Al-Ishlah: Jurnal Pendidikan
Vol.18, 1 (March, 2026), pp. 1325-1333
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v18i1.8835

Comparing Digital and Non-Digital Gamification in Cooperative Learning: Effects of TGT with Wordwall and Question Cards on Students' Mathematical Problem-Solving Ability

Astuti[1], Della Salvina[2]

[1] Universitas Pahlawan Tuanku Tambusai, Bangkinang, Indonesia; astutimasnur@gmail.com
[2] Universitas Pahlawan Tuanku Tambusai, Bangkinang, Indonesia; salvina150402@gmail.com

ARTICLE INFO

Keywords:

cooperatif learning model;
teams games tournament (TGT);
wordwall;
mathematical problem-solving;
question card

Article history:

Received 2025-11-01
Revised 2026-01-12
Accepted 2026-03-31

ABSTRACT

Students' mathematical problem-solving ability in Indonesia remains relatively low, partly due to the limited use of interactive and cooperative learning strategies in classrooms. The Teams Games Tournament (TGT) model, combined with instructional media, offers potential to enhance student engagement and problem-solving skills. This study aims to compare the effectiveness of TGT assisted by Wordwall, TGT assisted by question cards, and conventional learning in improving students' mathematical problem-solving ability. This study employed a quasi-experimental design with a posttest-only control group. The sample consisted of three seventh-grade classes selected through purposive sampling, each comprising 20 students. The first experimental group was taught using TGT assisted by Wordwall, the second experimental group used TGT assisted by question cards, and the control group received conventional instruction. Data were collected using a validated and reliable essay test and analyzed through descriptive statistics, normality and homogeneity tests, followed by Welch ANOVA and Games–Howell post hoc analysis. The results revealed significant differences among the three groups ($p < 0.05$). The highest mean score was achieved by the TGT with question cards group ($M = 89.60$), followed by TGT with Wordwall ($M = 77.00$), while the control group obtained the lowest mean score ($M = 54.70$). These findings indicate that both TGT-based approaches are more effective than conventional learning, with question card assistance producing the most substantial improvement. In conclusion, while digital media such as Wordwall can enhance learning, non-digital approaches that promote deeper cognitive engagement may yield better outcomes in developing mathematical problem-solving skills.

Corresponding Author:
Astuti
Universitas Pahlawan Tuanku Tambusai, Bangkinang, Indonesia; astutimasnur@gmail.com

1. INTRODUCTION

Mathematics education plays a crucial role in developing students' logical, analytical, and problem-solving abilities, which are essential for navigating complex real-world situations. Beyond mastering formulas and procedures, students are expected to understand concepts deeply and apply them in meaningful contexts. One of the core competencies emphasized in mathematics learning is problem-solving ability, which involves identifying problems, formulating strategies, executing solutions, and evaluating results. This competency is not only fundamental to academic success but also to lifelong learning and critical thinking development.

However, numerous studies and international assessments indicate that students' mathematical problem-solving ability in Indonesia remains relatively low. Results from large-scale assessments such as the Program for International Student Assessment (PISA) consistently show that Indonesian students perform below the average of OECD countries, particularly in tasks requiring higher-order thinking and real-world application (OECD, 2023). This condition suggests that many students still struggle to interpret problems, connect concepts, and apply appropriate strategies in solving mathematical tasks. Such findings highlight the urgent need for instructional approaches that actively engage students and promote deeper cognitive processing.

One of the contributing factors to this issue is the predominance of teacher-centered instructional practices, where learning is often limited to explanation, memorization, and routine exercises. In such environments, students tend to become passive recipients of information rather than active participants in knowledge construction. Consequently, opportunities to develop problem-solving skills through discussion, exploration, and reflection are limited. To address this challenge, educators are encouraged to adopt innovative and student-centered learning models that foster interaction, collaboration, and active engagement.

Cooperative learning has been widely recognized as an effective approach to improving students' academic achievement and social skills. This model emphasizes collaboration among students in small groups to achieve shared learning goals. According to Slavin (2015), cooperative learning promotes positive interdependence, individual accountability, and meaningful interaction, which collectively enhance students' understanding and motivation. One specific type of cooperative learning that has gained attention is the Teams Games Tournament (TGT) model. TGT integrates academic content with game-based competition, allowing students to participate in structured tournaments where they earn points for their teams. This approach not only increases engagement but also creates a supportive and enjoyable learning environment (Slavin, 2015).

In recent years, the integration of technology into education has further expanded the potential of cooperative learning models. Digital platforms such as Wordwall provide interactive and game-based learning experiences that can enhance student motivation and participation. Wordwall allows teachers to create various types of quizzes and activities, enabling students to engage in learning through competition and instant feedback. Research indicates that digital gamification can improve students' interest, engagement, and learning outcomes when implemented effectively (Sari et al., 2020; Dichev & Dicheva, 2017). However, the effectiveness of digital tools depends not only on their features but also on how they are integrated into pedagogical practices.

Despite the growing emphasis on digital learning, it is important not to assume that technology-based approaches are inherently superior to traditional or non-digital methods. In some cases, non-digital instructional media, such as question cards, can provide more opportunities for deep thinking, discussion, and collaborative problem-solving. Question cards typically present open-ended or non-routine problems that require students to explain their reasoning and engage in meaningful dialogue with peers. This aligns with constructivist learning theory, which emphasizes the importance of active knowledge construction through social interaction and reflection (Vygotsky, 1978).

Previous studies have demonstrated that both digital and non-digital media can support learning when combined with appropriate instructional strategies. However, limited research has directly compared the effectiveness of these two approaches within the same cooperative learning framework, particularly in the context of the TGT model. Most existing studies tend to focus either on digital gamification or traditional cooperative learning without examining their relative advantages and limitations. As a result, there is a need for empirical research that explores whether digital tools such as Wordwall truly provide added value compared to simpler, non-digital alternatives like question cards.

Furthermore, the context of classroom implementation plays a significant role in determining the success of instructional strategies. Factors such as students' familiarity with technology, classroom dynamics, and the nature of learning tasks can influence how students engage with different types of media. For example, while digital platforms may encourage quick responses and competition, they may also limit opportunities for in-depth discussion and reflection. Conversely, non-digital approaches may foster deeper cognitive engagement but require more time and facilitation from teachers. Understanding these dynamics is essential for designing effective learning experiences that balance engagement and cognitive depth.

Based on these considerations, this study aims to conduct a comparative analysis of the implementation of the Teams Games Tournament (TGT) model assisted by Wordwall and the TGT model assisted by question cards, as well as conventional learning, in improving students' mathematical problem-solving ability. By examining the differences in learning outcomes among these approaches, this study seeks to provide empirical evidence on the relative effectiveness of digital and non-digital media within cooperative learning. The findings are expected to contribute to the development of more effective instructional strategies that enhance students' problem-solving skills and support meaningful mathematics learning.

2. METHODS

This study employed a quasi-experimental research design using a posttest-only control group design. This design was selected because the researcher administered different instructional treatments to multiple groups and compared students' learning outcomes after the intervention without administering a pretest. The study aimed to examine differences in students' mathematical problem-solving ability among groups taught using the Teams Games Tournament (TGT) model assisted by Wordwall, the TGT model assisted by question cards, and conventional learning. The posttest-only control group design was considered appropriate to minimize testing effects and to ensure that students' performance reflected the impact of the instructional treatments.

2.1 *Population and Sample*

The population of this study consisted of all seventh-grade students at SMP Negeri 1 Bangkinang. The sampling technique used was purposive sampling, in which classes were selected based on specific criteria, including having relatively similar academic abilities and being taught by the same mathematics teacher. From the selected classes, three seventh-grade classes were chosen as the research sample, each consisting of 20 students. Subsequently, the selected classes were randomly assigned to the experimental and control groups. Experimental Group 1 was taught using the Teams Games Tournament (TGT) model assisted by Wordwall, Experimental Group 2 was taught using the TGT model assisted by question cards, and the Control Group was taught using conventional learning.

2.2 *Data Collection*

The data collection techniques included observation, tests, and documentation. The test instrument consisted of post-test essay questions completed individually by students to measure their mathematical problem-solving ability.

2.3 *Instrument Validity and Reliability*

To ensure the quality of the research data, the instrument used in this study was examined for validity and reliability prior to its implementation. The research instrument consisted of five essay questions designed to measure students' mathematical problem-solving ability. The items were developed based on problem-solving indicators, including understanding the problem, devising a plan, carrying out the plan, and evaluating the solution. Content validity was examined through expert judgment involving three validators consisting of mathematics education lecturers and a junior high school mathematics teacher. The validity index was calculated using Aiken's V, and all items were declared valid. The instrument was then pilot-tested on students outside the research sample. Reliability analysis using Cronbach's Alpha indicated that the instrument had a high level of reliability and was suitable for use in this study.

2.4 Learning Implementation

The learning intervention was conducted over four meetings**,** with each meeting lasting 2 × 40 minutes**.** The instructional material focused on mathematical topics appropriate to the seventh-grade curriculum and was delivered using different learning approaches for each group.

Experimental Group 1 was taught using the Teams Games Tournament (TGT) model assisted by Wordwall**.** The learning process began with a class presentation, followed by team discussions. During the tournament phase, students answered objective-based questions presented through the Wordwall digital platform. Each student submitted answers individually within a limited time, and team scores were accumulated based on individual performance.

Experimental Group 2 was taught using the TGT model assisted by question cards containing open-ended and non-routine mathematical problems. After the class presentation, students worked collaboratively in teams to discuss problem-solving strategies, write solution steps, and evaluate their answers. Group discussions were emphasized during the tournament phase, allowing students to exchange ideas and justify their reasoning before submitting their final answers.

The Control Group was taught using conventional learning methods, which primarily involved teacher explanations, question-and-answer sessions, and individual exercises without structured cooperative activities or instructional media.

2.5 Data Analysis

Data were analyzed using SPSS version 24 and included the following steps:

2.5.1 Descriptive Data Analysis

Descriptive statistics were used to describe the data in terms of mean, median, mode, and standard deviation. The Minimum Mastery Criteria (KKM) used in this study were:

Table 1. Minimum Mastery Criteria

Score Range	Category
$0 \leq x \leq 54$	Very Low
$54 \leq x \leq 65$	Low
$65 \leq x \leq 75$	Moderate
$75 \leq x \leq 85$	High
$85 \leq x \leq 100$	Very High

2.5.2 Assumption Tests

a. Normality Test (Kolmogorov-Smirnov): This test was conducted to determine whether the data were normally distributed.
b. Homogeneity Test (Levene's test): This test was used to examine whether the data variances were homogeneous or not.

2.5.3 Hypothesis Test

Since the homogeneity test indicated that the data were not homogeneous (Sig. < 0.05), Welch ANOVA and the Games–Howell post hoc test were used to analyze differences between groups.

3. FINDINGS AND DISCUSSION

3.1 Findings

The result of the Kolmogorov–Smirnov test indicated that the posttest scores of all groups were normally distributed ($p > 0.05$). However, Levene's test showed that the data variances were not homogeneous ($p < 0.05$). Therefore, further hypothesis testing was conducted using Welch ANOVA, which is more appropriate for data with unequal variances.

Descriptive analysis revealed that Experimental Group 2 (TGT assisted by question cards) obtained the highest mean posttest score (M = 89.60), followed by Experimental Group 1 (TGT assisted by Wordwall) with a mean score of 77.00. The Control Group achieved the lowest mean score (M = 54.70).

Table 2. Posttest Results of Mathematical Problem-Solving Ability

Class	N	Minimum	Maximum	Mean	Std. Deviation	Variance
TGT + *Wordwall*	20	32	100	77.00	16.059	257.895
TGT	20	72	100	89.60	79.89	63.832
Control (Conventional)	20	20	96	54.70	23.017	529.800

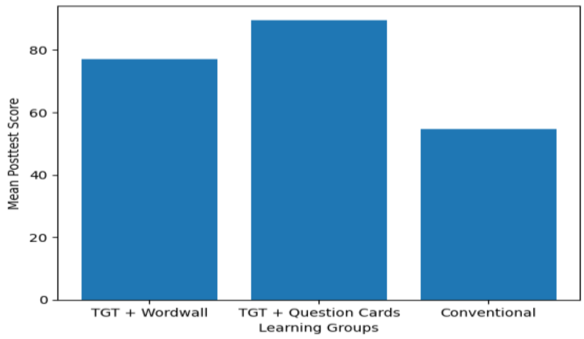

Figure 1. Comparison of mean post-test scores among the three groups

Figure 1 presents the comparison of mean post-test scores among the three groups. Based on Levene's test, the significance value of 0.000 indicates that the data were not homogeneous, meaning that the group variances were unequal. Therefore, the analysis proceeded using the Welch ANOVA test, which is more appropriate under non-homogeneous variance conditions.

Table 3. Robust Test of Equality of Means (Welch ANOVA)

	Statistic	df1	df2	Sig.
Welch	22.537	2	32.172	0.000

The results of the Welch ANOVA in Table 3.2 show a significance value of 0.000 ($p < 0.05$), indicating significant differences in mean scores among the three groups. To determine which pairs of groups differed significantly, a Post Hoc test (Games-Howell) was conducted.

Table 4. Games-Howell Post Hoc Test

Comparison	t-value	df	Sig. (2-tailed)	Decision	Description
Experimental 1 vs Experimental 2	-3.142	27.862	0.004	H_0 Rejected	Significant Difference
Experimental 1 vs Control	3.553	33.954	0.001	H_0 Rejected	Significant Difference
Experimental 2 vs Control	6.406	23.513	0.000	H_0 Rejected	Significant Difference

Post Hoc analysis using the Games–Howell test revealed that all pairwise comparisons among the three groups showed statistically significant differences ($p < 0.05$).

3.2 Discussion

The findings of this study demonstrate that the Teams Games Tournament (TGT) cooperative learning model, when supported by either digital or non-digital media, significantly improves students' mathematical problem-solving ability compared to conventional instruction. This result confirms the effectiveness of cooperative learning in fostering active engagement and deeper understanding of mathematical concepts. In line with Slavin (2015), cooperative learning environments promote positive interdependence, individual accountability, and peer interaction, all of which contribute to improved academic outcomes. The significantly lower performance of the control group indicates that traditional teacher-centered approaches may not provide sufficient opportunities for students to develop higher-order thinking skills, particularly in problem-solving contexts.

More specifically, the study reveals that the TGT model assisted by question cards produced the highest learning outcomes among the three groups. This finding suggests that non-digital instructional media can be highly effective in promoting mathematical problem-solving when designed to encourage active thinking and collaboration. Question cards used in this study contained open-ended and non-routine problems, which required students to engage in deeper cognitive processes such as analysis, reasoning, and evaluation. This aligns with previous research indicating that problem-solving skills are better developed through tasks that require students to construct their own understanding rather than simply recall information (Hiebert et al., 1996; Schoenfeld, 2014). The opportunity for students to discuss, justify, and refine their solutions collaboratively likely contributed to their superior performance.

In contrast, although the TGT model assisted by Wordwall also resulted in improved outcomes compared to conventional learning, its effectiveness was lower than that of the question card approach. One possible explanation lies in the nature of digital gamified platforms, which often emphasize speed, competition, and immediate responses. While these features can increase motivation and engagement, they may also limit opportunities for deeper reflection and discussion. Students in the Wordwall group tended to focus on answering questions quickly rather than collaboratively exploring solution strategies. This finding is consistent with the argument that gamification can enhance engagement but does not automatically guarantee deeper learning unless it is carefully aligned with pedagogical goals (Dichev & Dicheva, 2017).

From a cognitive perspective, the difference in effectiveness between the two experimental groups can be explained through the lens of cognitive load theory. Open-ended question cards may facilitate meaningful learning by allowing students to process information more elaborately and connect new knowledge with prior understanding. In contrast, fast-paced digital tasks may impose extraneous cognitive load, especially when students must simultaneously process time constraints, competition, and task demands (Sweller, Ayres, & Kalyuga, 2011). As a result, while students may perform well in answering objective questions, their ability to engage in deeper problem-solving processes—such as evaluating solutions or identifying underlying principles—may be less developed.

Furthermore, the findings highlight the importance of interaction and dialogue in cooperative learning settings. The success of the question card approach can be attributed to the quality of group discussions that occurred during the learning process. Students were encouraged to explain their reasoning, challenge each other's ideas, and reach consensus on problem-solving strategies. This aligns with Vygotsky's (1978) sociocultural theory, which emphasizes the role of social interaction in cognitive development. Through collaborative dialogue, students operate within their zone of proximal development, enabling them to achieve higher levels of understanding than they could individually. In this sense, the effectiveness of the TGT model is not solely determined by the presence of games or competition, but by the extent to which it facilitates meaningful interaction.

Another important implication of this study is the need to critically evaluate the role of technology in education. While digital tools such as Wordwall offer innovative and engaging learning experiences, their pedagogical value depends on how they are integrated into instructional design. The findings of this study challenge the common assumption that digital media are inherently more effective than non-digital approaches. Instead, they suggest that simpler, low-technology solutions—when aligned with sound pedagogical principles—can produce equal or even superior learning outcomes. This perspective is supported by Clark (1983), who argued that media do not influence learning directly; rather, it is the instructional method that determines learning effectiveness.

Despite its contributions, this study also has several limitations that should be considered when interpreting the results. First, the use of a posttest-only design limits the ability to fully ensure equivalence among groups prior to the intervention. Although the classes were selected based on similar characteristics, the absence of pretest data may affect the internal validity of the findings. Second, the study was conducted within a single school context with a relatively small sample size, which may limit the generalizability of the results. Future research is recommended to employ a pretest-posttest design, involve larger and more diverse samples, and explore additional variables such as students' motivation, attitudes, and collaborative skills.

In conclusion, this study provides empirical evidence that cooperative learning through the TGT model can significantly enhance students' mathematical problem-solving ability, particularly when supported by instructional media that promote deep cognitive engagement and meaningful interaction. While digital gamification tools offer valuable opportunities for increasing motivation, non-digital approaches such as question cards may be more effective in fostering critical thinking and problem-solving skills. Therefore, educators should carefully consider the alignment between instructional media and learning objectives to ensure optimal learning outcomes.

4. CONCLUSION

This study demonstrates that the Teams Games Tournament (TGT) cooperative learning model significantly enhances students' mathematical problem-solving ability compared to conventional instruction, with the highest achievement observed in the group using TGT assisted by question cards, followed by TGT with Wordwall. These findings indicate that while both digital and non-digital media can support learning, non-digital approaches that emphasize open-ended problem-solving and collaborative discussion may foster deeper cognitive engagement and lead to better outcomes. However, this study is limited by the use of a posttest-only design, which does not fully ensure initial group equivalence, as well as a relatively small sample size drawn from a single school context, which may restrict the generalizability of the findings. Therefore, future research is recommended to employ more rigorous experimental designs, such as pretest-posttest control group designs, involve larger and more diverse samples, and explore additional variables such as student motivation, interaction quality, and long-term retention to provide a more comprehensive understanding of the effectiveness of cooperative learning and instructional media in mathematics education.

REFERENCES

Ahyar, D. B., et al. (2021). *Model-model pembelajaran*. Pradina Pustaka.

Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings. *Educational and Psychological Measurement, 45*(1), 131–142.

Anggraini, L., Rinaldi, A., Syazali, M., & Pradana, K. C. (2023). Analisis kemampuan pemahaman konsep matematis: Dampak model pembelajaran ICM, CRH dan curiosity. *JMPM: Jurnal Matematika dan Pendidikan Matematika, 7*(2), 170–181.

Aprilia, P. K., Mistar, J., Mustofa, M., & Syabilla, Z. F. (2024). Can Wordwall assess students' words? Nurturing inclusivity and advancement in rural secondary education. *English Review: Journal of English Education, 12*(1), 167–176.

Ariawan, R., & Nufus, H. (2017). Hubungan kemampuan pemecahan masalah matematis dengan kemampuan komunikasi matematis siswa. *THEOREMS, 1*, 82–91.

Aspriyani, R. (2017). Pengaruh motivasi berprestasi siswa terhadap kemampuan pemecahan masalah matematis. *Jurnal Penelitian dan Pembelajaran Matematika, 10*(1).

Damianti, D., & Afriansyah, E. A. (2022). Analisis kemampuan pemecahan masalah matematis dan self-efficacy siswa SMP. *Jurnal Inovasi Pendidikan dan Pembelajaran Matematika, 8*(1), 21–30.

Dwi Novelza, I., & Nasution, E. Y. P. (2023). Analisis kemampuan penalaran matematis siswa kelas XI SMA pada materi limit fungsi aljabar. *Nabla Dewantara: Jurnal Pendidikan Matematika, 8*(1), 11–19.

Firdiansyah, M. S. (2015). Manajemen pengelolaan wahana rekreasi olahraga di wisata Water Blaster Semarang. *Journal of Physical Education, Sport, Health, and Recreation, 4*(2), 1582–1589.

Fitriani, A. A., Hidayat, F. A., & Suranti, D. (2021). Pengaruh model pembelajaran make a match berbantuan media gambar terhadap motivasi belajar siswa. *BASA: Jurnal Inovasi Pembelajaran IPA, 2*(2), 17–21.

Fryda Lucyani, D. (2019). Analisis kemampuan pemecahan masalah matematis dan self-efficacy melalui model problem based learning. *Journal Information, 10*(3), 1–16.

Gumanti, G., Maimunah, M., & Roza, Y. (2022). Kemampuan pemecahan masalah matematis siswa SMP Kecamatan Bantan. *Prisma, 11*(2), 310–319.

Hamimi, L., Zamharirah, R., & Rusydy, R. (2020). Analisis butir soal ujian matematika kelas VII semester ganjil. *Mathema: Jurnal Pendidikan Matematika, 2*(1), 57.

Hidayat, A., Anika, E., & Ediputra, K. (2018). Pengaruh model pembelajaran kooperatif tipe TGT terhadap pemahaman konsep matematika siswa. *Jurnal Cendekia, 2*(2), 101–110.

Junus, D. P. A., Odja, A. H., & Yusuf, M. (2025). Pengaruh model pembelajaran think pair share terhadap hasil belajar IPA. *Jurnal Luminous, 6*(1), 1–8.

Kesumawati, N., & Hera, T. (2022). Pengaruh PMRI terhadap kemampuan pemecahan masalah matematis. *Journal on Teacher Education, 4*(1), 237–249.

Laela, E., Afrilianto, M., & Senjayawati, E. (2024). Peningkatan kemampuan pemecahan masalah matematis dengan discovery learning. *Jurnal Pendidikan Matematika, 7*(4), 625–636.

Lestari, K. E., & Yudhanegara, M. R. (2017). Analisis kemampuan representasi matematis mahasiswa. *Jurnal Matematika Integratif, 13*(1), 29.

Lestari, S. (2021). Pembelajaran daring pada mata pelajaran matematika sekolah dasar. *JMIE: Journal of Madrasah Ibtidaiyah Education, 5*(1), 141.

Lestari, S. E. C. A., Hariyani, S., & Rahayu, N. (2018). Pembelajaran kooperatif tipe TGT untuk meningkatkan hasil belajar matematika. *Pi: Mathematics Education Journal, 1*(3), 116–126.

Magdalena, I., Fauziah, S. N., Faziah, S. N., & Nupus, F. S. (2021). Analisis validitas dan reliabilitas butir soal. *BINTANG: Jurnal Pendidikan dan Sains, 3*(2), 198–214.

Mahardi, I. P. Y. S., Murda, I. N., & Astawan, I. G. (2019). Model pembelajaran TGT berbasis kearifan lokal terhadap karakter. *Jurnal Pendidikan Multikultural Indonesia, 2*(2), 98.

Mahuda, I., Meilisa, R., & Nasrullah, A. (2021). Pengembangan media pembelajaran matematika berbasis android. *AKSIOMA, 10*(3), 1745.

Maulana, H. (2024). Pengaruh problem based learning berbantuan Wordwall terhadap kemampuan berpikir kritis siswa.

Nugroho, I. R., & Listyarini, I. (2018). Keefektifan model TGT berbantu media ular tangga. *Jurnal Sekolah, 2*(3), 236.

Okta Nadia, D., & Desyandri. (2022). Pengaruh media pembelajaran Wordwall terhadap hasil belajar siswa.

Oktarika, D., & Putri, N. F. M. (2019). Upaya meningkatkan hasil belajar dengan model TGT berbantuan Prezi. *Efektor, 6*(2), 115–119.

Pertiwi, G. R., Mulyanti, Y., & Balkist, P. S. (2022). Analisis kemampuan pemecahan masalah ditinjau dari disposisi matematis. *EQUALS, 5*(2), 64–77.

Putra, H. D., Amelia, R., & Sariningsih, R. (2021). Perbandingan kemampuan mathematical problem posing siswa. *Teorema, 6*(1), 69.

Rahmawati, L., Juandi, D., & Nurlaelah, E. (2022). Implementasi STEM dalam meningkatkan kemampuan berpikir kritis. *AKSIOMA, 11*(3), 2002.

Rosyada, S. A. (2024). Pengaruh model pembelajaran kooperatif team game tournament terhadap kemampuan berpikir kritis (Tesis/Skripsi).

Saniyah, W., & Alyani, F. (2021). Analisis kesulitan belajar siswa dalam pemecahan masalah matematis. *ANARGYA, 4*(2).

Sari, W. F., et al. (2020). Pemanfaatan Wordwall sebagai media pembelajaran interaktif.

Silaban, A. U. (2019). Menumbuhkan minat belajar siswa menggunakan video animasi. Retrieved from https://www.researchgate.net/

Sinaga, F. I. S. H. (2024). Pengaruh kemampuan berpikir kreatif terhadap hasil belajar. *Linear: Jurnal Ilmu Pendidikan, 8*(2), 92–101.

Sugiharto, S. (2024). Comparative test of reliability coefficient. *Journal of Education Research and Evaluation, 8*(1), 47–57.

Sugiyono. (2019). *Metode penelitian kuantitatif, kualitatif, dan R&D*. Alfabeta.

Sule, S. M., & Ismail, S. (2024). Pengaruh multimedia pembelajaran interaktif terhadap kemampuan pemecahan masalah.

Sulistiani, E., & Masrukan. (2016). Pentingnya berpikir kritis dalam pembelajaran matematika. In *Seminar Nasional Matematika X* (pp. 605–612).

Teni, T., & Yudiyanto, A. (2021). Pengaruh motivasi belajar terhadap hasil belajar siswa. *Jurnal Pendidikan Indonesia, 2*(1), 105–117.

Urnila, S., et al. (2024). Teachers' perceptions on digital games in vocabulary learning.

Utami, L., et al. (2024). Analisis indeks Aiken untuk validitas instrumen. *Journal of Research and Education Chemistry, 6*(1), 59.

Wahyuni, D., & Wahniati, E. (2025). Dampak model STAD terhadap kemampuan pemecahan masalah matematis.

Wardhani, A. K. (2022). Analisis kemampuan pemecahan masalah matematis pada soal TIMSS. *Didactical Mathematics, 4*(1), 94–103.

Widodo, S. A., & Sujadi, A. A. (2017). Analisis kesalahan mahasiswa dalam trigonometri. *SOSIOHUMANIORA, 1*(1), 51–63.

Zulhamma, R. (2020). Analisis kemampuan siswa dalam menyelesaikan soal bangun ruang. *Jurnal LEMMA, 6*(2), 76–83.