OPEN ACCESS
Jurnal Ilmiah Ilmu Terapan Universitas Jambi
Vol. 10 No. 3. June 2026, pp. 1371-1384 DOI. 10.22437/jiituj.v10i3.54898
Review Article

TEACHER PROFESSIONAL DEVELOPMENT AND INSTRUCTIONAL INNOVATION IN REMOTE CONTEXTS: TEACHERS' PERCEPTIONS OF GASING IMPLEMENTATION IN PAPUA

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Article Info
Received: Apr 27, 2026
Revised: May 30, 2026
Accepted: Jun 22, 2026
OnlineVersion: Jun 29, 2026

Abstract
Teacher professional development is widely recognized as a key driver of instructional innovation, particularly in geographically remote and under-resourced educational settings. However, limited evidence is available regarding how teachers perceive instructional innovations following professional development experiences in such contexts. This study aimed to examine teachers' perceptions of the GASING (*Gampang, Asyik, dan Menyenangkan*) method and explore the relationships among key perception dimensions associated with instructional innovation in a remote educational setting. A quantitative descriptive design was employed involving 22 elementary and junior high school teachers in Teluk Bintuni, West Papua, Indonesia, who had participated in GASING training. Data were collected using a structured questionnaire covering six dimensions: cognitive understanding, affective response, pragmatic value, contextual feasibility, interest and engagement, and behavioral intention. Descriptive statistics and Chi-square tests were used for data analysis. The results revealed consistently positive perceptions across all dimensions, with mean scores ranging from 4.00 to 4.77 on a five-point scale. Teachers demonstrated strong cognitive understanding, positive affective responses, and high perceived practical value of the GASING method. Chi-square analysis showed that most dimensions were statistically independent, although a marginal association was found between contextual feasibility and behavioral intention ($\chi^2 = 3.009$; $p = 0.083$). These findings suggest that positive teacher perceptions alone may not ensure sustained instructional change in remote contexts.

Keywords: GASING Method, Instructional Innovation, Remote Education, Teacher Perceptions, Teacher Professional Development

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INTRODUCTION

Mathematics education continues to be a major concern worldwide due to persistent challenges related to students' conceptual understanding, problem-solving ability, and engagement in learning. In many educational systems, including Indonesia, mathematics instruction remains dominated by procedural teaching approaches that emphasize memorization and algorithmic manipulation rather than conceptual reasoning and meaningful understanding. As a consequence, students often struggle to transfer mathematical knowledge across contexts, solve non-routine problems, and develop higher-order thinking skills. Previous studies have shown that excessive reliance on procedural instruction contributes to superficial learning outcomes and limits students' ability to apply mathematical concepts in authentic situations (Al-Mutawah et al., 2019; Jupri & Sispiyati, 2020). Recent research further indicates that students' conceptual understanding is strongly associated with their ability to solve complex mathematical problems, make connections among mathematical ideas, and apply knowledge flexibly in new situations (Rittle-Johnson et al., 2015; Reinhold et al., 2020). Studies have also highlighted the importance of mathematical reasoning and representational fluency in supporting students' conceptual growth and problem-solving performance (Fyfe et al., 2014; Lithner, 2017).

Furthermore, student engagement has been identified as a critical factor influencing mathematics achievement, particularly when learning environments encourage active participation, exploration, and meaningful interaction with mathematical concepts (Fredricks et al., 2019). In addition, the development of mathematical literacy has become increasingly important as contemporary educational systems seek to prepare learners to apply mathematical knowledge in real-world situations and make informed decisions in complex social and technological environments (Stacey & Turner, 2015; OECD, 2023). Moreover, international evidence suggests that instructional practices emphasizing conceptual learning lead to more sustainable learning outcomes and improved mathematical achievement compared to approaches focused primarily on procedural fluency (Siegler, 2016; OECD, 2023). These concerns have become even more significant in the context of twenty-first-century education, where adaptive expertise, critical thinking, and transferable problem-solving competencies are increasingly viewed as essential outcomes of mathematics learning (van Laar et al., 2020).

These challenges have become increasingly important in the context of twenty-first century education, where mathematical literacy, critical thinking, and adaptive problem-solving are regarded as essential competencies for lifelong learning and workforce participation. Consequently, educational systems are increasingly seeking innovative instructional approaches that can promote deeper conceptual understanding while simultaneously enhancing student engagement and learning motivation. Contemporary educational research highlights that student-centered, inquiry-based, and technology-enhanced learning environments can significantly improve students' mathematical reasoning, engagement, and self-regulated learning (Hwang & Tu, 2021; Chiu, 2022). Furthermore, fostering mathematical literacy has become a central educational goal because it enables learners to formulate, employ, and interpret mathematics in real-world contexts, thereby supporting informed decision-making and active citizenship (OECD, 2023). Therefore, researchers and policymakers increasingly advocate instructional innovations that integrate conceptual understanding, problem-solving, collaboration, and critical thinking to prepare students for the demands of the twenty-first century (van Laar et al., 2020; UNESCO, 2023). The persistence of these challenges highlights an urgent need for instructional approaches that can simultaneously promote conceptual understanding, mathematical reasoning, and meaningful student engagement. Without effective pedagogical interventions, students may continue to experience difficulties in applying mathematical knowledge to authentic situations, thereby limiting the development of mathematical literacy and higher-order thinking skills required in contemporary society. Therefore, identifying and implementing effective instructional innovations has become an important priority for improving mathematics education outcomes.

One instructional approach that has gained increasing attention in Indonesia is the GASING method (*Gampang, Asyik, dan Menyenangkan*), developed by Yohanes Surya. GASING was designed to transform mathematics learning into an enjoyable, intuitive, and meaningful experience by guiding learners from concrete experiences toward abstract mathematical concepts. The method emphasizes visualization, active participation, step-by-step conceptual progression, and repeated engagement with mathematical ideas in ways that reduce cognitive burden and increase learner confidence. These characteristics align closely with constructivist learning theories, which argue that knowledge is actively constructed through interaction, exploration, and reflection rather than passively transmitted from teacher

to student (Simon, 1995; Suhendi et al., 2021). Recent studies further suggest that mathematics instruction grounded in conceptual understanding and active knowledge construction enhances students' ability to connect mathematical ideas, transfer learning across contexts, and engage in meaningful problem-solving processes (Rittle-Johnson et al., 2015; Schoenfeld, 2016; Reinhold et al., 2020). Moreover, educational approaches that scaffold conceptual progression and encourage active participation have been associated with improved mathematical reasoning, self-efficacy, and long-term learning retention (Hwang & Tu, 2021; OECD, 2023).

Previous research has reported positive impacts of GASING on students' mathematical achievement, conceptual understanding, motivation, numeracy skills, and problem-solving performance (Rizaldi et al., 2023; Kurniawan & Ani Latifatunnisa, 2024). Similar instructional innovations that promote active learning and student-centered engagement have also demonstrated substantial benefits across science, technology, engineering, and mathematics (STEM) education (Prince, 2004; Freeman et al., 2014). More recent evidence indicates that active-learning environments can significantly reduce achievement gaps, improve academic performance, and foster higher levels of student engagement across diverse educational settings (Theobald et al., 2020; Chiu, 2022). Likewise, technology-enhanced and inquiry-based instructional approaches have been found to strengthen students' mathematical reasoning, collaborative learning, and self-regulated learning skills (Hwang & Tu, 2021). Therefore, GASING may be viewed not merely as a teaching technique but as a pedagogical innovation with the potential to reshape instructional practices and improve learning outcomes.

The successful implementation of instructional innovation, however, depends not only on the quality of the innovation itself but also on teachers' capacity and willingness to adopt it in their professional practice. Teacher professional development is widely recognized as one of the most influential factors in improving instructional quality and supporting educational reform (Desimone, 2009; Avalos, 2011). Effective professional development enables teachers to expand their pedagogical knowledge, strengthen instructional competence, and develop confidence in implementing innovative teaching approaches. Recent research has further emphasized that professional development is most effective when it promotes active teacher engagement, collaboration, reflection, and opportunities to apply new knowledge in authentic classroom settings (Kennedy, 2016; Darling-Hammond, L., Hyler, M.E., & Gardner, 2017). Such experiences not only enhance teachers' instructional skills but also contribute to the development of professional agency and self-efficacy, both of which are essential for sustaining instructional change and innovation (Zee & Koomen, 2016; Sims et al., 2021). Moreover, evidence suggests that teachers are more likely to adopt and maintain innovative practices when professional development is coherent, contextually relevant, and aligned with their instructional needs and school environments (Coldwell, 2017; Theobald et al., 2020). As educational systems increasingly seek to foster twenty-first-century competencies and improve learning outcomes, continuous professional learning has become a critical mechanism for equipping teachers with the knowledge, skills, and adaptive expertise required to respond to evolving educational demands and implement meaningful pedagogical innovations (Caena, 2014).

Research consistently shows that sustainable changes in classroom practice are more likely to occur when teachers engage in meaningful professional learning experiences that are coherent, contextually relevant, collaborative, and supported over time (Guskey, 2002; Kennedy, 2016; Darling-Hammond, Hyler, & Gardner, 2017; Kraft et al., 2018). Furthermore, effective professional development programs have been shown to enhance teacher efficacy, instructional quality, and student achievement when they incorporate active learning, coaching, reflection, and ongoing support mechanisms (Darling-Hammond, Hyler, & Gardner, 2017; Sims et al., 2021). Nevertheless, translating professional development experiences into classroom innovation remains challenging, particularly in geographically remote and under-resourced educational settings.

These challenges are especially evident in remote regions such as Papua, Indonesia, where teachers often face multiple barriers to professional growth and instructional innovation. Geographic isolation, limited infrastructure, restricted access to educational resources, and infrequent opportunities for sustained professional learning can significantly influence teachers' ability to adopt and maintain new pedagogical practices. Educational inequality in remote regions remains a global concern because geographic and socioeconomic constraints frequently limit access to quality teaching resources, mentoring opportunities, and collaborative professional networks (UNESCO, 2020; OECD, 2023). Recent studies on rural and remote education further emphasize that teachers working in geographically isolated communities often experience professional isolation, limited access to specialized training, and

difficulties in sustaining instructional innovation without institutional support (UNESCO, 2023). Such conditions may ultimately affect teachers' perceptions of innovation feasibility and their willingness to implement new instructional approaches in classroom practice. In response to these challenges, professional development programs that introduce innovative instructional approaches may provide a viable strategy for improving teaching quality in remote educational settings. Among these innovations, the GASING method offers a promising alternative because it emphasizes conceptual understanding, active participation, and enjoyable learning experiences. However, the effectiveness of such initiatives ultimately depends on how teachers perceive, accept, and implement the innovation within their specific educational contexts.

Within such contexts, instructional innovation cannot be understood solely as an individual teacher characteristic; rather, it emerges through the interaction between teacher beliefs, professional learning experiences, institutional support, and contextual conditions. Consequently, understanding how teachers perceive and respond to innovative instructional approaches becomes essential for designing professional development programs that are both effective and sustainable in remote educational environments. Recent research on educational innovation suggests that teachers' beliefs, self-efficacy, perceived usefulness, and contextual support are among the strongest predictors of successful innovation adoption and implementation (Scherer et al., 2016; Opre, 2022). Furthermore, the integration of innovative pedagogical approaches is strongly influenced by teachers' perceptions of practicality, compatibility with existing instructional practices, and institutional readiness for change (Opre, 2022).

Despite the growing body of research on GASING and mathematics education, several important gaps remain. First, most existing studies have concentrated on student outcomes, including achievement, conceptual understanding, motivation, and numeracy development, while relatively little attention has been devoted to teachers as the primary agents of instructional change. Second, although teacher perception has been widely recognized as a critical factor influencing the adoption of educational innovation (Bandura, 1989; Borg, 2003; Ajzen, 2011), empirical evidence regarding teachers' perceptions of GASING remains limited. Although several studies have investigated the effectiveness of GASING in improving students' learning outcomes, mathematical achievement, and numeracy skills, few studies have specifically examined how teachers perceive the method following professional development experiences. Third, research examining instructional innovation in geographically remote contexts is still scarce, particularly in Papua, where contextual challenges may substantially influence teachers' readiness and capacity to implement new pedagogical approaches. Finally, previous studies rarely examine how cognitive, affective, pragmatic, contextual, and behavioral dimensions interact to shape teachers' intentions to adopt instructional innovation following professional development experiences. Existing literature increasingly calls for more context-sensitive investigations that examine the complex relationships among teacher beliefs, professional learning experiences, contextual constraints, and innovation adoption processes, particularly in underrepresented educational settings (Scherer et al., 2016; van Laar et al., 2020; UNESCO, 2023). As a result, there remains limited understanding of how teacher professional development, instructional innovation, and contextual constraints intersect within remote educational settings.

This study addresses these gaps by positioning GASING not only as a mathematics teaching method but also as a professional development intervention that may stimulate instructional innovation among teachers working in remote contexts. The novelty of this study lies in three important contributions. First, it extends existing GASING research beyond student learning outcomes by focusing on teachers' perceptions as indicators of instructional change and professional growth. Second, it provides empirical evidence from Teluk Bintuni, Papua, a geographically remote region that remains underrepresented in the literature on teacher professional development and instructional innovation. Third, it investigates the relationship among multiple dimensions of teacher perception, particularly the role of contextual feasibility in shaping behavioral intentions to implement innovative instructional practices (Bond et al., 2021). By examining these relationships within a remote educational context, this study contributes to the growing literature on educational innovation, teacher professional learning, and twenty-first-century competencies while providing practical insights for policymakers and professional development providers seeking to promote sustainable instructional change in underserved regions (van Laar et al., 2020; UNESCO, 2023).

By integrating perspectives from teacher professional development, instructional innovation, and remote education, this study contributes to a more comprehensive understanding of how pedagogical change can be supported in geographically isolated and resource-constrained environments. Therefore,

the purpose of this study is to examine teachers' perceptions of the GASING method following their participation in professional development activities and to explore the relationships among key perception dimensions associated with instructional innovation in remote educational contexts. Specifically, this study seeks to answer the following research questions: How do teachers perceive the GASING method across cognitive understanding, affective response, pragmatic value, contextual feasibility, interest and engagement, and behavioral intention dimensions?; Are there significant associations among teachers' perception dimensions regarding the implementation of the GASING method in remote educational contexts?.

By addressing these questions, the study contributes to the growing literature on teacher professional development, instructional innovation, and mathematics education in remote settings while providing evidence-based insights for policymakers, educational leaders, and professional development providers seeking to strengthen educational quality in underserved regions.

RESEARCH METHOD

This study employed a quantitative descriptive design to examine teachers' perceptions of the GASING (Gampang, Asyik, dan Menyenangkan) method as an instructional innovation in mathematics education within a remote context. While the primary focus was to describe perception patterns, the study also incorporated an exploratory inferential approach to identify potential associations among key perception dimensions. This design is appropriate for capturing teachers' responses to pedagogical innovation in contexts where large-scale data collection is constrained by geographical and logistical limitations.

The study was conducted in Teluk Bintuni Regency, West Papua, Indonesia, a geographically remote region characterized by limited access to educational resources and professional development opportunities. A purposive sampling technique was employed to ensure that participants had direct experience with the GASING method. A total of 22 elementary and junior high school teachers participated in the study. All participants had been exposed to GASING-related instructional practices through training or classroom implementation. Their teaching experience varied across grade levels, providing a diverse representation of instructional contexts within the region. Although the sample size was relatively small (n = 22), it represented nearly the entire accessible population of teachers who had participated in GASING training within the targeted district. Therefore, the study was intended to generate exploratory and context-specific insights rather than statistical generalizations. The findings should be interpreted within the educational context of Teluk Bintuni and may serve as a foundation for future studies involving larger and more diverse samples.

Data were collected using a structured questionnaire designed to measure teachers' perceptions of the GASING method. The questionnaire was researcher-developed based on established theoretical frameworks proposed by Ajzen (2011), Bandura (1989), and Borg (2003). The instrument was developed based on the literature on teacher perception, instructional innovation, and professional development, encompassing six dimensions: cognitive understanding, affective response, pragmatic value, contextual feasibility, interest and engagement, and behavioral intention. The questionnaire consisted of 30 items distributed across six dimensions: Cognitive understanding; Affective response; Pragmatic value; Contextual feasibility; Interest and engagement; Behavioral intention. Content validity and reliability procedures are described in the following section.

The questionnaire measured six dimensions of teachers' perceptions toward the GASING method. Cognitive understanding refers to teachers' comprehension of the principles and instructional procedures of GASING. Affective response represents teachers' emotional reactions and attitudes toward the method. Pragmatic value refers to teachers' perceptions of the usefulness and effectiveness of GASING in supporting mathematics learning. Contextual feasibility reflects the extent to which the method can be implemented within existing school conditions and available resources. Interest and engagement describe teachers' enthusiasm and willingness to explore the method further. Behavioral intention refers to teachers' intention to continue implementing GASING in their future instructional practice. Each dimension was measured using five items on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The instrument comprised six dimensions of teachers' perceptions toward the GASING method, represented by 30 items. The operational definitions and distribution of items are presented in Table 1.

Table 1. Instrument Grid

Dimension	Operational Definition	Number of Items
Cognitive Understanding	Understanding of GASING concepts and procedures	5
Affective Response	Emotional acceptance of GASING	5
Pragmatic Value	Perceived usefulness in mathematics teaching	5
Contextual Feasibility	Suitability within local educational contexts	5
Interest and Engagement	Interest in learning and applying GASING	5
Behavioral Intention	Intention to continue implementation	5
Total		30

Content validity was established through expert review involving two mathematics education specialists who evaluated the relevance, clarity, and representativeness of each item. Both experts held doctoral qualifications in mathematics education and had more than five years of experience in curriculum and instructional design. Revisions were made based on their recommendations prior to data collection. The results are presented in Table 2.

Table 2. Reliability Statistics of the Research Instrument

Cronbach's Alpha	N of Items
.949	30

According to George and Mallery (2003), a Cronbach's alpha coefficient above 0.90 indicates excellent internal consistency. Internal consistency reliability was assessed using Cronbach's alpha coefficient. The overall instrument demonstrated excellent reliability ($\alpha = 0.949$) across 30 items, exceeding the recommended threshold of 0.70 and indicating a high level of internal consistency among questionnaire items. Data collection was conducted after teachers had implemented or been exposed to the GASING method in their instructional practice. Participants were informed about the purpose of the study and voluntarily completed the questionnaire. Ethical considerations, including informed consent and confidentiality of responses, were ensured throughout the data collection process.

Data analysis was conducted in two stages using IBM SPSS Statistics. First, descriptive statistics, including mean scores and standard deviations, were calculated to summarize teachers' perceptions across the six dimensions of the GASING method. These statistics were used to identify overall response patterns and the level of agreement within each dimension. Second, Chi-square tests of independence were performed to examine potential associations among the perception dimensions. The analysis aimed to explore whether cognitive, affective, pragmatic, contextual, and engagement-related perceptions were associated with teachers' behavioral intentions to implement the GASING method. The Chi-square test was selected because the study focused on identifying associations among categorical response patterns rather than predicting causal relationships.

Given the exploratory nature of the study and the relatively small sample size ($n = 22$), advanced multivariate techniques such as Structural Equation Modeling (SEM), SmartPLS, or AMOS were not considered appropriate. Therefore, descriptive statistics and Chi-square analysis were employed as suitable methods for identifying perception trends and indicative relationships among variables. Statistical significance was evaluated at the 0.05 level. Because of the limited sample size and the observed homogeneity of responses, inferential findings were interpreted cautiously and considered exploratory rather than confirmatory.

RESULTS AND DISCUSSION

Teachers' Perceptions of the GASING Method

To address the first research question regarding teachers' perceptions of the GASING method, descriptive statistical analysis was conducted across six perception dimensions: cognitive understanding, affective response, pragmatic value, contextual feasibility, interest and engagement, and behavioral intention. Mean scores and standard deviations were calculated to determine the overall level of teachers' perceptions toward the implementation of the GASING method. The results are presented in Table 3.

Table 3. Descriptive Statistics of Teachers' Perceptions toward the GASING Method

Dimension	Mean	SD	Interpretation
Cognitive Understanding	4.77	0.32	Very High
Affective Response	4.41	0.41	Very High
Pragmatic Value	4.35	0.50	Very High
Contextual Feasibility	4.26	0.56	Very High
Interest and Engagement	4.00	0.75	High
Behavioral Intention	4.07	0.74	High

The results indicate that teachers reported highly positive perceptions across all dimensions of the GASING method. Cognitive understanding obtained the highest mean score (M = 4.77), followed by affective response (M = 4.41), pragmatic value (M = 4.35), and contextual feasibility (M = 4.26). Interest and engagement (M = 4.00) and behavioral intention (M = 4.07) also remained within the high category. These findings suggest that teachers not only understood the principles and instructional procedures of the GASING method but also perceived it as useful, enjoyable, and feasible for classroom implementation.

The particularly high score for cognitive understanding indicates that the professional development activities successfully strengthened teachers' conceptual knowledge of the GASING approach. This finding suggests that the training program effectively communicated the pedagogical principles, instructional stages, and practical applications of the method. Recent studies have similarly emphasized that high-quality professional learning experiences can strengthen teachers' professional competence, pedagogical reasoning, and readiness to implement innovative instructional practices in classroom settings (Korthagen & Kessels, 1999; Mena et al., 2017; Santa Ana & Silvestre, 2025). Furthermore, the positive affective responses reported by participants indicate that teachers developed favorable attitudes toward the innovation, which is an important prerequisite for instructional change. Previous studies have shown that teachers' positive perceptions of instructional innovations are closely associated with their willingness to modify classroom practices and sustain pedagogical change over time (Thibaut et al., 2018). More recent evidence suggests that positive attitudes toward educational innovation are strongly linked to teachers' professional identity, agency, and commitment to instructional improvement (Goller, 2017; Miramadhani et al., 2024). In mathematics education, teacher perceptions are particularly important because teachers' beliefs and attitudes toward instructional approaches strongly influence classroom practices and student engagement (Attard & Holmes, 2020). Research in mathematics teacher education further indicates that instructional quality and opportunities for conceptual learning are shaped by teachers' professional competence and pedagogical decision-making (Charalambous & Praetorius, 2018; Kaiser & König, 2019). Therefore, the positive perceptions identified in this study may represent an important enabling condition for the successful implementation of GASING in mathematics classrooms.

These findings are consistent with previous studies reporting positive outcomes of GASING implementation in mathematics education. Earlier studies have shown that GASING can improve students' mathematical understanding, engagement, and learning achievement. While previous research has primarily focused on student outcomes, the present study extends the discussion by demonstrating that teachers also perceive GASING positively following participation in professional development activities. This finding reinforces the argument that teacher acceptance is a critical factor in the successful adoption of instructional innovations. Contemporary research on educational change increasingly recognizes that teachers are not merely recipients of innovation but active agents whose interpretations, beliefs, and professional judgments shape implementation outcomes (Miramadhani et al., 2024). In addition, studies on teacher learning suggest that professional development contributes most effectively to instructional change when teachers perceive new approaches as meaningful, practical, and compatible with their existing instructional goals (Korthagen & Kessels, 1999; Mena et al., 2017).

These findings therefore provide further evidence that positive teacher perceptions may serve as an important foundation for innovation adoption and sustained pedagogical change. From a teacher professional development perspective, the findings support the work of Desimone (2009) and Avalos (2011), who argue that effective professional development enhances teachers' knowledge, beliefs, and instructional competence. The high cognitive and affective scores observed in this study suggest that GASING training functioned not only as a method dissemination program but also as a professional

learning experience that strengthened teachers' readiness to adopt innovative instructional practices. This finding reinforces the argument that teacher acceptance is a critical factor in the successful adoption of instructional innovations.

The findings also have important implications for remote educational contexts. In regions such as Teluk Bintuni, where access to continuous professional development opportunities is often limited, positive teacher perceptions may serve as an important foundation for sustaining instructional innovation. The results indicate that well-designed professional development programs can foster teacher readiness and encourage the adoption of innovative approaches even in geographically isolated educational settings.

Relationships Among Perception Dimensions

To address the second research question, Chi-square tests of independence were conducted to examine potential associations among the six perception dimensions. The analysis explored whether teachers' cognitive understanding, affective response, pragmatic value, contextual feasibility, interest and engagement, and behavioral intention were related to one another. The results of the Chi-square analysis are presented in Table 4.

Table 4. Chi-Square Analysis of Relationships Among Perception Dimensions

Dimension Pair	χ^2	p-value
Cognitive–Affective	0.000	1.000
Cognitive–Pragmatic	0.183	0.669
Cognitive–Contextual	0.000	1.000
Cognitive–Feelings/Interest	0.000	1.000
Cognitive–Behavioral Intention	0.127	0.722
Affective–Pragmatic	0.196	0.658
Affective–Contextual	0.000	1.000
Affective–Feelings/Interest	1.224	0.269
Affective–Behavioral Intention	0.000	1.000
Pragmatic–Contextual	0.727	0.394
Pragmatic–Feelings/Interest	0.000	1.000
Pragmatic–Behavioral Intention	0.000	1.000
Contextual–Feelings/Interest	0.000	1.000
Contextual–Behavioral Intention	3.009	0.083
Feelings/Interest–Behavioral Intention	1.086	0.297

The Chi-square analysis revealed that most perception dimensions did not exhibit statistically significant associations ($p > 0.05$). This finding indicates that teachers' cognitive understanding, affective responses, pragmatic evaluations, contextual perceptions, and engagement levels tended to operate independently rather than as strongly interconnected constructs. The absence of significant relationships among most dimension pairs may be attributed to the relatively homogeneous response patterns observed across participants, as reflected in the consistently high mean scores reported in Table 3.

Despite the lack of statistically significant associations, one noteworthy pattern emerged from the relationship between contextual feasibility and behavioral intention ($\chi^2 = 3.009$, $p = 0.083$). Although the result did not meet the conventional significance threshold of 0.05, it demonstrated the strongest association among all dimension pairs. Although not statistically significant at the 0.05 level, this finding suggests a potential relationship between contextual feasibility and teachers' intentions to continue implementing the GASING method. The result should therefore be interpreted cautiously and viewed as an exploratory indication rather than conclusive evidence. The observed tendency is particularly relevant within the context of remote education. Teachers in geographically isolated regions often encounter challenges related to infrastructure, instructional resources, professional support, and institutional capacity. Consequently, even when teachers possess strong understanding of an instructional innovation and hold positive attitudes toward its implementation, their willingness to sustain the innovation may depend on whether the surrounding educational environment supports its continued use.

Although contextual constraints remain important considerations, the results indicate that well-designed professional development initiatives can foster positive attitudes toward innovation and strengthen teachers' willingness to improve instructional practice. In this respect, the GASING training

appears to have provided teachers with an accessible and practical instructional framework that was perceived as relevant to their local teaching context. This finding aligns with research suggesting that professional development is more likely to influence classroom practice when teachers perceive its content as directly applicable to their instructional realities and student needs (Glover et al., 2016). Therefore, positive teacher perceptions may serve as an important foundation for sustaining instructional innovation in geographically isolated educational environments.

This finding can be interpreted through the lens of Ajzen's Theory of Planned Behavior, which proposes that behavioral intentions are influenced not only by attitudes but also by perceived behavioral control. In the context of this study, contextual feasibility may function as a form of perceived behavioral control, influencing teachers' confidence in their ability to implement the GASING method consistently. Similarly, Bandura's Social Cognitive Theory emphasizes the reciprocal interaction between individual beliefs and environmental conditions. The findings therefore suggest that positive teacher perceptions alone may not guarantee sustained instructional change when contextual barriers remain present. This interpretation is consistent with recent research demonstrating that teachers' implementation decisions are shaped not only by pedagogical beliefs but also by perceptions of available resources, organizational support, and implementation feasibility (Coldwell, 2017; Toropova et al., 2021).

An important implication of these findings is that instructional innovation should not be viewed solely as a matter of teacher competence or motivation. While professional development programs can successfully enhance teachers' understanding and acceptance of innovative instructional approaches, long-term implementation also requires supportive institutional conditions. Previous studies have shown that organizational support, leadership commitment, and access to instructional resources are critical determinants of whether educational innovations become embedded in routine classroom practice (Fullan, 2020; Sims et al., 2025). This suggests that policymakers and educational stakeholders should complement professional development initiatives with sustained mentoring, resource provision, and school-level support systems to strengthen the adoption of instructional innovations in remote educational settings.

This study contributes to the growing body of literature on teacher professional development and instructional innovation by providing empirical evidence from a geographically remote educational context. While previous studies on the GASING method have primarily focused on student learning outcomes, mathematical achievement, and classroom effectiveness, the present study shifts attention toward teachers' perceptions as an important determinant of instructional innovation. By examining cognitive, affective, pragmatic, contextual, and behavioral dimensions simultaneously, the study offers a more comprehensive understanding of how teachers respond to instructional innovations following professional development experiences. Such multidimensional perspectives have increasingly been recommended in contemporary teacher learning research because innovation adoption is recognized as a complex process involving cognitive, motivational, contextual, and behavioral factors operating simultaneously (Opfer & Pedder, 2011; Hill et al., 2013).

The novelty of this study lies in its integration of teacher professional development, instructional innovation, and remote education within a single analytical framework. Specifically, the findings demonstrate that although teachers reported highly positive perceptions of the GASING method, the sustainability of implementation may be influenced by contextual feasibility. This insight extends existing research by suggesting that successful instructional innovation in remote educational settings depends not only on teachers' knowledge and attitudes but also on the contextual conditions that support implementation. This finding resonates with implementation research suggesting that educational interventions are more likely to succeed when individual readiness is accompanied by organizational capacity and contextual alignment (Century & Cassata, 2016). Consequently, the study highlights the importance of examining environmental and institutional factors alongside individual teacher characteristics when evaluating the impact of professional development programs. Unlike previous GASING studies that mainly examined student achievement and learning outcomes, the present study positions teachers as central actors in instructional innovation. The findings further suggest that contextual feasibility may play an important role in shaping teachers' intentions to sustain instructional change in remote educational settings. This contribution extends current understanding of how professional development, innovation adoption, and contextual conditions interact within underserved regions.

From a practical perspective, the findings have important implications for educational policymakers, school leaders, and professional development providers. The positive perceptions reported by teachers indicate that GASING has strong potential as an instructional innovation for mathematics

education in remote regions. However, the observed relationship between contextual feasibility and behavioral intention suggests that training programs alone may be insufficient to ensure long-term implementation. Educational stakeholders should therefore complement professional development initiatives with continuous mentoring, access to instructional resources, collaborative learning communities, and institutional support mechanisms that enable teachers to sustain innovative instructional practices. Research on educational change further indicates that collaborative professional communities and ongoing coaching mechanisms play a central role in supporting the long-term maintenance of instructional innovations beyond initial training programs (Trust et al., 2016; Vangrieken et al., 2017).

Despite its contributions, this study has several limitations. First, the sample size was relatively small and limited to teachers from a single district, which may restrict the generalizability of the findings to other educational contexts. Second, the study relied on self-reported questionnaire data, which may be influenced by social desirability bias and may not fully reflect actual classroom practices. Third, the cross-sectional nature of the study limits the ability to examine how teachers' perceptions evolve over time following professional development experiences. Future research should involve larger and more diverse samples across multiple regions to improve the generalizability of findings. In addition, mixed-methods approaches incorporating interviews, classroom observations, and longitudinal designs are recommended to explore how teachers' perceptions translate into sustained instructional practices. Further studies may also investigate the specific contextual factors that facilitate or hinder the implementation of instructional innovations in remote educational settings.

CONCLUSION

This study examined teachers' perceptions of the GASING method as an instructional innovation following professional development experiences in a remote educational context. The findings revealed consistently positive perceptions across all six dimensions, with cognitive understanding receiving the highest rating. These results indicate that the GASING training program successfully enhanced teachers' understanding, acceptance, and perceived usefulness of the method for mathematics instruction. The analysis further showed that most perception dimensions were statistically independent, suggesting a relatively homogeneous pattern of positive responses among participants. However, the observed tendency between contextual feasibility and behavioral intention indicates that teachers' willingness to sustain the implementation of GASING may be influenced by contextual conditions, including the availability of institutional support, resources, and enabling learning environments. This study contributes to the literature by extending research on GASING beyond student learning outcomes and highlighting teachers' perceptions as an important component of instructional innovation. The findings also underscore the importance of integrating professional development initiatives with context-sensitive support systems, particularly in geographically remote educational settings. Therefore, efforts to promote instructional innovation should address not only teacher capacity development but also the contextual factors that influence the sustainability of pedagogical change.

ACKNOWLEDGMENTS

The authors would like to express their sincere appreciation to the participating teachers in Teluk Bintuni for their valuable time, openness, and active participation in this study. We also thank colleagues and experts in mathematics education who provided constructive feedback during the development and validation of the research instrument. Their contributions significantly improved the quality of this research. This research was funded by the Government of West Papua Province through the Department of Education. The funding body supported the implementation of the study; however, it had no role in the study design, data collection, analysis, interpretation of data, or decision to publish.

AUTHOR CONTRIBUTIONS

Conceptualization, M.S.I.; Methodology, M.S.I. and F.M.L.; Software, F.M.L.; Validation, M.S.I. and F.M.L.; Formal Analysis, M.S.I.; Investigation, M.S.I. and A.L.; Resources, A.L.; Data Curation, A.L.; Writing – Original Draft Preparation, M.S.I.; Writing – Review & Editing, M.S.I. and M.Y.B.; Visualization, F.M.L. and M.Y.B.; Supervision, M.S.I.; Project Administration, M.S.I.; Funding Acquisition, M.S.I.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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