The effect of *soft skills-based group investigation* model on mathematical problem solving ability and *self-confidence of* secondary school student

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Abstract

Research indicates that the mathematical problem solving proficiency and *self-confidence* of Indonesian students, as evidenced by international assessments like PISA and TIMSS, remain areas demanding significant improvement. This situation underscores the critical necessity for an instructional paradigm that concurrently addresses both cognitive and affective development. This investigation aims to analyze the impact of implementing the Group Investigation learning model, integrated with deliberate soft skills reinforcement, on the mathematical problem-solving abilities and *self-confidence* of secondary high school students. Employing a quantitative methodology, the study involved two purposively selected eighth-grade classes from a public secondary high school in Bandung. Data were gathered using a descriptive test to evaluate problem-solving competency and a Likert scale questionnaire to measure *self-confidence* levels. Analytical findings revealed a statistically significant enhancement in both measured domains within the experimental group compared to the control group. Participants demonstrated superior conceptual comprehension, a more varied repertoire of solution strategies, and an enhanced capacity for logical justification of their reasoning. The implications of this research highlight the essential role of integrating social and emotional skill development into contemporary mathematics pedagogy. It is, therefore, recommended that educators adopt collaborative instructional strategies that foster an environment conducive to expressing opinions courageously, engaging in metacognitive reflection on thought processes, and employing adaptable problem-solving approaches. Such an environment facilitates the balanced and synergistic development of students' cognitive and affective domains.

Keywords: affective, cognitive, collaborative, cooperative learning, 21st century skills.

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INTRODUCTION

Mathematical problem solving ability is an essential competency in 21st century learning because it is directly related to higher order thinking skills (Wulandari et al., 2024; Oktiningrum & Wardani, 2019). Mathematics is not only taught as a set of procedures, but it must also train students to think critically, analytically, and creatively in dealing with complex real situations (Maharani & Kusno, 2023; Setiawan & Hendri, 2019; Marni & Pasaribu, 2021). Unfortunately, PISA 2018 data shows that Indonesia's math literacy score is only 379, far below the OECD average of 489 (OECD, 2019). This condition reflects a learning process that lacks reflection and conceptual exploration (Maryanti et al., 2021; Herlanti, 2024).

Another key factor is student *self-confidence*, as it plays an important role in motivation,

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perseverance, and learning expectations (Schunk, 2020; Ituga & Alman, 2023; Nilasari et al., 2020). The TIMSS 2019 survey indicates that Indonesian students' mathematical *self-confidence* is low, which causes a tendency to evitate new challenges (Mandini & Harini, 2022; Rahayu, 2021). For this reason, an approach that develops cognitive and affective aspects simultaneously is needed (Yuliarto, 2024; Nova et al., 2022).

The *Group Investigation* (GI) model is a cooperative approach that emphasizes problem identification, shared strategies, and collective evaluation (Taek & Masing, 2022; Serli et al, 2024). Junaidi & Taufiq (2021) stated in their research that GI significantly improved critical thinking and learning outcomes. However, the integration of soft skills such as collaboration, communication, and leadership proved to strengthen the effectiveness of GI (Ainiyah, 2022; Lestari, 2022).

Research indicates that the Group Investigation (GI) instructional model is consistently effective in enhancing a range of student competencies, from foundational to intermediate levels. A significant finding demonstrates that GI is efficacious in fostering critical thinking skills among elementary school students, a conclusion supported by a meta-analytic study (Yuliyanti & Rahayu, 2021). Furthermore, substantial gains in mathematical conceptual understanding and *self-confidence* were observed in elementary students exposed to GI-based instruction (Edison & Sowanto, 2021).

At the secondary school level, studies have established that the Group Investigation (GI) model produces analogous positive outcomes on student learning.. The development of critical thinking skills clearly occurs in secondary high school students who get the GI learning model (Sutarsa & Puspitasari, 2021). Not only the critical thinking aspect, GI combined with a scientific approach can also strengthen students' mathematical reasoning and resilience (Dian & Cahyani, 2024). Students' mathematical concept understanding ability can also be significantly improved through the application of GI, as shown in another study (Serli, et al., 2024). In addition, the GI model integrated with *soft skills* development is proven to be able to encourage the improvement of students' problem solving, communication, and collaboration skills (Sabirin et al., 2022; Marlisa & Jailani, 2023). Even in the context of speaking skills, GI also shows a positive influence on students' communication skills in learning activities (Rahma et al., 2023). These findings reinforce the belief that GI is not only effective in improving academic competence, but also in developing students' social-emotional aspects as a whole.

While numerous studies underscore the advantages of the Group Investigation (GI) model, there exists a paucity of research that explicitly incorporates soft skills and *self-confidence* within the context of secondary high school mathematics problem solving. Sholihah et al. (2021) established that GI enhances critical thinking, yet their work did not establish a direct correlation with soft skills or self-assurance. Similarly, Utama et al. (2020) examined the association between soft skills and academic achievement without connecting it to a specific pedagogical framework. Furthermore, the investigation by Hidayati et al. (2023) explored soft skills in isolation from the GI model, thereby illuminating a discernible research gap that necessitates further inquiry (Meika & Sujana, 2021; Murtiastuti, 2024). The principal novelty and contribution of this research reside in the deliberate and systematic integration of soft skills into every phase of the GI protocol. This is operationalized through meticulously structured activity designs, explicitly defined rubrics for affective assessment, and reflective feedback mechanisms specifically engineered to cultivate positive academic attitudes.

Therefore, the objective of this research is to analyze the effects of implementing the Group Investigation model, which is explicitly reinforced with soft skills, on both the problem-solving competency and the self-assurance of secondary high school students in mathematics. In addition, this study also compares the learning outcomes with conventional learning approaches that are still widely applied in schools. This comparison is important to find out the extent of the advantages of the *soft skills-based* GI model compared to traditional teaching methods that tend to be teacher-centered and focus on delivering material in one direction. Conventional models often lack space for students to develop collaborative skills, independence, and confidence in problem solving.

Therefore, through this comparison, it is expected to find empirical evidence that supports the effectiveness of innovative approaches in learning mathematics that not only develop students' cognitive, but also affective aspects. The results are expected to enrich the theoretical framework of 21st century learning and provide implementative recommendations for teachers.

Guided by Vygotsky's (1978) theory of social constructivism, this study assumes that learning occurs through active interaction, collaboration, and mediation among learners. The Group Investigation (GI) model reflects Vygotsky's Zone of Proximal Development (ZPD), in which social collaboration and peer scaffolding enable students to achieve higher levels of cognitive and affective competence. Within mathematics learning, such collaboration allows learners to co-construct meaning, share cognitive strategies, and internalize problem-solving processes through language and social interaction (Schunk, 2020; Saepuloh et al., 2022).

METHODS

This study employs a quantitative methodology, utilizing a quasi-experimental design to investigate the impact of a soft skills-integrated Group Investigation (GI) learning model on the mathematical problem-solving ability and *self-confidence* of secondary high school students. The quasi-experimental approach was selected due to the constraints inherent in formal educational settings, where the random assignment of subjects is not feasible because of pre-existing, fixed class structures established by the institution (Rahmawati & Susanto, 2020; Suharjo et al., 2021). The specific design implemented is a nonequivalent control group design. This quasi-experimental framework involves two intact groups: an experimental group and a control group, which are not randomly assigned. This design was chosen not only to assess the efficacy of the soft skills-based GI model but also to facilitate a direct comparison of its outcomes against those of conventional instructional methods typically employed in classrooms. Both groups were administered a pretest prior to the intervention and a posttest following its completion. This procedure enables the measurement of differential learning gains attributable to the distinct learning models. This design is deemed highly suitable for authentic classroom environments, as it accommodates administrative limitations and the predetermined organization of student groups, thereby upholding the ecological validity of the research (Yaniawati & Indrawan, 2024). The total sample of 78 students is considered sufficient for quasi-experimental research in mathematics education. Furthermore, using Cohen's (1988) power analysis approach, with an assumed medium effect size ($d = 0.65$), $\alpha = 0.05$, and statistical power ($1-\beta$) = 0.80, the sample size meets the requirement to detect meaningful differences between groups. Nevertheless, given the non-random nature of sampling, this adequacy should be interpreted cautiously, and future studies are encouraged to employ larger and randomized samples to enhance generalizability. Consequently, this methodological framework allows for an objective evaluation of the relative effectiveness of the soft skills-enhanced GI model compared to traditional teaching approaches in enhancing students' mathematical problem-solving skills and *self-confidence*.

The target population for this research comprised all eighth-grade students at a public secondary high school in Bandung. The sample consisted of two intact classes, designated as the experimental and control groups, each containing 39 students. The sampling procedure employed a purposive sampling technique, a non-probability method wherein subjects are selected based on specific criteria to ensure the sample optimally represents the population's characteristics (Yaniawati & Indrawan, 2024). The experimental group received instruction via the soft skills-integrated Group Investigation model, whereas the control group was taught using conventional methods. The study was conducted over a one-month period. Throughout this duration, the instructional approach in the experimental class adhered to a modified GI framework specifically designed to incorporate explicit soft skills development. Although the implementation period occurred in March–April 2016, the dataset is classified as archival data and was reanalyzed using updated theoretical and methodological perspectives relevant to the 2024–2025 educational context. The decision to use this dataset was based on its completeness, validity, and the continuing relevance of soft skills–based cooperative learning as emphasized in recent studies (Yuliarto, 2024). Reanalysis allowed the researchers to reinterpret the data through the lens of current frameworks in 21st-century mathematics education, which highlight socio-emotional competence and collaborative problem-solving as central learning goals.

This study involved two types of variables, namely independent variables and dependent variables. The independent variable is the *soft skills-based Group Investigation* learning model, while the dependent variable consists of students' mathematical problem solving ability and *self-confidence* (Dina & Siregar, 2022). Problem solving ability is measured through a context-based description test, while *self-confidence* is measured using a 4-point Likert scale questionnaire.

To ensure systematic integration, a structured mapping between the six stages of the Group Investigation (GI) model and the 14 targeted soft skill attributes was developed, as presented in Table 1. This design was adapted from several empirical and conceptual studies that integrate cooperative learning with affective skill formation (Ainiyah et al., 2022; Lestari, 2022).

Table 1. Structured mapping between the six stages of the GI model and the 14 targeted soft skill attributes

GI Phase	Integrated Soft Skill Attributes	Example of Implementation Activities
Topic Identification	Communication, Critical Thinking	Students collectively identify real-world mathematical issues and justify topic relevance.
Planning the Investigation	Cooperation, Responsibility, Independence	Groups plan procedures, assign roles, and design steps for data collection.
Conducting the Investigation	Creativity, Honesty, Hard Work	Students collect information, test hypotheses, and evaluate accuracy collaboratively.
Preparing Reports	Respect, Collaboration, Communication	Groups synthesize findings and prepare presentations using visual/mathematical representations.
Presenting Results	Courage, Courtesy, Confidence	Each group member presents results, answers peers' questions,

GI Phase	Integrated Soft Skill Attributes	Example of Implementation Activities
		and receives feedback.
Evaluation and Reflection	Self-Assessment, Caring, Religious Attitude	Learners reflect on performance, interpersonal ethics, and teamwork experiences.

Self-confidence was measured using a 4-point Likert-shaped attitude scale questionnaire based on indicators of *self-confidence* in learning mathematics. In addition, observations were made to record the implementation of learning and student engagement, especially in the experimental class (Sun at al., 2022). The *soft skills* attributes used as the basis in this study include: courtesy, caring, religion, cooperation, independence, communication, courage, respect for other opinions, hard work, creativity, critical thinking, responsibility, honesty, and self-assessment. Each of these attributes is assessed using a validated observation rubric to ensure consistent measurement of indicators.

Before use, the research instruments were theoretically and empirically validated. Content validity was determined through expert judgment, while empirical validity was obtained through instrument trials. Item validity was analyzed using Pearson Product Moment correlation, and instrument reliability was calculated using the Cronbach Alpha formula for questionnaires and KR-20 for tests. In addition, the analysis of the level of difficulty and distinguishing power was carried out to ensure the quality of the questions (Mustaqim & Sulisti, 2023). After processing, the instrument test results show that question number 1 has poor differentiating power, so based on the supervisor's justification, the question needs to be corrected.

Prior to performing comparative statistical analyses on the mathematical problem-solving abilities of the experimental and control cohorts, prerequisite assessments were conducted to evaluate the normality and homogeneity of the post-test data. A normality test was administered utilizing the Kolmogorov-Smirnov method at a 5% significance threshold. The analysis yielded significance values of 0.699 for the experimental group and 0.558 for the control group, both exceeding the 0.05 benchmark. These results indicate that the post-test data for both classes are normally distributed. Subsequently, a homogeneity test employing Levene's Test produced a significance value of 0.372, which is likewise greater than 0.05, leading to the conclusion that the data from both groups exhibit homogeneous variances. Given that the data met the assumptions of normality and homogeneity, an independent samples t-test was selected as the appropriate statistical procedure to determine the significance of differences in problem-solving abilities between the two groups. For *self-confidence* data, which were measured on an ordinal scale, analysis was conducted both descriptively, through percentage calculations, and inferentially, using the Mann-Whitney U test.

The research implementation procedure includes four stages, namely: (1) the preparation stage in the form of initial studies, preparation of learning devices and instruments, and trials; (2) the implementation stage includes giving pretests, implementing learning with different treatments in each group, and giving posttests; (3) the observation stage to observe the learning process; and (4) the data analysis and conclusion stage to answer the problem formulation (Rosdiana & Widodo, 2022). All of these stages are designed to ensure the measurability, reliability, and objectivity of the research results.

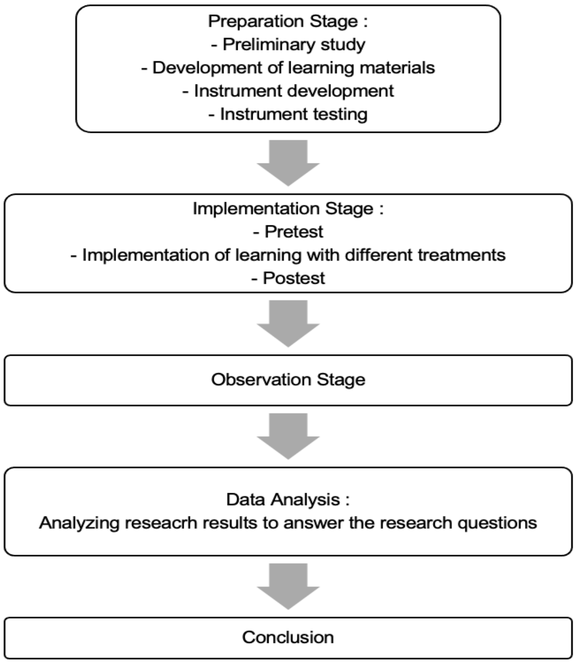

Figure 1. Flowchart of the research

RESULTS AND DISCUSSION

This research aims to examine the impact of the Group Investigation (GI) learning model on the mathematical problem-solving ability and *self-confidence* of secondary high school students. Data were gathered from two distinct groups: an experimental group, designated as the GIBSS class (which received instruction via the soft skills-integrated GI model), and a control group, referred to as the conventional (KNV) class (which was taught using conventional instructional methods).

The primary data collection technique for assessing mathematical problem-solving skills was a written test. This instrument was administered on two occasions: prior to the instructional intervention (pretest) and following its completion (posttest). Data pertaining to student *self-confidence* were collected after the treatment concluded and were subsequently transformed using the MSI (Method of Successive Intervals) technique. Qualitative data were derived from observational protocols recorded during the implementation of the GIBSS learning sessions.

Mathematical Problem Solving Ability

Descriptive statistics for the students' mathematical problem-solving ability, encompassing both pretest and posttest scores for the GIBSS and conventional classes, are presented below.

Table 2. Average of Pretest and Posttes of Students ‘Mathematical Problem Solving Ability

Class	Pretest Mean	Standard Deviation of Pretest	Posttest Average	Sandard Deviation of Posttest
GIBSS	2,85	1,61	9,59	3,17
KNV	2,67	1,67	7,56	3,24

As illustrated in Table 2, the mean pretest scores for students' mathematical problem-solving ability were relatively comparable between the two cohorts prior to the administration of the treatment. Following the instructional period, an increase in scores was observed in both groups; however, the class utilizing the **soft skills-integrated Group Investigation model (GIBSS)** demonstrated a higher mean post-test score than the conventional class. This suggests that the implementation of the GIBSS learning model **contributes more significantly** to the enhancement of students' mathematical problem-solving skills compared to conventional instructional methods. Although the standard deviations of the post-test results for both classes were relatively similar, the score distribution reveals variations in the dispersion of student abilities within each group. A more detailed examination of these differences was conducted through an analysis of the pretest data.

The analysis of the pretest data was performed to ascertain the initial mathematical problem-solving capabilities of students in both the GIBSS and conventional (KNV) classes before the learning intervention. According to Table 2, the mean pretest scores for mathematical problem-solving were notably low in both instructional settings prior to the study

A two-sample mean difference test was conducted using an independent samples t-test, as the data satisfied the assumptions of normality and homogeneity of variances. The results of this statistical analysis for the pretest data are presented in Table 3 below:

Table 3. Mean Difference Test Results of Two Pretests of Mathematical Problem Solving Ability

Pretest mathematical problem solving ability	t-test for Different of Means			criteria
	t	df	Sig.(2-tailed)	
Equal variances assumed	0,482	76	0,631	H_0 is accepted

As indicated in Table 3 for the two-tailed test, the significance value (Sig. (2-tailed)) is 0.631, which exceeds the 0.05 threshold. Consequently, the null hypothesis (H_0) is retained. This result indicates that there is no statistically significant difference in the mean mathematical problem-solving scores between the GIBSS class and the conventional class prior to the instructional intervention. In other words, the initial mathematical problem-solving abilities of students in both the GIBSS and conventional cohorts were equivalent at the outset of the study. This equivalence ensures that both groups began the learning process from a comparable baseline, thereby enhancing the validity of attributing any observed differences in post-test outcomes to the effects of the instructional treatment administered.

The analysis of the post-test data was conducted to evaluate the mathematical problem-solving abilities of students in both the GIBSS and conventional classes following the completion of the learning period. The results of the post-test assessments for mathematical problem-solving skills are summarized in Table 4.

Table 4. Descriptive Statistics of Posttest Data

Class	N	X_{min}	X_{maks}	Average	Standard Deviation
GIBSS	39	8	29	17,49	5,404
KNV	38	8	25	14,55	4,740

Based on the data presented, it can be concluded that the experimental group achieved a higher average score than the control group. Additionally, the spread of data in the experimental group is slightly more dispersed. This indicates a divergence in the outcome trends between the two groups, which may be attributed to the treatment administered to the experimental cohort.

Subsequently, a normality assessment was conducted using the Kolmogorov-Smirnov test at a 5% significance level. The analysis yielded significance values of 0.699 for the experimental class and 0.558 for the control class, both exceeding the 0.05 threshold. These results confirm that the post-test data for both groups are normally distributed. Moreover, a homogeneity test employing Levene's Test produced a significance value of 0.372, which is also greater than 0.05, indicating that the data from both classes exhibit homogeneous variances. Given that the assumptions of normality and homogeneity were met, an independent sample t-test was deemed appropriate to evaluate the difference in problem-solving abilities between the two groups. This statistical test was utilized to determine the comparative effectiveness of the instructional approaches on students' final problem-solving performance. The results of the t-test analysis are summarized in Table 5 below.

Table 5. Result of t Test (Independent Sample Test) Posttest Data

	Levene's Test for Equality of Variances		**t-test for Different of Means**		
	F	Sig.	t	df	Sig.(2-tailed)
Postes Equal variances assumed	.807	.372	2.531	75	.013

Based on the results of the independent samples t-test conducted at the 5% significance level, the obtained sig. (2-tailed) value of 0.013 is less than 0.05. Consequently, the null hypothesis (H_0) is rejected. It can be concluded that, following the instructional intervention, the mean post-test mathematical problem-solving ability of students in the experimental class is statistically significantly higher than that of the control class. These findings are consistent with the research conducted by Dina and Siregar (2022) which indicates that the Group Investigation (GI) model is effective in enhancing students' mathematical reasoning and problem-solving skills, as it promotes systematic thinking, problem identification, and the development of solutions through collaborative group discussions. Furthermore, in accordance with studies by Silva et al. (2023), Bucu (2022), and Salamor & Kempa (2024), GI has been demonstrated to be effective in improving critical thinking and problem-solving abilities by engaging students in a cooperative and reflective investigative process.

The analysis revealed a significant improvement in the mathematical problem-solving capabilities of the experimental group after the treatment. This aligns with previous findings, which assert that GI effectively stimulates higher-order thinking processes (Salamor & Kempa, 2024; Silva et al., 2023). The GI model encourages students to devise problem-solving strategies through collaborative group work, discursive interactions, and the exploration of authentic, real-world problems (Chen, 2024). This approach fosters a challenging learning environment while simultaneously supporting the development of students' metacognitive competencies, such as planning, monitoring, and self-evaluation during problem-solving (Rahmawati & Setyaningsih, 2023).

According to Dina and Siregar (2022), the investigation-based approach fosters a sense of individual and group responsibility in solving mathematical problems. On the other hand, conventional methods tend to emphasize procedural understanding without stimulating much reasoning. Another study by Nopriana (2020) also emphasized that GI helps improve students' interpersonal skills and mathematical communication. In this context, strong social interaction contributes to successful mathematical learning.

Data Analysis of Students' Self-Confidence Questionnaire

The analyzed data on mathematics *self-confidence* towards learning mathematics shows the attitudes and actions of students when learning mathematics. The data were obtained from the results of students' mathematics *self-confidence* questionnaires given to 62 experimental and control classes. This questionnaire was given to both classes after the post- test (final test). The questionnaire consists of 30 statements with 5 indicators presented in the table as follows.

Table 6. Mathematics Disposition Questionnaire Indicators

No	Indicator	Statement Number	
1.	Self-confidence with indicators confidence in ability/belief	Positive	1, 2, 5
		Negative	3, 4, 6
2.	Curiosity with frequent indicators asking questions, conducting investigation, enthusiasm/enthusiasm in learning, and read a lot/look for sources	Positive	7, 9, 10, 11
		Negative	8, 12, 13, 14
3.	Perseverance with indicators persistent/ diligent/ attentive/ sincere	Positive	15, 16, 19
		Negative	17, 18
4.	Flexibility with cooperation indicators and respect different opinions, and try to find other solutions/ strategies	Positive	22, 23, 24
		Negative	20, 21
5.	Reflective and enjoyment with indicators of acting and relating with mathematical and liking/feeling happy with math	Positive	26, 27, 30
		Negative	25, 28, 30

The data from the students' mathematics disposition questionnaire were processed by calculating the average score of each student on each indicator. From the average score of the mathematics disposition questionnaire of experimental and control class students, the percentage of many students who have an average score of more than or equal to 3 for each disposition indicator is calculated.

Table 7. Result of Mathematics Disposition Questionnaire

Indicator of Self-confidence	GIBSS		KNV	
	N	Percentage	N	Percentage
Indicator 1	32	82,05%	26	68,42%
Indicator 2	35	89,74%	28	73,68%
Indicator 3	25	64,10%	25	65,79%
Indicator 4	36	92,31%	32	84,21%
Indicator 5	37	94,87%	33	86,84%

The results of the analysis showed that students in the experimental class, who learned with mathematics teaching materials with character, tended to have a higher level of *self- confidence* than students in the control class. They feel more confident in their own abilities, have greater curiosity, and show a more flexible attitude in dealing with learning. In addition, the learning atmosphere in the experimental class also encouraged feelings of pleasure as well as the tendency to reflect on their learning process. Nonetheless, the perseverance indicator showed that both classes had relatively balanced achievements, so special efforts were still needed to improve this aspect in all students. This finding indicates that teaching materials with character not only impact the cognitive domain, but also strengthen the affective dimension of students in learning mathematics.

Furthermore, a statistical test of *self-confidence* questionnaire will be conducted on both classes to find out whether the *self-confidence of* students in both classes is significantly different or not. The Mann Whitney U test results are in the table as follows.

Table 8. Mann-Whitney Test Results of Mathematics Disposition Questionnaire

	Self-confidence
Mann-Whitney U	375.000
Wilcoxon	1098.000
Z	-3,914
Asymp Sig. (2-tailed)	.000

Based on the data presented in the table above and applying a 5% significance level, the obtained sig. (2-tailed) value is 0.000. Consequently, $\frac{1}{2}$ significance (sig.) = 0.000 < 0.05, leading to the rejection of the null hypothesis (H_0). This indicates that the *self-confidence* of students in the experimental class is significantly higher than that of their counterparts in the control class.

This finding was substantiated by observational data collected during the instructional process, which noted that students in the Group Investigation (GI) class demonstrated greater active participation in articulating their viewpoints and exhibited assurance when presenting the outcomes of group discussions. The observed improvement in students' *self-confidence* can be further interpreted through the lens of Bandura's (1997) *self-efficacy theory*, which posits that confidence develops through mastery experiences, social modeling, and verbal encouragement. Within the GI framework, collaborative group work enables learners to experience success collectively, observe peers' strategies, and receive positive feedback—all of which reinforce self-efficacy and perceived competence. Moreover, the cooperative nature of GI enhances learners' sense of autonomy and belongingness, fostering emotional safety and intrinsic motivation (Schunk, 2020; Gokhale et al., 2017). These findings suggest that the increase in confidence among students in the experimental group was not merely a by-product of group interaction, but a result of psychological empowerment through social support and shared responsibility (Ituga & Alman, 2023). According to Nilasari et al. (2020), *self-confidence* serves as a critical factor in mathematics education, as it enhances students' engagement in completing tasks and confronting academic challenges. A study by Gokhale et al. (2017), published in the journal *Education and Information Technologies*, further supports this, indicating that group-based learning approaches, such as GI, markedly boost students' *self-confidence* in expressing their ideas, attributable to the supportive dynamics within the group.

According to Bandura (1997), *self-confidence* is part of *self-efficacy* that allows individuals to take action despite facing challenges. In GI, students are encouraged to be active, discuss, and take roles in groups, thus strengthening their *self-confidence* (Gokhale et al., 2017). The study by Ainiyah et al. (2022)

showed that the collaborative learning approach is able to increase *self-confidence* because students feel more comfortable expressing opinions in front of peers. This is also supported by Dina and Siregar (2022) who stated that GI encourages students to become independent and confident learners.

Similar findings were conveyed by Ainiyah et al. (2022) in the JIPF journal which states that the project-based GI model provides an authentic experience that strengthens students' learning identity and *self-confidence*. Emotional and social engagement factors also play an important role. According to Nofita & Rusnilawati (2022), GI creates an emotionally supportive learning environment, so students feel safe to explore and learn from mistakes.

The implementation of soft skills, including communication, collaboration, and responsibility, substantially facilitates the effective execution of the Group Investigation (GI) model. This approach integrates the affective and cognitive dimensions of student learning into a cohesive instructional process (Ainiyah et al., 2022). Research conducted by Dina and Siregar (2022) affirmed that the reinforcement of soft skills exerts a positive influence on students' learning motivation and academic outcomes. In the context of mathematics education, soft skills enable students to remain open to alternative solution strategies and demonstrate respect for diverse perspectives. The findings reveal that students in the experimental group, who underwent soft skills-based Group Investigation learning, exhibited a more substantial enhancement in mathematical problem-solving ability compared to their counterparts in the control group. This improvement was observed across nearly all assessed indicators, including the capacity to comprehend problems, devise strategic plans, execute solutions, and evaluate outcomes. Theoretically, the GI model fosters active student engagement in investigative processes, facilitates the exchange of ideas, and promotes the construction of understanding through collaborative discourse. The incorporation of soft skills at each phase of GI, such as cooperation, communication, and critical thinking, amplifies social interaction and intellectual elaboration, which, aligned with Vygotsky's social constructivism theory, enhances the depth of mathematical comprehension.

Regarding *self-confidence*, students in the experimental class also demonstrated a more pronounced increase across most indicators, such as willingness to express opinions, collaborative capability, and self-reflective practices, relative to the control group. This outcome can be attributed to the inherent characteristics of GI, which position learners as active participants, provide a supportive environment for idea sharing, and cultivate self-assurance through the successful completion of group tasks. The emphasis on soft skills, including effective communication, respect for others' viewpoints, and cooperative behavior, establishes a framework of social support that reinforces *self-confidence*.

However, the increase in *self-confidence* did not occur evenly across all indicators. For example, the perseverance indicator did not show significant changes. One possible reason for this is the limited time of the intervention, which only lasted one month, so that changes in habitual behavior, such as perseverance, take longer to develop. In addition, external factors such as exam pressure, study habits at home, and perceptions of mathematics may also affect students' perseverance. The implication of this finding is the need for a sustainable learning design with intensive monitoring to shape dispositional *soft skills*, such as perseverance and hard work.

Collectively, the findings of this study substantiate the perspective that collaborative learning, when integrated with soft skills development, can yield a dual impact: enhancing cognitive learning outcomes while simultaneously fostering students' character development. By considering the factors that influence the cultivation of specific soft skills, educators can devise more effective and sustainable instructional strategies.

CONCLUSION

This study demonstrates that the implementation of a soft skills-based Group Investigation model significantly enhances the mathematical problem-solving ability and *self-confidence* of secondary high school students. Students instructed through this approach exhibited active participation, a willingness to express opinions, and superior critical and reflective thinking skills relative to their peers in conventional learning settings. Theoretically, these findings reinforce existing research indicating that the integration of soft skills into mathematics instruction can concurrently develop cognitive and affective domains while fostering 21st century skills. From a practical standpoint, these results offer educators a framework for adapting collaborative learning strategies that promote cooperation, communication, and student accountability in learning. This research acknowledges certain limitations, including the one-month intervention period, which may constrain the development of certain soft skills, such as perseverance and diligence, that require long-term habituation. External variables, including parental support, home learning environments, and examination schedules, were not fully controlled and may have influenced the outcomes. Nevertheless, the soft skills-based Group Investigation model contributes not only to academic achievement but also to character development and students' preparedness for future challenges. This pedagogical innovation warrants broader implementation as a holistic approach to empowering learners in mathematics education. For future investigations, it is advisable to employ larger and more diverse samples, incorporate schools from varied contexts, and extend the intervention duration. Subsequent research could also examine the effects of this model on other 21st century competencies, such as digital literacy or interdisciplinary collaboration skills, and investigate targeted strategies for cultivating soft skills that are particularly resistant to short-term improvement. In addition, future studies are encouraged to explore the application of the Group Investigation (GI) model within digital or hybrid learning environments, where online collaboration tools can enhance interaction, communication, and problem-solving processes. Such digital integration is particularly relevant in the post-pandemic education era, where blended instruction has become the norm Moreover, longitudinal research designs are recommended to trace the sustained development of soft skills such as persistence, adaptability, and teamwork across multiple semesters. Investigating these long-term trajectories would provide deeper insights into how cognitive, affective, and digital competencies evolve synergistically within modern mathematics classrooms.

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