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Research Article

TEACHERS' PERCEPTION, COMPETENCE, AND SCHOOL SUPPORT IN GASING MATHEMATICS IMPLEMENTATION IN KAIMANA: A MIXED-METHODS STUDY

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Abstract
This study aims to examine the key factors influencing the implementation of GASING mathematics, particularly teachers' perception, attitude, competence, and school support, in a rural educational context. The study addresses the limited integration of these variables within a single analytical framework, especially in remote areas such as Kaimana. A mixed-methods approach was employed involving 14 teachers who have experience in implementing the GASING method. Quantitative data were collected using structured questionnaires and analyzed using descriptive statistics and Spearman correlation, while qualitative data were obtained through open-ended responses and analyzed using thematic analysis. The results indicate that all variables are categorized as high to very high, reflecting positive responses toward the GASING method. Correlation analysis shows that teacher competence has the strongest relationship with implementation ($r = 0.62$), followed by school support ($r = 0.52$), perception ($r = 0.43$), and attitude ($r = 0.35$). These findings highlight the central role of teacher competence in ensuring effective implementation. Qualitative findings further reveal that despite positive perceptions and attitudes, teachers still encounter challenges related to limited practical skills and inconsistent institutional support. This study offers a novel contribution by integrating multiple teacher-related and institutional factors within a mixed-methods framework in a remote context. The findings imply that strengthening teacher competence through continuous professional development, supported by consistent school policies and resources, is essential for optimizing the implementation of innovative mathematics learning approaches such as GASING.

Keywords: GASING Method, Mathematics Learning, Mixed-Methods, School Support, Teacher Factors

INTRODUCTION

The quality of mathematics education remains a critical issue, particularly in improving students' conceptual understanding and engagement in learning. Mathematics is often perceived as abstract and difficult, which can reduce students' motivation and negatively affect learning outcomes. Prior studies indicate that these difficulties are largely associated with the dominance of traditional teaching approaches that emphasize procedural skills rather than conceptual understanding (Berry et al., 2016). In contrast, student-centered and activity-based learning approaches have been shown to enhance conceptual understanding and higher-order thinking skills (Daouk et al., 2016). This condition highlights the need for more effective instructional strategies that can make mathematics learning more meaningful and accessible.

One promising approach is the Gampang, Asyik, dan Menyenangkan (GASING) method, which emphasizes simplicity, enjoyment, and active student participation. By transforming abstract mathematical concepts into concrete and engaging learning experiences, GASING has the potential to improve students' motivation and learning outcomes (Papageorgiou et al., 2025). However, the effectiveness of such innovative approaches is not solely determined by the method itself. It is also influenced by key factors related to teachers and institutions, including teachers' perceptions, attitudes, competence, and the level of school support (Bosnjak et al., 2020; Roberts, 2023; Koh et al., 2023).

The urgency of this study becomes more apparent in rural and remote educational contexts, where limitations in infrastructure, access to professional development, and availability of learning resources often hinder the successful implementation of instructional innovation. Contextual factors such as school environment and resource availability play a significant role in shaping the effectiveness of teaching practices (Asad et al., 2025; Ehlert et al., 2025). In regions such as Kaimana, these challenges require adaptive and context-sensitive approaches to ensure that innovative methods like GASING can be effectively implemented.

Although previous research has examined innovative mathematics instruction, most studies tend to focus on single variables or isolated aspects, such as teaching methods or student outcomes. There is still limited empirical evidence that integrates multiple determinants, namely teachers' perception, attitude, competence, and school support, within a unified analytical framework, particularly in rural settings. This gap limits a comprehensive understanding of how these factors interact in influencing the implementation of instructional innovation. Therefore, this study offers a more holistic perspective by combining these variables using a mixed-methods approach, enabling both statistical analysis and in-depth exploration of teachers' experiences (Creswell & Creswell, 2023; Costa, 2024).

Based on this gap, this study aims to analyze the key determinants influencing the implementation of GASING mathematics in a rural educational context. Accordingly, this study addresses the following questions: To what extent are teachers' perception, attitude, competence, and school support reflected in the implementation of GASING mathematics? How strong are the relationships among these variables, and which factor exerts the most dominant influence on implementation? What challenges do teachers encounter in applying the GASING method, and how do competence and school support shape their classroom practices? The findings of this study are expected to contribute to a more integrated understanding of instructional innovation and provide practical insights for improving mathematics teaching, particularly in under-resourced educational contexts.

RESEARCH METHOD

This study employed a mixed-methods approach by integrating quantitative and qualitative techniques to obtain a comprehensive understanding of the implementation of GASING mathematics. Mixed-methods research enables the combination of numerical data with in-depth contextual insights, thereby providing a more holistic perspective on complex educational phenomena. The quantitative component aimed to examine teachers' perception, attitude, competence, and school support, as well as their relationships with the implementation of GASING (Mertens, 2023; Creswell & Plano Clark, 2017). Meanwhile, the qualitative component explored teachers' experiences, challenges, and perspectives in greater depth, which is essential for understanding educational practices in real contexts (Miles et al., 2019; Puspitasari, 2025).

The study was conducted from October to December 2025 in Kaimana, a rural and remote region characterized by limited educational resources and challenges in implementing innovative teaching

methods. The participants consisted of 14 mathematics teachers who had experience in applying the GASING method in their classrooms. The participants were selected using purposive sampling, which is commonly applied in qualitative and mixed-methods research to ensure that participants possess relevant experience aligned with the research objectives (Ahmad & Wilkins, 2025; Mason, 2018). Although the sample size is relatively small (n = 14), it is considered appropriate for this study due to the nature of mixed-methods research, which emphasizes depth of analysis and contextual understanding rather than broad statistical generalization. Small sample studies remain meaningful when supported by appropriate analytical techniques and triangulation (Flick, 2018; Kawar et al., 2024).

Each variable in this study was conceptually defined to ensure clarity of measurement. Teachers' perception refers to teachers' understanding and beliefs regarding the GASING method. Attitude toward implementation reflects teachers' readiness and confidence in applying the method. School support includes institutional factors such as facilities, leadership, and collaboration among teachers. Teacher competence refers to teachers' ability to design, implement, and evaluate GASING-based instruction. GASING implementation represents the extent to which the method is applied in classroom practice. The measurement indicators for each variable are summarized in Table 1.

Table 1. Research Instrument and Measurement Items

Variable	Code	Item Description
Teachers' Perception of GASING	P1	I understand the concept of Gampang, Asyik, dan Menyenangkan in the GASING method.
	P2	I believe that the GASING method is effective in improving students' conceptual understanding of mathematics.
Attitude toward Implementation	S1	I am confident in using the GASING method in classroom instruction.
	S2	I am ready to implement the GASING method in mathematics learning.
School Support	D1	The school provides facilities and learning media that support the implementation of the GASING method.
	D2	The school principal provides guidance in implementing the GASING method.
	D3	Fellow teachers support the implementation of the GASING method.
Teacher Competence	K1	I understand basic numeracy concepts relevant to the implementation of the GASING method.
	K2	I am able to develop GASING-based learning media to improve students' interest.
	K3	I am able to create an enjoyable numeracy learning environment through the GASING method.
	K4	I collaborate with fellow teachers in implementing the GASING method.
GASING Implementation	I1	I design GASING-based learning according to students' needs.
	I2	The GASING method encourages students to think critically and creatively.
	I3	I apply the steps of the GASING method in classroom learning.
	I4	I use GASING-based evaluation to assess students' understanding.

As presented in Table 1, each variable is represented by several indicators that capture its essential dimensions. Teachers' perception and attitude are measured through indicators related to understanding and readiness, while school support reflects institutional conditions such as facilities and collaboration. Teacher competence is measured through indicators related to instructional ability, and GASING implementation reflects the practical application of the method in classroom activities. This structured instrument design ensures that each construct is measured comprehensively and consistently.

The instrument used in this study was a structured questionnaire consisting of 15 items representing the five variables. The instrument was developed and adapted from relevant theoretical

frameworks and previous studies to ensure content validity (DeVellis & Thorpe, 2023; Taherdoost, 2016). All items were measured using a four-point Likert scale ranging from strongly disagree to strongly agree. The exclusion of a neutral option encourages respondents to provide a clear position on each statement, which is particularly useful in studies with a limited number of participants (Brown & Shulruf, 2023; Kankaraš & Capecchi, 2025).

In addition to the questionnaire, qualitative data were collected through semi-structured interviews, allowing participants to express their experiences freely while enabling the researcher to explore issues in greater depth (DeMarrais et al., 2024; Quintela Do Carmo et al., 2024). Supporting data were also obtained through documentation to strengthen the contextual understanding of the study. The research procedure consisted of several stages, including preparation, data collection, data processing, and data analysis. During the preparation stage, research instruments were developed and refined based on theoretical frameworks and prior studies. In the data collection stage, questionnaires were distributed to all participants, followed by semi-structured interviews. The collected data were then organized, coded, and prepared for further analysis. A systematic procedure is essential to ensure the rigor and credibility of research findings (Bingham, 2023).

Prior to data analysis, the instrument was tested for validity and reliability. Item validity was evaluated using corrected item-total correlation, where all items exceeded the acceptable threshold, indicating that they were valid. Reliability was assessed using Cronbach's alpha coefficient, with all variables achieving values above 0.70, which indicates satisfactory internal consistency (Hair et al., 2019; Hussey et al., 2025). These results confirm that the instrument is reliable and appropriate for measuring the constructs in this study.

Quantitative data were analyzed using descriptive statistics, including mean and standard deviation, to describe the overall trends of each research variable. Furthermore, Spearman rank correlation analysis was employed to examine the relationships among variables. This method was selected due to the ordinal nature of the data and the relatively small sample size, making it more appropriate than parametric techniques (Cheng et al., 2020; MacFarland & Yates, 2016). All statistical analyses were conducted using RStudio software, which provides reliable and flexible tools for statistical computation.

Qualitative data were analyzed using thematic analysis, involving data transcription, coding, theme identification, and interpretation. This approach enables researchers to systematically identify patterns and derive meaningful interpretations from qualitative data (Braun & Clarke, 2022; Nowell et al., 2017). The integration of quantitative and qualitative findings enhances the credibility of the results through triangulation, which is a key strength of mixed-methods research (Flick, 2018; Kawar et al., 2024).

RESULTS AND DISCUSSION

Descriptive Statistics of Research Variables

Descriptive statistical analysis was conducted to examine the overall patterns of teachers' responses across the five research variables, namely teachers' perception, attitude toward implementation, school support, teacher competence, and GASING implementation. The analysis employed measures of central tendency (mean) and dispersion (standard deviation), in line with the quantitative procedures outlined in the research method. The summary of the results is presented in Table 2, which addresses the research objective of identifying the general condition of each variable in relation to the implementation of GASING mathematics.

Table 2. Descriptive Statistics of Research Variables

Variable	Mean	Std. Deviation	Category
Teachers' Perception	3.71	0.43	Very High
Attitude toward Implementation	3.68	0.46	Very High
School Support	3.05	0.43	High
Teacher Competence	3.36	0.42	Very High
GASING Implementation	3.39	0.40	Very High

As shown in Table 2, all variables are classified within the high to very high category, indicating that teachers generally demonstrate positive responses toward the GASING method. Teachers' perception

obtained the highest mean score (M = 3.71; SD = 0.43), followed closely by attitude toward implementation (M = 3.68; SD = 0.46). Teacher competence (M = 3.36; SD = 0.42) and GASING implementation (M = 3.39; SD = 0.40) are also categorized as very high, suggesting that teachers possess adequate capabilities and have applied the method effectively in classroom practices. In contrast, school support recorded the lowest mean score (M = 3.05; SD = 0.43), although it remains within the high category. To provide a clearer comparison across variables, the mean scores are further visualized in Figure 1.

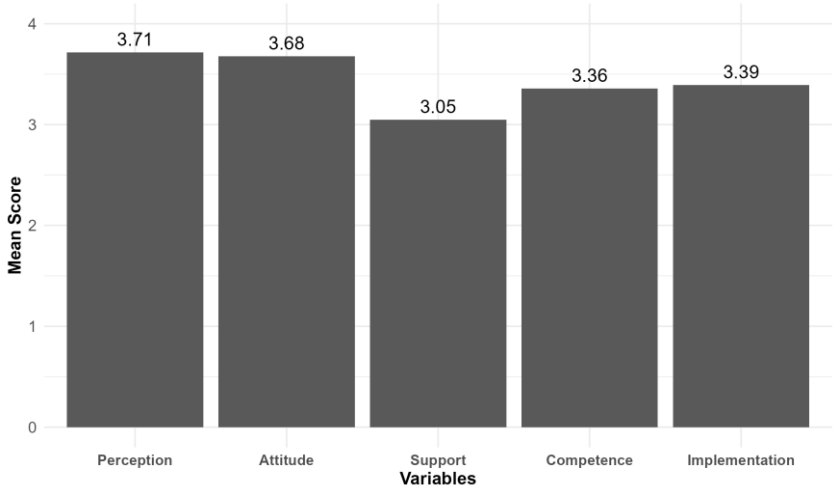

Figure 1. Mean Score of Each Research Variable

As illustrated in Figure 1, teachers' perception and attitude toward implementation consistently show higher values compared to other variables, reflecting strong internal readiness among teachers. Teacher competence and GASING implementation also demonstrate relatively stable and high scores, indicating that teachers are able to translate their understanding into instructional practice. However, school support appears comparatively lower, suggesting that institutional factors such as leadership, facilities, and collaboration may not be as strong as individual teacher-related factors.

These findings suggest that teachers' positive perceptions and attitudes toward the GASING method play an important role in supporting its implementation. This result is consistent with the theory of planned behavior, which highlights that individual beliefs influence behavioral intentions and practices (Jia et al., 2025). In addition, the high level of teacher competence indicates that teachers are capable of translating instructional concepts into effective classroom practices, supporting previous findings that emphasize the importance of teacher competence in determining instructional quality (Leijen et al., 2024; Mukti & Noviafitri, 2024).

However, the relatively lower level of school support indicates that external factors such as institutional leadership, facilities, and collaboration may not yet be fully optimized. This finding aligns with prior studies that highlight the critical role of school support in sustaining educational innovation (Basister et al., 2025; Prenger et al., 2022). The gap between strong individual readiness and relatively lower institutional support suggests that improving school-level conditions is necessary to enhance the effectiveness of GASING implementation.

Overall, these results indicate that while teachers demonstrate strong internal readiness through positive perceptions, attitudes, and competence, strengthening institutional support remains essential to ensure the sustainability and effectiveness of innovative mathematics teaching practices. These findings also provide an important foundation for further analysis of the relationships among variables.

Validity and Reliability Analysis

Validity and reliability analyses were conducted to ensure that the research instrument accurately measured the intended constructs and produced consistent results across items. From a measurement perspective, construct validity reflects the extent to which the items represent theoretical concepts, while reliability indicates the internal consistency of the instrument. In this study, construct validity was assessed using corrected item–total correlation, while reliability was evaluated using Cronbach's alpha

coefficient. These procedures are consistent with classical test theory and widely used approaches in educational research to ensure measurement quality (DeVellis & Thorpe, 2023; Basister et al., 2025).

Establishing validity and reliability is particularly important in studies involving latent constructs such as teachers' perception, attitude, competence, and school support, as these variables cannot be measured directly. Prior research has emphasized that well-validated instruments contribute to more accurate and credible findings in educational studies (Furr, 2018; Hasyim et al., 2026). Therefore, this step serves as a prerequisite before proceeding to further statistical analysis. The results of the validity and reliability analysis are summarized in Table 3.

Table 3. Validity and Reliability Results of Research Instruments

Variable	Item	Corrected Item-Total Correlation	Status	Cronbach's Alpha
Teachers' Perception	P1	0.65	Valid	0.79
	P2	0.65	Valid	
Attitude toward Implementation	S1	0.85	Valid	0.92
	S2	0.85	Valid	
School Support	D1	0.59	Valid	0.74
	D2	0.56	Valid	
	D3	0.58	Valid	
Teacher Competence	K1	0.81	Valid	0.84
	K2	0.82	Valid	
	K3	0.47	Valid	
	K4	0.71	Valid	
GASING Implementation	I1	0.53	Valid	0.83
	I2	0.68	Valid	
	I3	0.84	Valid	
	I4	0.61	Valid	

As presented in Table 3, all measurement items meet the acceptable validity criteria, as the corrected item–total correlation values exceed the minimum threshold of 0.30. The coefficients range from 0.47 to 0.85, indicating moderate to strong associations between each item and its corresponding construct. This suggests that all indicators are conceptually aligned and adequately represent the variables being measured.

In terms of reliability, all variables demonstrate satisfactory levels of internal consistency, with Cronbach's alpha values exceeding the commonly accepted threshold of 0.70 (Taber, 2018). Among the constructs, attitude toward implementation shows the highest reliability ($\alpha = 0.92$), indicating very strong internal consistency among its items. This is followed by teacher competence ($\alpha = 0.84$), GASING implementation ($\alpha = 0.83$), teachers' perception ($\alpha = 0.79$), and school support ($\alpha = 0.74$). These results confirm that the instrument consistently measures each construct and minimizes measurement error.

The relatively high reliability observed across variables is consistent with previous studies, which suggest that instruments measuring educational perceptions, attitudes, and competencies tend to demonstrate strong internal consistency when developed and validated systematically (DeVellis & Thorpe, 2023; Field, 2024). In addition, the balanced range of validity coefficients indicates that each item contributes meaningfully to the overall construct without redundancy or misalignment.

From an analytical perspective, these findings confirm that the instrument possesses adequate psychometric properties, making it suitable for further statistical analysis. The established validity ensures that the constructs are accurately represented, while the confirmed reliability supports the consistency of the measurement. Consequently, the dataset can be confidently used to examine the relationships among variables, particularly through correlation analysis, which is presented in the subsequent section.

Correlation Analysis Between Variables

A correlation analysis was conducted to examine the relationships among teachers' perception, attitude toward implementation, school support, teacher competence, and the implementation of the GASING method. In line with the research design and considering the relatively small sample size as well as the ordinal nature of the data, Spearman's rank correlation was employed to identify the direction and strength of associations among variables, as outlined in the research method. The correlation matrix is presented in Table 4, which directly addresses the research objective of determining the relative influence of each factor on GASING implementation.

Table 4. Spearman Correlation Matrix of Research Variables

Variable	Perception	Attitude	Support	Competence	Implementation
Perception	1.00	0.56	0.55	0.04	0.43
Attitude	0.56	1.00	0.04	0.31	0.35
Support	0.55	0.04	1.00	-0.02	0.52
Competence	0.04	0.31	-0.02	1.00	0.62
Implementation	0.43	0.35	0.52	0.62	1.00

As shown in Table 4, the relationships among variables range from negligible to moderate positive associations, with one near-zero and one slightly negative correlation observed. Overall, GASING implementation is positively associated with all explanatory variables, although the strength of these relationships varies. The strongest relationship is found between teacher competence and GASING implementation ($r = 0.62$), indicating a moderate and meaningful association. This suggests that teachers with higher levels of pedagogical and instructional competence are more likely to implement the GASING method effectively in classroom practice. This finding reinforces the perspective that teacher competence is a key determinant of instructional quality and the successful application of innovative teaching methods (Blömeke et al., 2022; Mukti & Noviafitri, 2024). It further implies that practical capability plays a more decisive role than other factors in translating instructional innovation into real classroom practices.

School support also demonstrates a moderate positive relationship with implementation ($r = 0.52$), highlighting the importance of institutional conditions such as leadership, collaboration, and availability of learning resources. This result is consistent with previous studies emphasizing that school-level support is essential for sustaining educational innovation, particularly in contexts with limited resources (Schreurs et al., 2025). The finding indicates that even when teachers are competent, supportive institutional environments are still necessary to optimize implementation.

In comparison, teachers' perception ($r = 0.43$) and attitude toward implementation ($r = 0.35$) show weaker but still positive relationships with GASING implementation. This pattern suggests that cognitive understanding and positive attitudes alone are not sufficient to ensure effective classroom application. Rather, these factors appear to function as supporting conditions that may facilitate implementation when combined with stronger competence and institutional support. This interpretation aligns with behavioral frameworks such as the Theory of Planned Behavior, which posits that attitudes and beliefs influence behavior indirectly through perceived control and capability (Hagger & Hamilton, 2025).

Interestingly, several independent variables exhibit very weak or negligible relationships with one another, such as perception and competence ($r = 0.04$) and school support and competence ($r = -0.02$). These findings indicate that the constructs operate relatively independently within the studied context. In practical terms, having positive perceptions or strong institutional support does not automatically correspond to higher levels of teacher competence. This separation may reflect contextual characteristics of rural educational settings, where professional development opportunities and institutional resources may not develop simultaneously or in a coordinated manner. To provide a clearer overview of the correlation patterns, the relationships among variables are further illustrated in Figure 2.

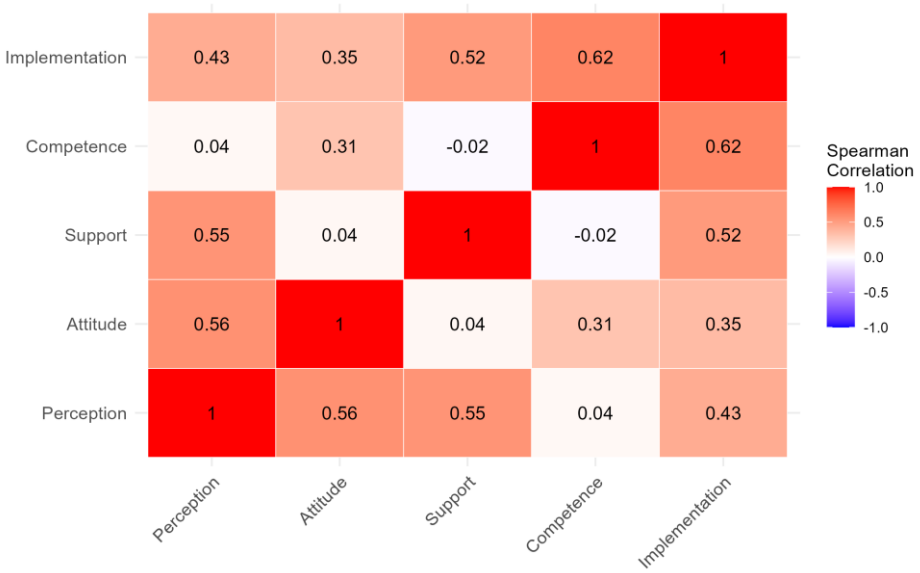

Figure 2. Correlation Heatmap of Research Variables

As illustrated in Figure 2, teacher competence and school support show stronger associations with GASING implementation compared to perception and attitude. The visual pattern confirms that implementation is most strongly linked to competence, followed by institutional support, while perceptual and attitudinal factors play comparatively smaller roles. Overall, these findings suggest that the implementation of the GASING method is primarily driven by practical instructional capability, supported by institutional conditions.

Meanwhile, psychological factors such as perception and attitude appear to function as indirect facilitators rather than primary determinants. This pattern provides an important extension to existing literature by emphasizing that, particularly in rural and resource-constrained contexts, successful instructional innovation depends more heavily on teachers' practical competence than on their attitudes alone. Furthermore, the relatively weak interrelationships among several variables indicate that each factor contributes in a distinct and complementary manner. This highlights the multi-dimensional nature of GASING implementation, where no single factor operates in isolation. Instead, effective implementation emerges from the interaction of competence, institutional support, and individual readiness, each playing a different but interconnected role.

Discussion on Key Findings

The findings of this study provide a comprehensive understanding of how teachers' perception, attitude, competence, and school support are associated with the implementation of the GASING method. In relation to the research questions, the results indicate that while all variables are positively associated with implementation, their strength and role differ significantly, particularly between internal teacher-related factors and external institutional support. Teachers' perception and attitude toward the GASING method are found to be at a very high level, indicating that teachers generally understand the principles of GASING and demonstrate strong willingness to apply it in classroom practice.

This indicates a favorable cognitive and emotional orientation toward instructional innovation, where positive beliefs and attitudes are likely to strengthen individuals' intention to engage in and adopt innovative teaching practices (Scherer & Teo, 2019; Teo & Noyes, 2011). However, the correlation results show that attitude has only a moderate association with implementation ($r = 0.35$), suggesting that positive disposition alone is not sufficient to ensure effective classroom execution. This discrepancy between intention and practice has also been observed in previous educational studies, where attitudinal readiness does not always translate into instructional behavior due to contextual and skill-related constraints.

Teacher competence emerges as the most influential factor in the implementation of the GASING method ($r = 0.62$). This indicates that the ability to design learning activities, apply pedagogical strategies, and adapt instructional materials plays a decisive role in transforming conceptual understanding into classroom practice. This pattern is consistent with prior research emphasizing that pedagogical content knowledge is central to effective teaching performance (Blömeke et al., 2022; König et al., 2022). In

contexts such as GASING implementation, competence appears to function as a bridge between conceptual acceptance and practical execution, suggesting that methodological understanding must be accompanied by sufficient instructional skills to achieve meaningful application.

School support also demonstrates a meaningful relationship with implementation (r = 0.52), although its descriptive score is relatively lower compared to individual teacher factors. This indicates that institutional conditions, such as leadership support, availability of learning resources, and collegial collaboration, play an enabling role in facilitating instructional innovation. This aligns with prior research emphasizing that sustainable educational change depends on supportive school environments and strong organizational capacity (Prenger et al., 2022; Sun, 2026). The pattern observed here suggests that even when teachers are highly motivated, the absence of strong institutional backing may limit the consistency and scalability of implementation.

Interestingly, the near-zero correlation between perception and competence (r = 0.04) suggests that understanding of the GASING concept does not necessarily translate into higher pedagogical competence. A similar gap between conceptual understanding and practical ability is often reported in innovation adoption studies, where cognitive acceptance does not automatically lead to skill development. Likewise, the moderate relationship between perception and implementation (r = 0.43) reinforces the idea that awareness and understanding must be reinforced through experiential practice to influence actual classroom behavior.

The pattern of findings suggests that internal factors, particularly teacher competence, play a more dominant role in shaping the implementation of GASING compared to perception and attitude. At the same time, school support functions as a contextual condition that can either strengthen or constrain implementation processes. In practical terms, this indicates that strengthening teacher competence through sustained professional development, mentoring, and collaborative practice is essential for effective instructional innovation. Meanwhile, enhancing institutional conditions may further reinforce teachers' ability to consistently apply new teaching approaches in diverse classroom settings.

From a broader perspective, these findings reflect how instructional innovation in education is not solely determined by willingness to change, but also by the alignment between knowledge, skills, and contextual support. In similar educational contexts, particularly in rural or resource-limited schools, such interaction between individual and institutional factors may follow comparable patterns, although variations may occur depending on local conditions and policy environments.

Qualitative Findings

The qualitative findings provide deeper insights into teachers' experiences in implementing the GASING method and are organized into three main themes: challenges, perceived benefits of GASING, and school support. These themes help explain the quantitative results by illustrating how teachers interpret and apply GASING in real classroom contexts. The summary of qualitative themes is presented in Table 5.

Table 5. Summary of Qualitative Themes

Theme	Description
Challenges	Teachers experience difficulties in designing GASING-based lessons, managing time, and adapting the method to diverse student abilities.
Benefits of GASING	GASING helps simplify abstract mathematical concepts and increases student engagement and motivation.
School Support	Support varies across schools, including availability of learning resources, training opportunities, and leadership encouragement.

As shown in Table 5, teachers' experiences reflect a combination of positive perceptions and practical constraints in implementing the GASING method. The first theme, challenges, indicates that teachers still face difficulties in applying GASING effectively despite their positive understanding of the method. The main challenges include designing structured GASING-based lessons, managing limited instructional time, and adapting the approach to diverse student abilities. One teacher stated, "Saya memahami konsep GASING, tetapi masih kesulitan dalam menyusun langkah pembelajaran di kelas." Another teacher added, "Waktu pembelajaran sering tidak cukup untuk menerapkan GASING secara maksimal." These findings suggest that implementation barriers are closely related to teachers' practical

competence rather than their conceptual understanding. This supports the quantitative result, which identified teacher competence as the most influential factor in GASING implementation.

The second theme highlights that teachers hold consistently positive perceptions of the GASING method. They reported that GASING makes mathematics more accessible, engaging, and less intimidating for students, particularly in understanding abstract concepts. One teacher stated, "Siswa menjadi lebih aktif dan tidak takut lagi dengan matematika karena pembelajarannya lebih menyenangkan," while another added, "GASING membantu siswa memahami konsep yang sebelumnya sulit menjadi lebih mudah dipahami." These experiences reflect constructivist learning principles, where meaningful understanding is developed through active engagement and simplified conceptual representations (Wilfredo et al., 2024). Moreover, the findings are consistent with prior studies showing that interactive and enjoyable learning environments enhance student motivation and participation (Fredricks et al., 2016; Kahu & Nelson, 2018). The strong acceptance of GASING among teachers further aligns with the quantitative results, which indicate high levels of perception and attitude, suggesting that GASING is widely perceived as a pedagogically relevant and beneficial instructional approach in rural classroom settings.

The third theme indicates that school support plays an important but uneven role in the implementation of GASING. While some teachers reported strong institutional encouragement in the form of learning resources, teaching flexibility, and leadership support, others experienced limited professional development opportunities and a lack of sustained training. One participant noted, "Sekolah mendukung dengan menyediakan alat peraga dan memberi kebebasan dalam mengajar," whereas another stated, "Belum ada pelatihan lanjutan atau pendampingan setelah diperkenalkan metode GASING." These contrasting experiences indicate that school support is not uniformly distributed across contexts, which may influence the consistency of GASING implementation. Drawing on Funk et al. (2022) and Sari et al. (2025), effective educational innovation requires not only initial introduction but also continuous leadership support, adequate resources, and ongoing professional learning opportunities. In this regard, school support does not merely function as a background factor, but actively shapes classroom practice by enabling or constraining teachers' ability to implement GASING consistently and effectively.

Across these three themes, a consistent pattern emerges in which teachers demonstrate positive perceptions and attitudes toward GASING, yet face practical and structural constraints in its implementation. These constraints are primarily related to pedagogical execution and institutional support systems. The qualitative findings therefore reinforce the quantitative results by showing that teacher competence is not only statistically significant but also practically crucial in shaping classroom implementation, while school support serves as an enabling condition that determines the consistency and sustainability of instructional practices. Overall, the integration of findings suggests that the successful implementation of GASING in rural educational contexts depends on the interaction between individual teacher competence and broader institutional support systems, rather than perception alone.

Integration of Findings (Mixed Methods)

The integration of quantitative and qualitative findings provides a comprehensive understanding of the factors influencing the implementation of the GASING method. In relation to the research questions, which examine how teachers' perception, attitude, competence, and school support are associated with GASING implementation, the combined results not only identify statistical relationships but also explain the underlying mechanisms that shape these relationships in real classroom contexts. By linking numerical trends with teachers' lived experiences, this integration enhances the explanatory depth and credibility of the study (Basister et al., 2025; Zhou et al., 2024).

The findings consistently indicate that teacher competence is the most influential factor in determining the successful implementation of GASING. Quantitatively, competence demonstrates the strongest correlation with implementation ($r = 0.62$), while qualitatively, teachers report difficulties in translating conceptual understanding into structured instructional practices. This convergence suggests that competence is not merely a supporting variable but a central mechanism that directly determines implementation quality. This finding is consistent with previous studies highlighting the importance of pedagogical competence in effective teaching (Maries & Singh 2019), particularly the concept of pedagogical content knowledge, which emphasizes teachers' ability to transform subject matter into meaningful and teachable learning experiences (Mafa-Theledi, 2024). However, this study extends prior research by demonstrating that, in rural educational contexts, competence plays a more decisive role than attitudinal factors. From a broader perspective, this result indicates that instructional innovation depends

less on teachers' willingness and more on their practical capability to operationalize instructional strategies in real classroom settings.

In contrast, teachers' perception and attitude are categorized as very high in the quantitative results, yet their relationships with implementation remain moderate. The qualitative findings clarify this discrepancy by revealing that positive beliefs toward the GASING method do not automatically translate into effective classroom practices. Teachers acknowledge that GASING enhances student engagement and simplifies abstract concepts; however, they still encounter challenges in execution due to limited pedagogical experience. This pattern aligns with behavioral theories suggesting that intention alone is insufficient to produce behavioral change without adequate capability and contextual support (Hagger & Hamilton, 2025). Therefore, perception and attitude can be interpreted as enabling psychological conditions rather than direct determinants of implementation.

School support also plays a significant role, with a moderate positive relationship with implementation ($r = 0.52$). Qualitative evidence reveals variability in institutional support, ranging from strong leadership encouragement and availability of learning resources to limited training and lack of sustained professional development. This finding is consistent with prior studies emphasizing that sustainable educational innovation requires continuous institutional support systems (Hargreaves & Shirley, 2022; Vangrieken et al., 2017). More importantly, the results suggest that school support functions as a contextual enabler that strengthens or constrains the effectiveness of teacher competence in practice. In this sense, even highly competent teachers may face limitations in implementing GASING optimally without adequate institutional backing.

A notable insight from the integration is the weak relationship between certain variables, such as perception and competence. Qualitative findings explain that this reflects a gap between conceptual understanding and practical capability. Teachers may possess strong awareness of GASING principles but still lack sufficient experience in applying them effectively in classroom settings. This finding highlights that knowledge acquisition alone is insufficient without sustained practice and professional development. Such a gap is particularly evident in rural contexts, where access to continuous training and instructional support is often limited (OECD, 2019). This result provides an important refinement to existing literature by explicitly demonstrating the disconnect between knowing and doing in instructional innovation.

From a broader perspective, the integrated findings suggest that the implementation of GASING follows a multi-layered process, in which teacher competence serves as the core driver, while perception, attitude, and school support function as reinforcing factors. This interaction reflects a dynamic system in which individual capability and institutional conditions must work together to achieve effective instructional change. Therefore, the success of instructional innovation should be understood as the result of both internal readiness and external support systems operating simultaneously.

The novelty of this study lies in its integrated examination of psychological factors (perception and attitude), professional capacity (competence), and institutional support within a single analytical framework using a mixed-methods approach. Unlike previous studies that tend to examine these variables separately, this research demonstrates their relative contributions and interactions, providing new empirical evidence that teacher competence is the most decisive factor in the implementation of innovative teaching methods, particularly in rural educational contexts. This contributes to the literature by offering a more contextualized and holistic model of instructional innovation.

In terms of practical implications, the findings suggest that improving the implementation of GASING should prioritize strengthening teacher competence through continuous professional development, hands-on training, and mentoring systems. In addition, schools need to provide consistent institutional support, including leadership involvement, adequate learning resources, and collaborative professional environments. Efforts that focus solely on improving teachers' attitudes without enhancing their practical capabilities are unlikely to produce significant improvements in classroom implementation.

Several limitations should be acknowledged. The relatively small sample size limits the generalizability of the findings, and the focus on a specific rural context may not fully represent other educational environments with different characteristics. Despite these limitations, the study provides valuable insights into the dynamics of instructional innovation in under-resourced settings.

Based on these findings, future research is recommended to involve larger and more diverse samples to enhance generalizability. Longitudinal studies are also needed to examine how teacher competence and school support evolve over time in sustaining the implementation of GASING.

Furthermore, intervention-based research focusing on teacher training and institutional support systems may provide deeper insights into effective strategies for improving innovative mathematics instruction.

CONCLUSION

This study concludes that the implementation of the GASING mathematics method in rural educational contexts is shaped by the interaction of teachers' perceptions, attitudes, pedagogical competence, and school support. While all variables are generally at a high level, teacher competence emerges as the most dominant factor influencing successful implementation, indicating that positive perceptions and attitudes alone are insufficient without strong pedagogical capability. The qualitative findings reinforce this pattern by revealing that teachers still face practical challenges in lesson design, time management, and adapting instruction to diverse student needs, which are closely linked to pedagogical content knowledge, while school support remains uneven and affects the consistency of implementation across schools. Overall, the study extends instructional innovation literature by demonstrating that the effectiveness of pedagogical reform in rural contexts is not driven by isolated factors but by the interaction between teacher competence and institutional support as a key explanatory mechanism shaping classroom practice. Practically, the findings emphasize the need for sustained professional development to strengthen teachers' pedagogical competence alongside consistent institutional support through leadership engagement, adequate learning resources, and continuous training. In addition, at the policy level, education authorities are encouraged to prioritize systematic teacher capacity building and ensure equitable school support systems to enable the sustainable implementation of innovative learning approaches such as GASING in under-resourced and rural settings.

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AUTHOR CONTRIBUTIONS

Conceptualization, Trigarcia Maleachi Randa and Chrisaria Palungan; Methodology, Trigarcia Maleachi Randa; Software, Trigarcia Maleachi Randa; Validation, Trigarcia Maleachi Randa; Formal Analysis, Trigarcia Maleachi Randa; Investigation, Dahlia Gladiola Rurina Menufandu; Resources, Trigarcia Maleachi Randa and Chrisaria Palungan; Data Curation, Dahlia Gladiola Rurina Menufandu; Writing – Original Draft Preparation, Trigarcia Maleachi Randa; Writing – Review & Editing, Hugo Warami and Yusuf Willem Sawaki; Visualization, Trigarcia Maleachi Randa; Supervision, Jonni Marwa; Project Administration, Yusuf Willem Sawaki; Funding Acquisition, Hugo Warami.

CONFLICTS OF INTEREST

The author(s) state that there are no conflicts of interest related to this study.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors confirm that no artificial intelligence (AI)-assisted tools were employed in the development, analysis, or writing of this manuscript. Every stage of the research process, including data gathering, interpretation of findings, and preparation of the manuscript, was completed solely by the authors without any support from AI-based technologies.

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