

Systematic Literature Review: The Effectiveness of the Group Investigation (GI) Learning Model Assisted by Manipulative Media on Mathematics Learning

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Abstract

Mathematics learning should be designed with strategies that foster students' critical thinking and collaborative skills, as well as conceptual understanding. However, in reality, the mathematics learning process in the classroom still focuses heavily on procedural aspects. Teachers tend to emphasize problem-solving exercises without optimizing the use of manipulative media to deepen conceptual understanding. One approach considered effective in addressing this problem is the Group Investigation (GI) cooperative learning model, especially when combined with manipulative media that can help students represent abstract concepts concretely. This study aims to identify and analyze the effectiveness of implementing the GI model, supported by manipulative media, in mathematics learning using a Systematic Literature Review (SLR) approach. The research method was conducted by reviewing various scientific articles from national and international databases using strict inclusion and exclusion criteria to ensure the relevance and quality of the sources. The results of the study indicate that the use of the GI model, supported by manipulative media, consistently improves students' mathematics learning at various levels of education. Therefore, this study recommends the implementation of the GI model assisted by manipulative media as an innovative alternative in mathematics learning that focuses on active and in-depth learning experiences.

Keywords: Group Investigation, Manipulative Media, Mathematics Learning.

1 INTRODUCTION

Mathematics learning essentially aims to develop logical, analytical, and creative thinking skills through problem-solving activities. However, in reality, many students still experience difficulty in understanding abstract concepts, so the learning process tends to be mechanistic and oriented towards memorizing formulas (Istikomah et al., 2020). This condition requires teachers to develop a more interactive, collaborative, and contextual approach so that students are actively involved in building knowledge. One learning model relevant to the *student-centered learning paradigm* is the cooperative model of the *Group Investigation (GI)* type. John Dewey, initiated the concept of education, In essence, the classroom is a mirror for society and is useful as a laboratory in learning about real life. Dewey's ideas were finally realized in the *group investigation model*, which was later developed by Herbert Thelen. Thelen (2015), stated that the classroom should be a miniature democracy that aims to examine social problems between individuals. *Group Investigation (GI)* is a cooperative learning model, students search for material (information) independently, using materials that are already available. In addition, *group investigation model* combines the principles of a democratic model where students are actively involved in learning activities, from the initial stage to the final stage of learning (Rahmat & Fitri, 2024). According to M. Hosnan (2014), the GI model can be used to guide students to be able to think systematically, critically, analytically, actively participate in learning and have a creative culture through problem-solving activities. This model also emphasizes group work, investigation, and presentation of results that encourage students to think critically and be responsible for their learning process (Sharan et.al, 1992).

In addition to learning models, manipulative media also plays a crucial role in helping students understand abstract mathematical concepts. According to Cecep Kustandi (2021) , the use of manipulative media can increase student engagement and help link concrete concepts with symbolic representations. The combination of the GI method and manipulative media is expected to create more meaningful, collaborative, and effective learning, improving learning outcomes .

Various previous studies have shown that the implementation of the GI model has a positive impact on mathematics learning. Research by (Marlisa et.al., 2023) found that the GI model improves students' communication, collaboration, and critical thinking skills. Meanwhile, a study by (Ponte et.al., 2023) showed that manipulative media can improve elementary school students' conceptual understanding and learning interest. However, most of these studies have been conducted separately, focusing on the effectiveness of the GI model or manipulative media, rather than a combination of the two. Therefore, a systematic review is important to identify the effectiveness of integrating the GI method with manipulative media in mathematics learning across various educational contexts .

Although numerous empirical studies have addressed the effectiveness of the GI model and manipulative media, there remains a gap in the literature regarding a systematic synthesis of evidence on how the combination of the two affects mathematics learning. Some research remains local, limited to specific levels, and has not been comprehensively analyzed using a *Systematic Literature Review (SLR) approach* . Therefore, research is needed that can summarize, assess, and interpret empirical findings in a structured manner to provide a comprehensive picture of the effectiveness of this approach.

This study aims to systematically examine the results of research related to the effectiveness of the Group Investigation (GI) learning method assisted by manipulative media on mathematics learning. The main focus of this study is to analyze the impact of implementing this combination on conceptual understanding, critical thinking skills, learning outcomes, reasoning and proof, problem solving, mathematical communication, and mathematical connections (NCTM, 2000) . This research has several important contributions. Theoretically, the results of this study enrich the literature on the integration of cooperative learning models and the use of concrete media in the context of mathematics education. Practically, the findings of this study can serve as a reference for teachers, curriculum developers, and educational researchers in designing more interactive and meaningful mathematics learning. Furthermore, the results of this *Systematic Literature Review* are expected to serve as a basis for further research oriented towards empirical implementation in the classroom.

2 RESEARCH METHODS

This study uses the *Systematic Literature Review (SLR)* method with a descriptive qualitative approach. This approach is used to systematically examine the results of previous studies related to the effectiveness of implementing the *Group Investigation (GI)* learning model assisted by manipulative media in mathematics learning. According to Kitchenham & Charters (2007) , SLR is a research procedure that aims to identify, evaluate, and interpret all findings relevant to the research question in a structured and transparent manner. This approach was chosen to obtain a comprehensive scientific synthesis of empirical results that have been conducted over the past decade (2020–2025) .

sources are scientific articles published in national journals accredited by Sinta and reputable international journals. The articles reviewed include publications including: 1) Discussing mathematics learning at elementary, secondary, and tertiary levels, 2) Using the *Group Investigation (GI)* model, either purely or in combination with other approaches, 3) Utilizing manipulative media in the learning process, 4) Reporting empirical results in the form of increased conceptual understanding, motivation, critical thinking, or mathematics learning outcomes .

techniques through several SLR stages include: 1) Identification, 2) Screening, 3) Feasibility, 4) Inclusion (PRISMA, 2020). The collected data are then synthesized using the thematic narrative method, namely by grouping research results into mathematics learning indicators, including: conceptual understanding, critical thinking skills, learning outcomes, reasoning & proof, problem solving, mathematical communication and mathematical connections. The synthesis results are used to answer the research questions, namely: RQ 1: How effective is the application of the GI learning model assisted by manipulative media to mathematics learning?, RQ 2: What levels of education are usually used as research samples? RQ 3: What are the limitations and challenges faced in implementing the GI method assisted by manipulative media based on the results of previous studies? RQ 4: What are the implications of these SLR findings for the development of mathematics learning strategies in the future, especially in the context of the Independent Curriculum?

3 RESULTS AND DISCUSSION

Based on the research conducted, five articles relevant to the keywords used were selected. Next, the researchers reviewed articles related to the research problem.

3.1 Group Investigation

Herbert Thelen is one of the founders of the National Training Laboratory and has drawn on his experience and studies in organizational development and academic inquiry to develop the GI model (Joyce, 2000). He sought to create experiential learning situations that were easy to apply later and characterized by a high level of inquiry.

According to Slavin (2005), the GI learning model integrates the cognitive and social domains into the classroom learning process. This model emphasizes the importance of student engagement, both intellectually and socially, through collaborative investigative activities. In this context, the teacher's role is no longer as the center of learning, but rather as a guide, facilitator, and provider of constructive feedback, helping students direct their investigative process to be more effective and meaningful.

3.2 Manipulative Media

Kennedy (1986), defines manipulatives as objects that appeal to multiple senses and can be touched, moved, rearranged, and handled by students. Similarly, Smith, (2009) defines manipulatives as physical objects used as teaching tools to engage students in hands-on learning.

Tujuan penggunaan media manipulatif dalam pembelajaran diantaranya adalah : 1) Mempermudah pemahaman konsep abstrak, 2) Meningkatkan aktivitas dan partisipasi siswa, 3) Mengembangkan kemampuan berpikir logis, kritis, dan kreatif, 4) Meningkatkan motivasi dan minat belajar siswa, 5) Menumbuhkan keterampilan sosial dan kolaboratif (Şeker at.al, 2020)

3.3 Mathematics Learning

Mathematics learning is a process of interaction between teachers and students that aims to develop logical, analytical, critical, and creative thinking skills through understanding concepts and applying mathematical principles in everyday life. The main goal of mathematics learning is not only to master formulas and calculations, but also to train problem-solving skills, reasoning, mathematical communication, and foster a careful, diligent, and confident attitude. Important components in mathematics learning include learning objectives, material or lesson content, learning strategies and methods, media or tools, and evaluation of learning outcomes that function to assess the extent to which students understand and are able to apply the concepts they have learned.

The GI model and manipulative media are an effective combination in mathematics learning, as both can increase student active engagement and in-depth conceptual understanding. By integrating the GI model and manipulative media, the mathematics learning process becomes more meaningful, interactive, and student-centered, thus encouraging the development of critical thinking and creative thinking skills, as well as social skills.

Researchers reviewed articles related to the problem under study. These articles present the data in Table 1.

Table 1. Research Results related to the GI Model assisted by Manipulative Media in Mathematics Learning

Researchers	School level	Manipulative Media	Research result
Cut Yuniza Eviyanti (2025)	JUNIOR HIGH SCHOOL	Domino	This study was a quasi-experimental study, with the population being ninth-grade junior high school students. The experimental class used GI with domino media, while the control class used the expository method. The results showed that students who learned using the GI model with domino media had better learning outcomes than those who learned using the expository method (Eviyanti et al., 2021).
Ma'rifatunnisa (2023)	JUNIOR HIGH SCHOOL	Geogebra	The study was conducted in eighth-grade students of SMPN 2 Bolo using a two-cycle CAR method. Data were collected through tests and observations. The results showed that the GI model, assisted by the GeoGebra application, can be used as an effective alternative to improve students' mathematical conceptual understanding of circles (Marifatunnisa et al., 2023).
Alya Salsabila Setyawan (2023)	Vocational School	Edugames Baamboozle	A quasi-experimental design study was conducted at SMK Negeri 1 Jombang, grade XI students. Data collection was conducted using multiple-choice pre-test and post-test methods. The results showed that the GI model assisted by the Baamboozle educational game significantly influenced the critical thinking skills of grade XI students (Setyawan & Panduwinata, 2023).
Ahmad Enggal Sabili (2024)	Elementary School	3 Dimensions	This study used a quantitative experimental method, a pre-experimental design was used because there was only one group and no control variables. Based on the research results described, it can be seen that the GI model assisted by three-dimensional media can influence

Dwi Susanti (2022)	SENIOR HIGH SCHOOL	Geogebra	student learning outcomes. (Sabili et al., 2024) The study used a quantitative approach, appropriate tools, and statistical analysis, so that the findings obtained did not differ from the actual situation. The results showed that GeoGebra-assisted GI model learning was effective in improving the collaborative communication and problem-solving skills of 10th-grade students (Susanti et al., 2022) .
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Based on Table 1, which is the summary results obtained from *the literature review* of 5 relevant articles, it can be concluded that the GI model assisted by manipulative media in mathematics learning shows significant effectiveness in improving conceptual understanding, critical thinking, mathematical communication and problem solving.

RQ 1. How effective is the application of the GI learning model assisted by manipulative media in mathematics learning?

Table 1 summarizes the impact of implementing the GI model with the help of manipulative media on mathematics learning, as seen in the increased understanding of concepts, critical thinking skills, mathematical communication skills, and problem solving. Through the GI model, students are actively involved in investigations and group discussions, while manipulative media helps students visualize abstract concepts more concretely.

RQ 2. What levels of education are usually used as research samples?

Based on the summary results, researchers found that most previous studies applied the GI model at higher levels, such as junior high, high school, or college. This is because the GI model demands higher levels of critical thinking and analytical skills, as well as learning independence. Students are required to be able to implement all the syntax of the GI model, including planning investigations, searching for and processing information, collaborating in groups, and compiling and presenting findings.

RQ 3. What are the limitations and challenges faced in implementing the GI method assisted by manipulative media based on the results of previous research?

A summary of previous studies reveals several limitations and challenges that require attention. These include: the relatively long implementation time, teachers' ability to manage classes and provide group guidance, the availability and appropriateness of teaching aids relative to the number of students and media, not all students are accustomed to independent and collaborative learning, and the final obstacle is the issue of evaluation, where assessment instruments are more complex than conventional methods. Therefore, careful planning and adequate support facilities are needed to maintain effectiveness in improving mathematics learning outcomes.

RQ 4. What are the implications of these SLR findings for the development of mathematics learning strategies in the future, particularly in the context of the Independent Curriculum?

Based on the findings of the Systematic Literature Review (SLR), it can be concluded that the development of future mathematics learning strategies needs to emphasize the implementation of student-centered, contextual learning models and encourage active student involvement in accordance with the spirit of the Independent Curriculum. Strategies such as project-based and collaborative learning and the use of manipulative

media have been shown to improve students' conceptual understanding, critical thinking skills, and mathematical problem-solving. The implications of these findings suggest that teachers need to be more creative in designing learning experiences that integrate exploratory and reflective activities so that students can construct knowledge meaningfully. Furthermore, the development of learning strategies must also consider learning differentiation, the use of interactive digital technology, and authentic assessments that align with the principles of independent learning and are oriented towards developing 21st-century competencies.

4 CONCLUSION

Based on the results and discussion of the literature review of five articles published in 2020-2025, it can be concluded that: 1) The use of the GI model assisted by manipulative media can encourage student activeness in investigation and collaboration and improve conceptual understanding, critical thinking and problem-solving skills, 2) In its application, the GI Model is carried out on students who already have independent learning, can work together in groups and already have high analytical skills, 3) The need for thorough preparation in designing learning using the GI model assisted by manipulative media, adequate facilities, and training for teachers so that the implementation of the GI model can run optimally, 4) One of the principles of the Independent Curriculum is student-centered. Contextual, collaborative, and project-based learning models need to be developed with the support of manipulative media and digital technology. Thus, teachers are expected to be able to design learning that is exploratory, reflective, and oriented towards the development of 21st-century competencies through the application of authentic assessment and learning differentiation.

5 REFERENCES

- Cecep Kustandi, D. D. (2021). *Pengembangan Media Pembelajaran*.
[https://books.google.co.id/books?id=VJtIDwAAQBAJ&pg=PR4&dp=buku+media+pembelajaran+april+2017&hl=id&sa=X&ved=2ahUKEwjJ16Wp4czsAhVw7XMBHVxwAgsQ6AEwAHoECAMQAg#v=onepage&q=buku media pembelajaran\\$20april 2017&f=false](https://books.google.co.id/books?id=VJtIDwAAQBAJ&pg=PR4&dp=buku+media+pembelajaran+april+2017&hl=id&sa=X&ved=2ahUKEwjJ16Wp4czsAhVw7XMBHVxwAgsQ6AEwAHoECAMQAg#v=onepage&q=buku%20april%202017&f=false)
- Eviyanti, C. Y., Rista, L., Hadijah, S., & Andriani, A. (2021). The Implementation of Group Investigation Learning Model Through Domino Mathematics Media on the Rank Number and Root Form Materials. *Malikussaleh Journal of Mathematics Learning (MJML)*, 4(1), 28.
<https://doi.org/10.29103/mjml.v4i1.3118>
- Istikomah, I. (2020). Pemanfaatan Geoboard Dan Karet Gelang Untuk Meningkatkan Minat Belajar Siswa Pada Bangun Datar. *Prismatika: Jurnal Pendidikan Dan Riset Matematika*, 2(2), 55–62.
<https://doi.org/10.33503/prismatika.v2i2.764>
- Joyce, B. & W. . (2000). *Models of Teaching*.
- Joyce, B., Weil, M., & Calhoun, E. (2015). *Models of Teaching 9th Edition*. Prentice Hall of India.
- Keele, S. (2007). Guidelines for performing systematic literature reviews in software engineering. *Technical Report, Ver. 2.3 EBSE Technical Report*. EBSE, October.
- Kennedy, M. . (1986). *A Rationale Arithmetic Teacher*.

- M.Hosnan. (2014). *Pendidikan Saintifik dan Kontekstual dalam Pembelajaran Abad 21* (G. Indonesia (ed.)).
- Marifatunnisa, M., Adiansha, A. A., & Syarifuddin, S. (2023). Penerapan Model Pembelajaran Kooperatif Tipe Group Investigation Berbantuan Aplikasi Geogebra untuk Meningkatkan Pemahaman Konsep Matematis Siswa Pada Materi Lingkaran di Kelas VIII SMPN 2 Bolo. *DIKSI: Jurnal Kajian Pendidikan Dan Sosial*, 4(1), 33–39. <https://doi.org/10.53299/diksi.v4i1.318>
- Marlisa, S. (2023). *PEMBELAJARAN MODEL KOOPERATIF TIPE GROUP INVESTIGATION UNTUK MENINGKATKAN KOMUNIKASI MATEMATIS , KOLABORASI DAN BERPIKIR KRITIS SISWA*. 12(2), 2264–2273.
- NCTM. (2000). *Principles and Standards for School Mathematics*.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Bmj*, 372. <https://doi.org/10.1136/bmj.n71>
- Ponte, R., Viseu, F., Neto, T. B., & Aires, A. P. (2023). Revisiting manipulatives in the learning of geometric figures. *Frontiers in Education*, 8(June), 1–13. <https://doi.org/10.3389/educ.2023.1217680>
- Rahmat, T., & Fitri, H. (2024). Pengaruh Model Pembelajaran Kooperatif Tipe Group Investigation (GI) Terhadap Kemampuan Pemahaman Konsep Matematika Siswa. *Jurnal Pendidikan Dan Sains*, 5, 50–59.
- Robert E, S. (2005). *Cooperative Learning*.
- Sabili, A. E., Herpratiwi, H., & Mashari, A. (2024). The Influence of Group Investigation Learning Model Assisted by Three-Dimensional Media on Mathematics Learning Outcomes. *Jurnal Teknologi Pendidikan : Jurnal Penelitian Dan Pengembangan Pembelajaran*, 9(3), 395. <https://doi.org/10.33394/jtp.v9i3.11929>
- Setyawan, A. S., & Panduwinata, L. F. (2023). Pengaruh Model Group Investigation Berbantuan Edugames Baamboozle. *INNOVATIVE: Journal Of Social Science Research*, 3, 5960–5968.
- Sharan, Y. (1992). *Expanding Coopertive Learning Through Group Investigation* (Teacher College (ed.)).
- Smith, S. . (2009). *Early Childhood Mathematics*.
- Susanti, D., Jailani, J., & Irfan, L. (2022). Pembelajaran Kooperatif Tipe Group Investigation Berbantuan Geogebra Untuk Mendukung Keterampilan Collaboration, Problem Solving, Dan Communication. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 11(2), 1000. <https://doi.org/10.24127/ajpm.v11i2.4726>