



STUDENTS' VOICES MATTER: A QUALITATIVE INQUIRY INTO MOTIVATIONAL TRANSFORMATION THROUGH STUDENT CENTERED MATHEMATICS INSTRUCTION

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ABSTRAK

Motivasi dan keterlibatan siswa dalam pembelajaran matematika masih menjadi tantangan pada jenjang sekolah dasar. Meskipun metode GASING (Gampang, Asyik, dan Menyenangkan) telah banyak digunakan dalam pembelajaran matematika, penelitian sebelumnya lebih banyak menekankan hasil belajar dan belum banyak mengkaji proses perubahan motivasi dari perspektif siswa. Penelitian ini bertujuan mendeskripsikan bagaimana penerapan metode GASING memfasilitasi pemenuhan kebutuhan psikologis dasar, yaitu kompetensi, otonomi, dan keterhubungan, serta bagaimana pemenuhan kebutuhan tersebut berkaitan dengan keterlibatan siswa dalam pembelajaran matematika. Penelitian menggunakan desain deskriptif kualitatif yang dilaksanakan selama empat bulan di tiga sekolah dasar negeri di Lampung, Indonesia. Data diperoleh melalui observasi pembelajaran, wawancara semiterstruktur dengan 40 siswa dan 6 guru, serta analisis dokumen. Data dianalisis menggunakan analisis tematik Braun dan Clarke dengan triangulasi sumber dan metode serta *member checking*. Hasil penelitian menunjukkan bahwa GASING memfasilitasi pemenuhan kebutuhan kompetensi melalui penggunaan benda konkret dan tahapan pembelajaran secara bertahap, kebutuhan otonomi melalui permainan, tantangan, dan pilihan strategi penyelesaian masalah, serta kebutuhan keterhubungan melalui pembelajaran kolaboratif dan lingkungan belajar yang suportif. Pemenuhan kebutuhan tersebut berkaitan dengan meningkatnya partisipasi, ketekunan, kesenangan belajar, berkurangnya kecemasan, serta penggunaan strategi belajar yang lebih aktif. Dengan demikian, GASING tidak hanya memberikan pengalaman belajar matematika yang menyenangkan, tetapi juga menyediakan kondisi pembelajaran yang mendukung keterlibatan siswa melalui pemenuhan kebutuhan psikologis dasar.

Kata kunci: pendidikan dasar; metode GASING; keterlibatan matematika; pemenuhan kebutuhan psikologis; studi kualitatif; *Self-Determination Theory*

ABSTRACT

Student motivation and engagement in mathematics learning remain challenges at the elementary school level. Although the GASING (Gampang, Asyik, dan Menyenangkan) method has been increasingly used in mathematics instruction, previous studies have largely emphasized learning outcomes and have paid less attention to the motivational processes experienced by students. This study aims to describe how the GASING method facilitates the satisfaction of basic psychological needs, namely competence, autonomy, and relatedness, and how such need satisfaction is associated with students' engagement in mathematics learning. A qualitative descriptive design was employed over four months in three public elementary schools in Lampung, Indonesia. Data were collected through classroom observations, semi-structured interviews with 40 students and 6 teachers, and document analysis. The data were analyzed using Braun and Clarke's thematic analysis, supported by source and methodological triangulation and member checking. The findings indicate that GASING facilitates competence satisfaction through the use of concrete manipulatives and gradual instructional sequences, autonomy satisfaction through games, challenges, and choices of problem-solving strategies, and relatedness satisfaction through collaborative learning and supportive classroom environments. These experiences were associated with increased participation and persistence, greater enjoyment, reduced mathematics anxiety, and more

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active use of learning strategies. Thus, GASING provides more than an enjoyable mathematics learning experience; it creates instructional conditions that support student engagement through the satisfaction of basic psychological needs.

Keywords: elementary education; GASING method; mathematics engagement; psychological need satisfaction; qualitative study; Self-Determination Theory

INTRODUCTION

Low motivation and limited engagement in mathematics learning remain persistent concerns that can affect students' learning experiences and the development of future human resources. TIMSS 2019 data indicate that only 38% of fourth-grade students in participating countries reported positive attitudes toward mathematics, with lower proportions observed in developing countries (Mullis et al., 2020). In Indonesia, the 2022 Asesmen Kompetensi Minimum (AKM) reported that 68% of elementary students performed below the minimum numeracy standard, highlighting the continuing challenge of strengthening elementary students' mathematical competencies (Kemendikbudristek, 2023). The problem is not limited to cognitive achievement. Affective barriers can also influence how students participate in and respond to mathematics learning. Math anxiety has been associated with poorer mathematics performance and can contribute to negative attitudes toward mathematics (Ashcraft & Moore, 2009). Recent evidence from elementary classrooms shows that fourth-grade students may experience both cognitive and affective forms of mathematics anxiety, while the use of concrete learning media, gradual examples, and supportive and enjoyable classroom environments can help create more positive learning experiences (Azhra et al., 2026; Sari et al., 2026). These conditions indicate the need for instructional approaches that address not only what students learn but also how they experience and engage in mathematics learning.

Student engagement is particularly important because learning mathematics requires sustained participation, effort, interest, and strategic thinking. Engagement is multidimensional, involving behavioral engagement through participation and persistence, emotional engagement through interest and enjoyment, and cognitive engagement through self-regulation and the use of learning strategies (Middleton et al., 2023). From a motivational perspective, students are more likely to engage actively when they experience themselves as capable, have meaningful opportunities to make choices, and feel supported by teachers and peers. These conditions are consistent with *Self-Determination Theory* (SDT), which proposes that motivation is strengthened when three basic psychological needs are satisfied: autonomy, competence, and relatedness (Deci & Ryan, 2000). Autonomy refers to experiencing a sense of choice and volition, competence refers to feeling capable and effective, and relatedness refers to feeling connected to and accepted by others. In mathematics learning, these needs are particularly relevant because students may perceive mathematics as difficult, abstract, and threatening when learning environments provide limited opportunities for successful experiences, meaningful choices, or supportive interactions.

The relevance of these motivational conditions is also supported by research on self-efficacy. Students' successful experiences can strengthen their beliefs in their mathematical capabilities, which in turn can influence their willingness to persist when facing challenging tasks (Bandura, 2022). Recent research further shows that the relationship between mathematics self-efficacy, achievement, and academic anxiety is complex, indicating that students' beliefs about their capabilities are closely connected to their experiences in mathematics learning (Peng et al., 2024). In addition, learning environments that emphasize progress, effort, and development rather than fixed ability can support students' motivation and persistence (Dweck, 2023). Productive struggle is also relevant in this context because movement from initial

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confusion toward clarity through effort and learning support can contribute to students' confidence and positive dispositions toward mathematics (Russo & Hubbard, 2024). Therefore, an instructional approach that provides gradual success, opportunities for meaningful participation, supportive feedback, and interaction with others may create conditions in which students' psychological needs are more likely to be satisfied.

The Indonesian context provides an important setting for examining these motivational processes. Research applying SDT to mathematics education has shown that students' interest, motivation, and confidence can shape their mathematical problem-solving behavior. Autonomy-supportive learning practices, particularly those that provide choices and acknowledge students' perspectives, can strengthen students' intrinsic motivation (Zulkarnaen & Ruli, 2023). However, research on self-determination in Indonesian mathematics education has also focused substantially on measurement and instrument development. For example, Annisa et al. (2022) developed an instrument for determining students' self-determination in mathematics learning, while Muhammad et al. (2025) examined the validity of a self-determination instrument. Research has also examined self-determination in online mathematics learning (Zulkarnaen, 2022). These studies demonstrate the relevance of SDT to Indonesian mathematics education but provide limited insight into how elementary students themselves experience the satisfaction of autonomy, competence, and relatedness during everyday mathematics instruction.

One instructional approach that provides a relevant context for examining these processes is the GASING method (*Gampang, Asyik, dan Menyenangkan* [Easy, Fun, and Enjoyable]). GASING was developed to make mathematics more accessible and enjoyable through structured learning experiences, concrete representations, gradual progression, and engaging activities. Existing research has reported positive learning outcomes associated with the method. Puspitasari et al. (2026), for example, reported improvements in mathematics learning outcomes and accuracy in two-digit multiplication among fifth-grade students. Daullu et al. (2025) found improvements in basic calculation skills among first-year university students participating in a GASING-based matriculation program, while Matahelumual and Yohamintin (2025) examined the influence of GASING on elementary students' mathematical understanding. More recent quasi-experimental evidence also indicates that GASING can contribute to improvements in elementary students' numeracy outcomes (Lahabu et al., 2025). In addition, Baity et al. (2026) found that implementing GASING influenced teachers' views of students' errors, instructional strategies, and reflective practices. Collectively, these studies demonstrate the potential of GASING as an instructional approach, but they have predominantly emphasized learning outcomes or teacher perspectives rather than students' motivational experiences.

The existing literature therefore leaves an important question insufficiently addressed: how does GASING support the motivational processes through which students become more engaged in mathematics learning? Previous GASING studies have largely documented changes in achievement, calculation ability, mathematical understanding, or teacher practices (Baity et al., 2026; Daullu et al., 2025; Lahabu et al., 2025; Matahelumual & Yohamintin, 2025; Puspitasari et al., 2026). They provide limited explanation of whether and how the concrete, enjoyable, gradual, and collaborative characteristics of GASING satisfy students' basic psychological needs. At the same time, SDT research in Indonesia has tended to emphasize instruments, teacher-reported perspectives, online learning, or relatively small-scale investigations (Annisa et al., 2022; Muhammad et al., 2025; Zulkarnaen, 2022; Zulkarnaen &



Ruli, 2023). Elementary students' own accounts of how they experience autonomy, competence, and relatedness during mathematics learning remain comparatively underexplored.

A further gap concerns the affective experiences of elementary students. Research on mathematics anxiety has documented students' cognitive and emotional responses to mathematics and highlighted the importance of concrete media, gradual explanation, and supportive classroom conditions (Sari et al., 2026). However, such findings do not yet explain how these classroom practices may operate through the satisfaction of basic psychological needs to support broader forms of mathematics engagement. Similarly, research on affective engagement emphasizes the complexity of students' emotional involvement in mathematics learning (Middleton et al., 2023), but the processes connecting specific instructional practices with students' motivational experiences require further qualitative examination. This gap is particularly important because students' perceptions and voices can reveal motivational processes that may not be captured adequately through achievement scores or standardized instruments.

The present study addresses these gaps by examining GASING through the lens of *Self-Determination Theory*. Rather than treating motivation simply as an outcome, the study investigates need satisfaction as a potential motivational pathway connecting GASING learning experiences with mathematics engagement. Concrete manipulatives and gradual instructional sequences are examined in relation to competence; games, challenges, and opportunities to select strategies are considered in relation to autonomy; and collaborative learning and supportive teacher–student interactions are examined in relation to relatedness. These dimensions are then considered in relation to behavioral, emotional, and cognitive engagement. This perspective enables the study to move beyond the question of whether GASING improves learning outcomes toward a more process-oriented question of how students experience and respond to the learning environment.

This qualitative descriptive study explores how the GASING method facilitates the satisfaction of basic psychological needs—autonomy, competence, and relatedness—as a pathway to mathematics engagement among elementary school students. Specifically, it aims to: (1) describe the characteristics of changes in students' learning motivation, including emotional, cognitive, and behavioral aspects; (2) identify the components of GASING that most strongly influence motivational change from the students' perspectives; (3) describe the dynamics of motivational change over time; and (4) provide a holistic portrayal of students' learning experiences with GASING. The study focuses on students' experiences in their natural classroom context without variable manipulation or experimental control.

The study offers four contributions. Theoretically, it extends the application of SDT to a locally developed mathematics instructional approach by examining how competence, autonomy, and relatedness are experienced within GASING-based learning. Methodologically, it provides a qualitative descriptive account of motivational processes that complements the predominantly outcome-oriented research on GASING. Substantively, it places elementary students' voices at the center of the analysis, providing an *emic* perspective on how students experience mathematics learning. Temporally, the four-month implementation provides an opportunity to examine how need satisfaction and engagement develop throughout the learning process rather than relying solely on a single cross-sectional measurement. By bringing these dimensions together, the study seeks to provide a clearer explanation of how student-centered and enjoyable mathematics instruction can support more positive and sustained engagement among elementary students.



METHODS

This study employed a qualitative descriptive design to examine changes in students' learning motivation and engagement during mathematics instruction using the GASING method. The study was conducted over four months, from October 2025 to January 2026, in three public elementary schools in Lampung, Indonesia. The design was selected to capture students' experiences in their natural classroom setting without manipulating variables or applying experimental controls. The research focused on how GASING learning activities were experienced by students in relation to competence, autonomy, relatedness, and mathematics engagement. The research process included preparation, data collection, data analysis, and interpretation, with flexibility to follow emerging findings during the study.

The participants consisted of 40 fourth- and fifth-grade students and six elementary school teachers selected through purposive sampling. Students had participated in GASING-based mathematics instruction for at least eight instructional sessions and represented variation in gender, academic ability, and socioeconomic background. The teachers had implemented the GASING method for at least one year and were included to provide additional contextual information and support the interpretation of students' accounts. Student participation required written parental or guardian consent and verbal student assent after an age-appropriate explanation of the study. Confidentiality was maintained by using participant codes or pseudonyms in the research records and reporting.

Table 1. Participant Characteristics

Variable	Students (n = 40)	Teachers (n = 6)
Gender	21 male, 19 female	2 male, 4 female
Age (Mean)	10.4 years	38 years
Grade Level	22 Grade IV, 18 Grade V	Bachelor of Education
GASING Experience	3.2 months	1.8 years (mean)
Academic Level	High: 12, Medium: 18, Low: 10	—
Socioeconomic Status	High: 8, Medium: 22, Low: 10	—
Interview Duration	37.2 minutes (mean)	59.5 minutes (mean)

Note: Academic level was classified based on average mathematics scores from the previous semester. Socioeconomic status was determined based on parents' education and occupation.

Data were collected using classroom observations, semi-structured interviews, and document analysis over the four-month research period. Classroom observations were conducted across eight instructional sessions and focused on student participation, classroom interactions, emotional expressions, learning activities, and responses to mathematical tasks. Semi-structured interviews were conducted with 40 students and six teachers, with student interviews lasting approximately 30–45 minutes and teacher interviews approximately 60 minutes. The interviews were conducted in Indonesian using age-appropriate and open-ended questions concerning students' experiences before and during GASING instruction, perceived motivational changes, learning choices, confidence, social interactions, and engagement. Document analysis included students' reflective journals, teachers' lesson plans, students' work products, and formative assessment records, while all interviews were audio-recorded and transcribed verbatim.

The unit of analysis was students' experiences of psychological need satisfaction during GASING-based mathematics instruction and their relationship to mathematics engagement. Need satisfaction included autonomy, competence, and relatedness as experienced by students

during learning activities. Autonomy referred to students' experiences of having choices and control over learning activities and problem-solving strategies. Competence referred to students' perceptions of their ability to understand mathematical concepts and successfully complete learning tasks, while relatedness referred to positive and supportive interactions with peers and teachers. Mathematics engagement was examined through behavioral engagement, emotional engagement, and cognitive engagement, including participation, persistence, enjoyment, reduced anxiety, self-regulation, reflection, and strategy use.

Data were analyzed using thematic analysis of 46 interview transcripts, observational field notes, and documentary materials. The analysis began with repeated readings of the data, followed by coding of meaningful units related to psychological need satisfaction, motivational change, and mathematics engagement. The coding process generated 678 meaning units, which were grouped into 22 categories and synthesized into five main themes. The analysis was conducted iteratively by comparing patterns across students, teachers, observations, and documents to identify consistent and contrasting accounts. The final themes were reviewed against the original data to ensure that the interpretation remained closely connected to participants' experiences.

The trustworthiness of the findings was supported through source triangulation, methodological triangulation, member checking, prolonged engagement, and an audit trail. Source triangulation involved comparing information from students, teachers, classroom observations, and documents. Methodological triangulation was achieved by comparing evidence from interviews, observations, and document analysis. Member checking was conducted with 15 participants, consisting of 10 students and five teachers, to confirm the consistency of the emerging interpretations with their experiences. In addition, two researchers independently coded the data and achieved 87% agreement, while the four-month research period and documented analytical decisions strengthened the credibility and transparency of the findings.

Table 2. Data Triangulation by Theme

Theme	Sub-theme	Students (n = 40)	Teachers (n = 6)	Observation	Documents
Competence Satisfaction	Concrete manipulatives	40	6	✓	–
	Gradual structure	38	6	✓	✓
Autonomy Satisfaction	Games and challenges	39	5	✓	–
	Choice in strategies	37	5	✓	✓
Relatedness Satisfaction	Collaborative learning	38	6	✓	–
	Supportive environment	40	5	✓	✓
Behavioral Engagement	Participation increase	39	6	✓	✓
	Persistence increase	37	6	✓	–
Emotional Engagement	Reduced anxiety	40	6	✓	–
	Increased enjoyment	39	6	✓	✓
Cognitive Engagement	Strategic learning	35	5	✓	✓

Note: ✓ = data source contributes to the theme; – = data source does not contribute.

RESULTS AND DISCUSSION

Hasil

Competence Satisfaction Through GASING

The analysis revealed that competence satisfaction emerged as the most prominent theme in students' experiences during GASING-based mathematics instruction. Prior to participating in GASING activities, many students perceived mathematics as difficult and expressed limited confidence in their mathematical abilities. These perceptions gradually changed as students engaged in learning activities that emphasized concrete manipulatives and a structured progression from concrete representations to abstract mathematical concepts.

Students consistently described how physical objects helped them understand concepts that had previously appeared confusing or inaccessible. Rather than memorizing procedures, they were able to construct understanding through direct interaction with learning materials. These experiences created opportunities for repeated success, which strengthened students' confidence and willingness to participate in mathematics learning. As one student explained:

"I used to think I was bad at math. But when I used sticks to learn addition, I understood it right away. It felt like... I could do it."

Teachers reported similar observations. Students who had previously been reluctant to answer questions or explain their reasoning became increasingly willing to participate in classroom discussions and present their solutions. The findings suggest that competence satisfaction developed through meaningful learning experiences that enabled students to experience success progressively rather than being confronted immediately with abstract symbolic representations. To illustrate the development of students' cognitive engagement and persistence during the implementation of GASING, observational findings are summarized in Figure 1.



Figure 1. Increase in Cognitive Engagement and Learning Persistence

Figure 1 illustrates a noticeable increase in students' willingness to engage with mathematical tasks, persist when facing difficulties, and employ various problem-solving strategies. Students demonstrated greater confidence in attempting challenging tasks and were less likely to abandon problems before reaching a solution. These findings indicate that competence satisfaction contributed not only to students' confidence but also to their sustained engagement in learning activities.

Autonomy Satisfaction Through Games and Challenges

A second major theme concerned students' experiences of autonomy during mathematics learning. Participants described GASING as providing greater opportunities to make decisions, select problem-solving approaches, and engage actively in learning activities. Unlike traditional

teacher-centered instruction, GASING encouraged students to explore mathematical ideas through games, challenges, and interactive tasks. Students reported that the opportunity to choose strategies and participate in game-based activities made mathematics learning more enjoyable and meaningful. One student stated:

“I enjoy solving math problems through play; we have to choose strategies to solve the problems quickly.”

Teachers also observed increased independence among students. Rather than immediately seeking answers from the teacher, students increasingly attempted to solve problems independently and collaborated with peers when difficulties arose. The opportunity to make choices during learning activities appeared to strengthen students’ sense of ownership over their learning process.

Furthermore, game-based activities reduced the pressure commonly associated with mathematics learning. Students focused on solving challenges and exploring ideas rather than avoiding mistakes. As a result, learning became a more self-directed experience in which students actively contributed to the construction of knowledge rather than passively receiving information.

Relatedness Satisfaction Through Positive Social Interaction

The findings also demonstrated the importance of relatedness satisfaction in supporting students’ motivation. Collaborative learning activities created opportunities for meaningful interaction among students and between students and teachers. Participants consistently described the classroom environment as supportive, encouraging, and enjoyable.

Students reported feeling more comfortable asking questions, expressing opinions, and discussing mathematical ideas with classmates. Teachers emphasized the importance of creating a classroom culture in which mistakes were viewed as opportunities for learning rather than failures. This shift was reflected in changes to feedback practices, with teachers focusing more on students’ thinking processes than on correct answers alone.

Such experiences contributed to a stronger sense of belonging and acceptance within the classroom. Students felt supported by both teachers and peers, which reduced mathematics-related anxiety and encouraged greater participation in learning activities. The development of social interaction and collaborative learning during GASING implementation is illustrated in Figure 2.



Figure 2. Social Interaction and Learning Collaboration

As shown in Figure 2, students became increasingly involved in collaborative discussions, peer support activities, and group problem-solving tasks. These interactions created a learning environment in which students felt safe to share ideas, seek assistance, and learn from one

another. The findings suggest that relatedness satisfaction played a significant role in fostering positive emotional experiences during mathematics learning.

From Psychological Need Satisfaction to Mathematics Engagement

The analysis indicates that changes in students' motivation occurred through the satisfaction of three basic psychological needs: competence, autonomy, and relatedness. Concrete manipulatives and gradual instructional sequences supported competence satisfaction by enabling students to experience success. Games, challenges, and opportunities to select problem-solving strategies promoted autonomy satisfaction by allowing students to exercise choice and control. Collaborative learning and supportive teacher-student relationships strengthened relatedness satisfaction by fostering positive social connections.

The fulfillment of these needs was associated with increased mathematics engagement across behavioral, emotional, and cognitive dimensions. Behaviorally, students became more active participants during classroom activities and demonstrated greater persistence when encountering difficulties. Emotionally, students reported enjoying mathematics more and experiencing lower levels of anxiety. Cognitively, students demonstrated greater use of learning strategies, reflection, and conceptual understanding.

Another important finding concerned the relevance of mathematics to students' everyday lives. Through contextualized learning activities, students increasingly recognized the practical value of mathematics beyond the classroom. This realization enhanced the perceived meaningfulness of learning and further strengthened students' motivation to engage with mathematical concepts. To provide an overall synthesis of the findings and their theoretical foundations, a summary is presented in Table 3.

Table 3. Summary of Research Findings and Theoretical Support

Aspect of Finding	Research Contribution	Supporting Theory/Previous Research	Implications for the <i>GASING</i> Method
Increased Emotional Engagement	Provides specific evidence of how enjoyable instructional design can actively build positive emotional engagement	Middleton et al. (2023) on the importance of affective engagement in mathematics learning	The " <i>Asyik</i> " (Fun) and " <i>Menyenangkan</i> " (Enjoyable) principles in <i>GASING</i> are proven effective in building students' positive emotional engagement
Changes in Self-Perception	<i>GASING</i> provides a structure enabling students to experience gradual success, thereby building mathematical self-efficacy	Self-efficacy theory (Bandura, 2022) that experiences of success enhance beliefs about one's own abilities	The phased learning structure of <i>GASING</i> (concrete → abstract) facilitates gradual success experiences
Techno-Positive Discourse Caution	Reminds that enjoyment must be explicitly connected to the development of mathematical critical thinking skills, not merely entertainment	Piedra Moreno (2024) on the phenomenon of <i>techno-positive discourse</i> in recontextualising transformative discourse	The " <i>Asyik</i> " and " <i>Menyenangkan</i> " principles need to be balanced with the development of critical thinking skills, not merely focusing on entertainment

Aspect of Finding	Research Contribution	Supporting Theory/Previous Research	Implications for the <i>GASING</i> Method
Role of Concrete Manipulatives	Proves that simple manipulatives made from local materials are effective in supporting mathematics learning in the Indonesian context	Research on embodied cognition in mathematics education (Shapiro, 2019)	The use of concrete manipulatives in <i>GASING</i> helps students understand abstract concepts through sensory experiences
Supportive Learning Environment	<i>GASING</i> creates a process-focused environment through feedback and normalisation of errors	Growth mindset research (Dweck, 2023) that development-focused environments enhance motivation and persistence	Process-focused feedback and normalisation of errors as part of learning

Table 3 summarizes the major findings of the study and demonstrates their alignment with the theoretical framework underpinning the research. Collectively, the findings indicate that *GASING* functions not only as an instructional method for improving mathematical understanding but also as a learning environment that supports students' psychological needs and promotes sustained engagement in mathematics learning.

Pembahasan

The findings of this study demonstrate that *GASING* facilitates mathematics engagement by supporting students' satisfaction of the three basic psychological needs proposed by Self-Determination Theory (SDT): competence, autonomy, and relatedness. Rather than merely improving learning outcomes, *GASING* appears to create instructional conditions that foster positive motivational experiences, which subsequently influence students' behavioral, emotional, and cognitive engagement in mathematics learning.

The first major finding concerns competence satisfaction. Students' increased confidence in mathematics was closely associated with the use of concrete manipulatives and gradual instructional sequences. These learning experiences enabled students to achieve repeated success, thereby strengthening their perceptions of competence. According to Bandura (2022), mastery experiences constitute the most influential source of self-efficacy because successful performance reinforces individuals' beliefs in their capabilities. The present findings support this argument by showing that students developed stronger confidence when mathematical concepts were introduced through accessible and achievable learning experiences. Similarly, Peng et al. (2024) reported that students' beliefs about their mathematical capabilities are closely linked to academic achievement and anxiety. The findings also support Shapiro's (2019) perspective on embodied cognition, which emphasizes the role of physical interaction with objects in facilitating conceptual understanding.

The second finding highlights the importance of autonomy satisfaction. Students consistently described *GASING* as a learning approach that provided opportunities for choice, exploration, and independent decision-making. Through games and problem-solving challenges, students were able to select strategies and determine how they approached mathematical tasks. This finding aligns with Self-Determination Theory, which argues that autonomy-supportive environments promote intrinsic motivation by allowing learners to experience volition and personal agency. Consistent with previous research, students who



perceived greater autonomy demonstrated stronger engagement and persistence during learning activities (Zulkarnaen & Ruli, 2023). The present study extends these findings by illustrating how autonomy is experienced directly within GASING-based classroom practices.

The third finding emphasizes the role of relatedness satisfaction in supporting motivation. Students reported feeling more comfortable participating in mathematics learning because classroom interactions were collaborative and supportive. Positive relationships with teachers and peers reduced anxiety and encouraged students to take intellectual risks, such as sharing ideas or attempting unfamiliar problem-solving strategies. These findings support previous SDT research suggesting that students are more likely to engage actively when they feel accepted and supported within their learning environment (Annisa et al., 2022; Muhammad et al., 2025). Importantly, the present study contributes a student-centered perspective by demonstrating how relatedness develops through everyday classroom experiences rather than through survey-based measurement alone.

The findings further reveal that competence, autonomy, and relatedness operate together as motivational pathways leading to mathematics engagement. Students who felt capable, autonomous, and socially connected demonstrated higher levels of participation, persistence, enjoyment, and strategic learning. This result is consistent with Middleton et al. (2023), who conceptualized mathematics engagement as a multidimensional construct encompassing behavioral, emotional, and cognitive dimensions. The present study contributes to this literature by providing qualitative evidence regarding the processes through which instructional practices influence these dimensions of engagement.

An important contribution of this study is its explanation of why GASING appears effective beyond its emphasis on enjoyable learning. Previous studies have largely focused on improvements in learning outcomes, numeracy skills, and mathematical understanding following GASING implementation (Daullu et al., 2025; Lahabu et al., 2025; Matahelumual & Yohamintin, 2025; Puspitasari et al., 2026). The present findings suggest that these improvements may be partly explained by the method's ability to satisfy students' basic psychological needs. In other words, GASING does not simply make mathematics enjoyable; it creates learning conditions that enable students to feel competent, autonomous, and connected, thereby supporting sustained engagement in mathematics learning.

Overall, this study extends the application of Self-Determination Theory within elementary mathematics education by demonstrating how a locally developed instructional approach can support students' psychological needs and engagement. The findings contribute to a deeper understanding of the motivational processes underlying successful mathematics learning and highlight the importance of designing learning environments that prioritize students' experiences as active participants in the learning process.

CONCLUSION

This study concludes that the GASING method supports the transformation of elementary students' motivation and engagement in mathematics through the satisfaction of three basic psychological needs: competence, autonomy, and relatedness. Competence was strengthened through the use of concrete manipulatives and gradual instructional sequences that enabled students to experience repeated success. Autonomy was supported through games, challenges, and opportunities to choose problem-solving strategies, while relatedness developed through collaborative learning and supportive interactions with teachers and peers.

The satisfaction of these psychological needs was associated with greater behavioral,



emotional, and cognitive engagement. Students demonstrated increased participation and persistence, greater enjoyment of mathematics, reduced anxiety, and more active use of learning strategies. Overall, the findings indicate that GASING functions not only as an enjoyable instructional method but also as a student-centered learning environment that supports positive motivational experiences and sustained engagement in elementary mathematics learning.

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