematics teaching practices, student engagement, classroom interaction, and the integration of higher order thinking skills (HOTS) in learning activities. Semi structured interviews were carried out with the principal, vice principal, mathematics teachers, and students to explore their perceptions and experiences regarding mathematics learning, assessment practices, and factors influencing students' TKA achievement. Document analysis included lesson plans, assessment instruments, curriculum documents, students' mathematics achievement records, and Mathematics TKA results. Documentation was used to corroborate and complement the evidence obtained from classroom observations, interviews, and document analysis.

Data were analyzed using the interactive model proposed by (Miles et al., 2014), consisting of data condensation, data display, and conclusion drawing and verification. Data condensation involved organizing, coding, and categorizing information according to emerging themes. The categorized data were then organized into narrative descriptions and matrices to facilitate interpretation. The final stage involved drawing conclusions through continuous comparison of data sources and verification to ensure the consistency of the findings.

To ensure the trustworthiness of the study, credibility was established through source and technique triangulation and member checking. Transferability was enhanced by providing a detailed description of the research context and participants, while dependability was maintained through systematic documentation of the research procedures. Confirmability was ensured by maintaining an audit trail throughout the research process (Lincoln & Guba, 1985). Ethical considerations were addressed prior to data collection by obtaining permission from the school and securing informed consent from all participants before their involvement in the study. Participants' confidentiality and anonymity were maintained by removing all personal identifiers from the research data and reporting the findings in an aggregated form.

RESULTS AND DISCUSSION

Students' Mathematics Academic Competency Test Achievement

Describe students' achievement in the Mathematics Academic Competency Test (TKA). The distribution of students' TKA achievement is presented in Table 1.

Table 1. Distribution of Students' Mathematics Academic Competency Test Achievement

Achievement Level	Value Range	Number of Students	Percentage (%)
Kurang	0 - 250	2	6,06%
Memadai	251 - 500	25	75,76%
Baik	501 - 750	6	18,18%
Istimewa	751 - 1000	0	0%
Total	**-**	**33**	**100%**

As shown in Table 1, the majority of students (75.76%) were classified in the adequate achievement category, while only 18.18% attained the good category. A small proportion of students (6.06%) remained in the low achievement category, and none reached the excellent category. These findings indicate that although most students achieved the minimum expected level of mathematical competency, their performance had not yet met the school's target of academic excellence.

Interview data with the Vice Principal for Curriculum Affairs further revealed that the average Mathematics Academic Competency Test (TKA) score of science-stream students was 40.72, slightly exceeding the national average score of 36.10, but still substantially below the school's target score of 70. According to the Vice Principal, students encountered the greatest difficulties when solving contextual problems that required mathematical reasoning rather than routine procedural calculations. This finding was supported by document analysis of the Mathematics TKA reports, which consistently identified algebra, systems of inequalities, mathematical reasoning, and contextual problem-solving as the weakest areas of student performance. Furthermore, classroom observations showed that many students tended to apply memorized procedures without fully understanding the underlying mathematical concepts when faced with unfamiliar or non-routine questions. The convergence of evidence obtained through interviews, document analysis, and classroom observations strengthens the credibility of these findings through methodological triangulation.

The findings suggest that students' mathematical competency remains insufficient to meet the demands of competency-based assessment, despite their average performance being slightly above the national benchmark. The persistent difficulties in conceptual

understanding, mathematical reasoning, and contextual problem-solving indicate that students have not yet fully developed the higher order thinking skills required by the Mathematics TKA. Rather than assessing procedural fluency alone, the TKA emphasizes students' ability to analyse mathematical situations, integrate concepts, evaluate alternative solution strategies, and justify their reasoning. Consequently, students who rely primarily on memorized algorithms are more likely to experience difficulties when confronted with unfamiliar mathematical contexts.

These findings are consistent with the study conducted by (Maarif et al., 2026), which demonstrated that students' achievement in mathematics is strongly associated with conceptual understanding developed through meaningful learning experiences. Likewise, (Nurhayati et al., 2024) reported that adaptive mathematical reasoning and conceptual knowledge significantly contribute to students' success in solving non-routine and competency based mathematical problems. In addition, (Zana et al., 2024) emphasized that students' higher order thinking skills are highly dependent on the alignment between curriculum implementation, instructional practices, and assessment systems. When classroom instruction continues to emphasize procedural exercises rather than reasoning-oriented learning activities, students have limited opportunities to develop the analytical competencies measured in competency-based assessments.

The present findings also support the argument of (Purnomo et al., 2022) that competency-based mathematics assessments are designed to measure numeracy, reasoning, and the application of mathematical concepts in authentic contexts rather than students' ability to recall formulas or execute routine procedures. Similarly, (Arriza et al., 2025) found that high-quality HOTS assessment instruments require students to analyse information, evaluate alternative solutions, and apply mathematical reasoning across various contextual situations. Therefore, the relatively low achievement observed in this study reflects not only students' limited conceptual understanding but also the need for more systematic implementation of HOTS oriented instruction and formative assessment practices throughout the learning process.

Beyond supporting previous studies, the present findings reveal a distinctive pattern within the context of SMA Islam Assafiiyah Bekasi. Although students' Mathematics Academic Competency Test achievement exceeded the national average, it remained considerably

below the school's academic expectations, indicating that the main challenge lies not in achieving minimum competency standards but in developing the higher order mathematical competencies expected by the school. Students' persistent difficulties in solving contextual problems suggest that they were generally able to perform routine procedural calculations but encountered obstacles when required to analyse unfamiliar situations, integrate mathematical concepts, and justify their reasoning. These findings imply that improving students' higher-order thinking skills requires a systematic learning progression in which conceptual understanding, mathematical reasoning, and problem solving competencies are continuously developed through meaningful classroom experiences rather than being addressed only during examination preparation.

Overall, these findings indicate that improving students' Mathematics Academic Competency Test achievement requires a comprehensive instructional approach that systematically strengthens conceptual understanding, mathematical reasoning, and problem solving competence while providing continuous opportunities for students to engage with authentic HOTS oriented assessment tasks. In practice, HOTS oriented mathematics instruction should incorporate structured scaffolding, collaborative problem solving, contextual mathematical investigations, and formative assessment that progressively develops students' reasoning abilities before introducing more complex contextual problems. Such an approach is expected not only to improve students' readiness for competency-based assessments but also to foster meaningful and sustainable mathematical learning.

Internal Factors Influencing Students' Mathematics Academic Competency Test Achievement

The second objective of this study was to identify the internal factors influencing students' Mathematics Academic Competency Test achievement. Thematic analysis of interview data generated five major internal factors, as presented in Table 2.

Table 2. Internal Factors Influencing Students' Mathematics Academic Competency Test Achievement

Internal Factor	Student	Teachers	Vice Principal
Limited conceptual understanding	✓	✓	✓
Low learning motivation	✓	✓	-
Weak mathematical reasoning	✓	✓	✓
Limited problem-solving skills	✓	✓	✓
Low learning independence	✓	✓	-

As presented in Table 2, limited conceptual understanding emerged as the most dominant internal factor influencing students' Mathematics Academic Competency Test (TKA) achievement. Mathematics teachers consistently reported that students with lower TKA scores experienced considerable difficulty in mastering prerequisite mathematical concepts, particularly algebra and systems of inequalities. Students also acknowledged that these topics were among the most challenging sections of the examination because many questions required them to analyse contextual situations rather than apply routine computational procedures. Document analysis of students' TKA reports corroborated these perceptions, revealing that algebraic reasoning and contextual problem solving consistently produced the lowest levels of achievement. Classroom observations further indicated that many students attempted to solve unfamiliar problems by recalling memorized algorithms instead of constructing mathematical meaning from the given information. The convergence of evidence obtained from interviews, observations, and document analysis strengthens the credibility of these findings through methodological triangulation.

These findings demonstrate that conceptual understanding constitutes the foundation of mathematical competency and strongly influences students' readiness for competency based assessment. Students with insufficient conceptual understanding experienced difficulties connecting mathematical ideas, interpreting contextual information, selecting appropriate solution strategies, and justifying their reasoning. Consequently, they struggled to solve Higher Order Thinking Skills (HOTS) problems that required analysis, evaluation, and mathematical reasoning rather than procedural computation. The present findings indicate that students with stronger conceptual understanding are better able to interpret mathematical situations, construct logical arguments, and apply appropriate solution strategies when solving contextual problems. Similar findings have been reported by (Maarif et al., 2026), who demonstrated that meaningful conceptual understanding is a prerequisite for developing mathematical reasoning. Likewise, (Nurhayati et al., 2024) found that students with stronger conceptual knowledge exhibit superior adaptive reasoning and problem-solving abilities in competency based mathematics assessments. (Purnomo et al., 2022) emphasized that competency based mathematics assessments are designed to evaluate students' numeracy, reasoning, and application of mathematical concepts in authentic contexts rather than procedural fluency alone. Furthermore, (Arriza et al., 2025) explained that HOTS

oriented assessment requires students to integrate conceptual understanding with analytical reasoning when solving complex mathematical problems, making conceptual understanding a critical determinant of success in competency-based mathematics assessment.

Another important internal factor identified in this study was learning motivation. Interview data revealed that many students devoted limited time to preparing for the Mathematics TKA and rarely practiced reasoning oriented mathematical problems before the examination. Teachers similarly observed that students achieving higher TKA scores generally demonstrated stronger intrinsic motivation, greater persistence when solving difficult problems, and more consistent independent learning habits. These findings indicate that motivated students are more likely to engage in self-directed learning, seek additional learning resources, complete supplementary mathematical exercises, and maintain confidence when encountering unfamiliar mathematical situations. Such findings are consistent with the principles of self-regulated learning, which emphasize that learning motivation encourages students to actively plan, monitor, and evaluate their own learning processes. The results also align with (Ainie et al., 2026), who reported that mathematics learning environments emphasizing active participation, reflection, and independent exploration contribute positively to students' conceptual understanding and readiness to solve higher order mathematical problems.

The study also identified weak mathematical reasoning and problem solving skills as major internal constraints affecting students' Mathematics TKA achievement. Teachers explained that although classroom instruction had gradually incorporated HOTS oriented learning activities, many students continued to depend on memorized procedures when confronted with unfamiliar or contextual mathematical problems. The Vice Principal further indicated that misconceptions regarding fractions, percentages, algebra, and mathematical representations, together with limited mathematical literacy, prevented many students from interpreting contextual questions accurately. Classroom observations confirmed that students frequently experienced difficulty explaining their reasoning processes, even when they successfully obtained numerical answers.

These findings indicate that students' success in solving competency based mathematics problems depends not only on procedural knowledge but also on their ability to reason mathematically, interpret contextual information, evaluate alternative solution

strategies, and justify their thinking. Students who relied primarily on memorized procedures tended to experience greater difficulty when confronted with nonroutine mathematical tasks requiring higher order thinking. This finding is consistent with (Nurhayati et al., 2024), who reported that adaptive mathematical reasoning significantly contributes to students' ability to solve contextual problems. Similarly, (Purnomo et al., 2022) emphasized that competency based mathematics assessments are designed to evaluate students' numeracy, reasoning, and application of mathematical concepts in authentic contexts rather than procedural fluency alone. Furthermore, (Arriza et al., 2025) explained that HOTS oriented assessment requires students to integrate conceptual understanding with analytical reasoning when solving complex mathematical problems.

Beyond confirming previous studies, the present findings reveal a distinctive pattern within the context of SMA Islam Assafiiyah Bekasi. Rather than functioning independently, the identified internal factors formed an interconnected learning process in which limited conceptual understanding constrained students' mathematical reasoning, subsequently reducing their ability to solve contextual problems and weakening their confidence to engage in independent learning. Similarly, low learning motivation limited students' engagement in reasoning oriented mathematical practice, further affecting the development of problem solving competence. This pattern extends previous findings by demonstrating that Mathematics Academic Competency Test achievement is influenced not by a single internal factor but by the interaction among conceptual understanding, mathematical reasoning, problem solving skills, learning motivation, and learning independence. This interpretation is consistent with the arguments of (Zana et al., 2024), who emphasized that higher order thinking skills develop through the alignment of curriculum, instruction, and assessment, and (Gradini et al., 2025), who highlighted the importance of authentic HOTS oriented learning experiences in developing students' analytical reasoning and problem-solving competencies. Therefore, improving students' Mathematics Academic Competency Test achievement requires comprehensive instructional strategies that simultaneously strengthen these interconnected competencies through sustained HOTS oriented instruction, meaningful mathematical learning experiences, and formative assessment practices. Such an integrated approach is expected to better prepare students for competency based mathematics assessments while fostering meaningful and sustainable mathematical learning.

External Factors Influencing Students' Mathematics Academic Competency Test Achievement

The third objective of this study was to explore the external factors influencing students' Mathematics Academic Competency Test achievement. Data obtained from classroom observations, interviews, and document analysis identified five major external factors, as summarized in Table 3.

Table 3. External Factors Influencing Students' Mathematics Academic Competency Test Achievement

Internal Factor	Student	Teachers	Vice Principal
HOTS-oriented mathematics instruction	✓	✓	✓
Mathematics TKA-oriented assessment	✓	✓	-
School academic support	✓	✓	✓
Learning resources	✓	✓	✓
Parental involvement	-	✓	-

Table 3 shows that the most influential external factors affecting students' Mathematics Academic Competency Test (TKA) achievement were the implementation of HOTS oriented instruction, assessment practices, school academic support, learning resources, and parental involvement. Data obtained through classroom observations, interviews, and document analysis consistently indicated that these factors collectively shaped students' readiness to participate in competency based mathematics assessment. The consistency of evidence across multiple data sources strengthens the trustworthiness of the findings through methodological triangulation.

Mathematics teachers explained that classroom instruction had gradually adopted Problem Based Learning (PBL) to foster students' mathematical reasoning and problem solving skills. Nevertheless, its implementation remained suboptimal because a considerable proportion of instructional time was still devoted to strengthening students' prerequisite mathematical concepts before engaging them in higher order thinking activities. Classroom observations further revealed that although contextual and reasoning oriented learning activities had been incorporated into mathematics lessons, many students remained unfamiliar with the characteristics of Mathematics TKA questions, particularly multiple response items and contextual HOTS problems requiring analytical reasoning and justification. These findings suggest that the adoption of innovative instructional models alone is insufficient to improve students' competency based assessment performance if

learners have not yet acquired adequate conceptual understanding and reasoning skills. This finding is consistent with (Gradini et al., 2025), who argued that HOTS oriented mathematics instruction enhances students' analytical thinking only when implemented systematically through authentic mathematical activities supported by appropriate instructional guidance. Likewise, (Zana et al., 2024) emphasized that the successful development of higher order thinking skills depends on the alignment of curriculum, classroom instruction, and assessment practices, while (Ainie et al., 2026) reported that active exploration, collaborative discussion, and reflective learning significantly strengthen students' conceptual understanding and readiness to solve higher order mathematical problems. Therefore, HOTS oriented mathematics instruction should be implemented progressively by integrating conceptual understanding, mathematical reasoning, and contextual problem solving throughout the learning process rather than focusing solely on instructional innovation.

Another important external factor identified in this study concerns assessment practices. Interviews with students revealed that opportunities to practice Mathematics TKA type questions before the examination were relatively limited. Mathematics teachers confirmed that structured TKA oriented exercises, enrichment programs, and periodic try outs had only recently been introduced following the implementation of the Mathematics Academic Competency Test. Document analysis also demonstrated that the school had intensified formative assessment activities, mathematics enrichment classes, and diagnostic evaluations to better prepare students for competency based assessment. These findings indicate that assessment should function not merely as a tool for measuring learning outcomes but also as an integral component of the learning process. Continuous formative assessment enables teachers to identify students' misconceptions, provide timely feedback, monitor learning progress, and gradually develop students' readiness for competency based mathematics assessment. This finding supports (Purnomo et al., 2022), who emphasized that competency based mathematics assessments require continuous exposure to numeracy and reasoning tasks rather than isolated examination practice. Likewise, (Arriza et al., 2025) argued that regular engagement with HOTS oriented assessment improves students' mathematical reasoning, problem solving ability, and confidence in solving contextual mathematical problems. Therefore, competency based assessment should be integrated into

daily mathematics instruction so that students continuously develop higher order thinking skills instead of preparing only shortly before the examination.

The findings also highlight the significant contribution of school academic support to students' Mathematics Academic Competency Test achievement. Interviews with the Vice Principal revealed that the school had implemented several academic support initiatives, including mathematics enrichment classes, collaboration with external tutoring institutions, regular try outs, teacher coordination meetings, and continuous monitoring of students' academic progress. These initiatives demonstrate the school's commitment to strengthening students' preparedness for the Mathematics TKA beyond regular classroom instruction. The findings suggest that systematic school support provides additional learning opportunities that reinforce conceptual understanding, mathematical reasoning, and examination readiness. This interpretation is consistent with (Zana et al., 2024), who emphasized that competency based mathematics learning requires collaboration among multiple educational stakeholders. Therefore, sustained academic support from schools should be integrated with classroom instruction and assessment practices to create a coherent learning environment that promotes students' mathematical competency development.

Parental involvement also emerged as an important external factor influencing students' Mathematics Academic Competency Test achievement. Teachers reported considerable variation in the extent to which parents supervised learning activities, encouraged independent study, and monitored students' academic progress. Students receiving consistent parental support generally demonstrated stronger learning motivation, more disciplined study habits, and greater persistence in solving challenging mathematical problems. These findings suggest that parental involvement contributes indirectly to mathematics achievement by fostering a supportive home learning environment that reinforces students' motivation and independent learning. This interpretation aligns with (Zana et al., 2024), who emphasized that students' competency development requires active collaboration among schools, families, and other educational stakeholders. Consequently, strengthening communication and partnerships between schools and parents may further enhance students' readiness for competency-based mathematics assessment.

While the present findings support previous studies, they also reveal a distinctive pattern within the context of SMA Islam Assafiiyah Bekasi. The findings indicate that

improving students' Mathematics Academic Competency Test achievement requires not only HOTS oriented instruction and competency based assessment but also the alignment of school academic support with students' conceptual understanding, learning motivation, mathematical reasoning, problem solving skills, and learning independence. This integrated perspective contributes to the existing literature by demonstrating that mathematics competency develops through the interaction between internal competencies and external educational support rather than through isolated educational interventions. Therefore, improving students' Mathematics Academic Competency Test achievement should be viewed as a shared responsibility among teachers, school leaders, students, parents, and other educational stakeholders.

Based on the thematic analysis, the findings indicate that students' Mathematics Academic Competency Test achievement is shaped by the interaction between internal and external factors. To synthesize these relationships, Figure 1 presents the conceptual framework developed from the qualitative findings of this study.

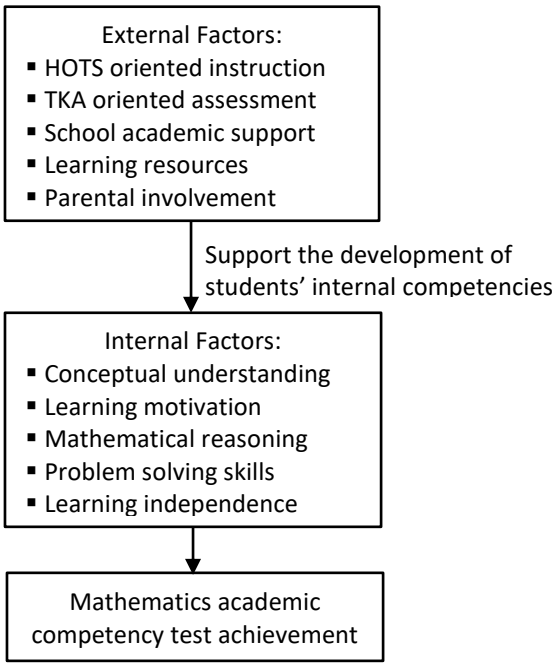

Figure 1. Conceptual Framework of Factors Affecting Mathematics TKA Achievement

Figure 1 illustrates that students' Mathematics Academic Competency Test achievement emerges from the interaction between internal and external factors identified in this study. External factors, including HOTS oriented instruction, competency based assessment practices, school academic support, learning resources, and parental

involvement, create learning conditions that facilitate the development of students' internal competencies, namely conceptual understanding, learning motivation, mathematical reasoning, problem solving skills, and learning independence. These interconnected internal competencies subsequently determine students' readiness to analyse, reason, and solve contextual mathematical problems assessed in the Mathematics Academic Competency Test. The framework represents a conceptual synthesis of the qualitative findings rather than a causal model and serves to explain how the identified factors collectively contribute to students' mathematics competency achievement.

From a theoretical perspective, the conceptual framework suggests that HOTS oriented mathematics instruction functions as an external pedagogical catalyst that stimulates the development of students' internal competencies. This interpretation is consistent with the argument that the successful development of higher order thinking skills depends on the alignment between curriculum, instruction, and assessment (Zana et al., 2024), while authentic HOTS-oriented learning experiences provide opportunities for students to develop analytical reasoning and problem solving competencies (Gradini et al., 2025). Rather than operating independently, conceptual understanding, learning motivation, mathematical reasoning, problem solving skills, and learning independence interact dynamically throughout the learning process. Conceptual understanding provides the cognitive foundation for reasoning (NCTM, 2014), while learning motivation encourages sustained engagement in self-regulated learning and meaningful mathematical practice (Ainie et al., 2026). Through this reciprocal interaction, students become better prepared to analyse, reason, and solve contextual mathematical problems assessed in the Mathematics Academic Competency Test. Accordingly, the present study proposes that mathematics competency develops through the continuous interaction between instructional conditions and students' cognitive and affective characteristics rather than through isolated instructional interventions.

The conceptual framework has important implications for HOTS oriented mathematics instruction. Rather than introducing higher order thinking tasks immediately, teachers should first ensure that students possess adequate conceptual understanding and mathematical reasoning before engaging them in complex contextual problems. Structured scaffolding, formative assessment, collaborative problem solving, and authentic mathematical investigations should be integrated throughout the learning process to progressively

strengthen students' higher order thinking skills. Such an instructional approach is expected to improve students' readiness for competency based mathematics assessment while fostering meaningful, transferable, and sustainable mathematical learning.

Beyond its theoretical contribution, the present study also provides practical insights into the implementation of HOTS oriented mathematics instruction in an authentic school setting. Although SMA Islam Assafiiyah Bekasi had implemented various academic support initiatives and gradually adopted HOTS oriented instructional practices, students continued to experience difficulties in applying mathematical concepts to unfamiliar contextual problems. These findings suggest that the primary challenge lies not merely in introducing HOTS-oriented learning activities, but in ensuring that students possess sufficient conceptual readiness, receive regular exposure to contextual mathematical tasks, and have continuous opportunities to develop reasoning through formative assessment. This interpretation extends the findings of (Gradini et al., 2025), who highlighted practical challenges in implementing HOTS oriented mathematics instruction, and (Zana et al., 2024), who emphasized that successful HOTS implementation requires coherence between curriculum, instruction, and assessment rather than isolated classroom innovations. Furthermore, teachers reported that considerable instructional time was still devoted to strengthening prerequisite mathematical concepts before students were able to engage effectively in higher order thinking activities. Consequently, improving Mathematics Academic Competency Test achievement requires continuous alignment among instructional strategies, competency based assessment, students' conceptual readiness, and parental support. Unlike previous studies that have examined these factors separately, the present study highlights their dynamic interaction within an authentic school setting, thereby providing a more comprehensive understanding of mathematics competency development in competency-based assessment.

CONCLUSION

This study explored the internal and external factors influencing students' Mathematics Academic Competency Test (TKA) achievement through a qualitative case study conducted at SMA Islam Assafiiyah Bekasi. The findings indicate that students' TKA achievement is shaped by the interaction between internal competencies and external educational support rather

than by a single factor. Limited conceptual understanding, low learning motivation, weak mathematical reasoning, limited problemsolving skills, and insufficient learning independence emerged as the major internal factors, while HOTS oriented instruction, competency based assessment, school academic support, learning resources, and parental involvement constituted the principal external factors influencing students' readiness to solve contextual and reasoning-oriented mathematical problems.

This study contributes to the existing literature by providing a qualitative perspective on how mathematics competency develops through the interaction between students' internal characteristics and the educational environment. The findings suggest that improving Mathematics Academic Competency Test achievement requires not only HOTS oriented instruction but also the alignment of conceptual learning, formative assessment, school academic support, and parental involvement. Therefore, mathematics teachers and schools should implement integrated instructional strategies that systematically strengthen students' conceptual understanding, mathematical reasoning, and problem-solving competencies through meaningful learning experiences.

This study was conducted in a single senior high school using a qualitative case study design; therefore, the findings cannot be generalized to all educational contexts. Future research is recommended to involve a broader range of schools, employ mixed methods or longitudinal designs, and further examine the relationships among instructional practices, students' mathematical competencies, and achievement in competency based mathematics assessments to provide stronger empirical evidence for improving mathematics instruction and assessment.

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