

The Effect of the Question Box-Assisted Team Games Tournament (TGT) Learning Model on Students' Collaboration Ability on the Excretory System Sub-Material

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Abstract: The purpose of this study is to ascertain how the Question Box-assisted Team Games Tournament (TGT) learning model affects the sub-material excretory system collaboration skills of junior high school students in grade VIII. The research used a quasi-experimental design in the form of a nonequivalent control group design. The sample consisted of 23 students in class VIII-C as the experimental class and 20 students in class VIII-F as the control class, determined by purposive sampling. Data were collected through questionnaires and observation sheets during two meetings, then analyzed using the Shapiro-Wilk normality test, Wilcoxon Signed Rank Test, Mann-Whitney U Test, and Effect Size. The result showed that there was no significant difference in collaboration ability between the experimental class and the control class (Mann-Whitney U = 152.000, $p = 0.057 > 0.05$). Nonetheless, the experimental class showed greater descriptive improvement than the control class. The calculated effect size ($r = 0.3$) indicates a moderate practical effect. These findings indicate the potential of the TGT model assisted by Question Box to support students' collaboration skills in classroom practice, although the difference between the experimental and control classes was not statistically significant.

Keywords: Collaboration; Excretory system; Junior high school; Question box; Team games tournament

Introduction

Education is one of the main pillars in shaping a competitive and advanced society, especially in the 21st century era, which is marked by the rapid developments of science and technology. These changes require students not only to master knowledge but also abilities that are relevant to the demands of the times (Mahendra et al., 2023). Relevant 21st-century abilities to deal with the impact of the times are critical thinking, communication, collaboration, and creativity (Alfaeni et al., 2022). One of the abilities that has a vital role is the ability to collaborate. Collaboration enables students to work in teams, strengthen social relationships with the community, and prepare themselves for the changes that occur in the modern era. With these skills, students can

build productive synergies, both in and outside of the educational environment (Nurmayasari et al., 2023).

Collaboration in education helps students think effectively, participate, and solve problems together through meaningful tasks and teamwork (Masrurroh & Arif, 2021). According to Dewi et al. (2024), collaboration is a process of group learning in which students actively participate in problem-solving or idea-transmission while also accepting accountability for their individual assignment. Therefore, collaboration skills are not just complementary but essential competencies that need to be trained systematically through the right learning strategies.

At junior high school (SMP), collaborative skills in science must be developed, especially in materials that require a deep understanding of concepts such as the

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excretory system. However, science learning that is still dominated by teacher-centered methods tends to make students passive and less actively involved in group discussions, so that collaboration skills have not developed optimally (Fina et al., 2023; Paramitha & Zulherman, 2022). This condition contradicts the 21st-century learning paradigm, which emphasizes a student-centered approach, where students actively construct knowledge through cooperation, while teachers act as facilitators (Sabila et al., 2023). Interviews with science teachers at SMP Negeri 8 Pontianak showed that although learning had been implemented, systematic collaboration assessment had not been carried out, and the active involvement of all students was not guaranteed. As a result, students' collaboration skills were uneven, and some students tended to be passive in group discussions (Firmayanti & Fardhani, 2023).

Through group projects, peer tutoring, games, and academic competitions, the Team Games Tournament (TGT) learning model can assist students in developing their collaborative skills (Miroh et al., 2019). However, TGT has weaknesses in managing discussion time and equalizing student involvement (Hamdani et al., 2019; Simbolon et al., 2025), thus requiring learning media support that can regulate the flow of discussion and ensure the participation of all group members. A Question Box is a medium consisting of question cards that are taken and discussed by a group over a predetermined period of time. This medium can maximize discussion and encourage active student participation (Ayuni et al., 2017; Rahmawati et al., 2023). Theoretically, the TGT model assisted by Question Box is based on Vygotsky's social constructivism, which emphasizes that knowledge is constructed through social interaction and the Zone of Proximal Development, where students construct understanding collaboratively through group discussion, peer tutors, and academic tournaments (Rofilah et al., 2025).

Although research on the TGT and Question Box models has been conducted previously, studies that specifically focus on students' collaborative abilities of eighth-grade junior high school students, particularly on the sub-material of the excretory system, are still limited. Therefore, the goal of this study is to ascertain how students' capacity for collaboration is impacted by the implementing of the TGT learning model with Question Box support. According to the research hypothesis, the experimental class that received the TGT model with the Question Box assistance and the control class, which was not given any treatment, differed significantly in their ability to collaborate.

Method

Time and Place of the Research

The research was conducted during the odd semester of the 2025/2026 academic year at SMP Negeri 8 Pontianak.

Research Design

The research used a quasi-experimental design in the form of a nonequivalent control group design. The population consists of all Class VIII students at SMP Negeri 8 Pontianak in the 2025/2026 school year, consisting of six classes with a total of 193 students. The sample consisted of 43 students, with Class VIII-C ($n = 23$) as the experimental class and Class VIII-F ($n = 20$) as the control class. Purposive sampling was used to select the sample based on the students' initial abilities, as determined by the pretest results, including the mean, standard deviation, normality and homogeneity of the data. The independent variable is the Team Games Tournament (TGT) learning model assisted by the Question Box, while the dependent variable is the student's collaborative ability, which is measured based on five indicators: (1) working productively with others, (2) actively participating and contributing, (3) being flexible and willing to compromise, (4) taking shared responsibility for completing tasks, and (5) valuing the contributions of each group member (Greenstein, 2012). Data were collected using two instruments: a 20-item collaboration ability questionnaire used before and after learning with a Question Box-assisted TGT model and an observation sheet used during two learning meetings. The questionnaire uses a four-point Likert scale, while the observation sheet is filled out by four observers who observe two groups each during the learning process. The questionnaire was empirically validated using Product Moment correlation, with calculated r -values ranging from 0.382 to 0.791, which is greater than the table r -value of 0.344 at a significance level of 0.05. The questionnaire reliability test using Alpha Cronbach yielded a coefficient of 0.913, which is greater than 0.70, indicating that the questionnaire was reliable. Research tools and materials include teaching modules, student worksheets (LKPD), Question Box, collaboration ability questionnaires, and observation sheets.

Research Procedure

The research procedure consisted of three stages: preparation, implementation, and reporting. In the preparation stage, the researcher conducted an initial interview with the science teacher of grade VIII at SMP Negeri 8 Pontianak, consulted with the supervisor and teacher, determined the research sample, and prepared the research materials and instruments, including teaching modules, student worksheets (LKPD),

Question Box, collaboration ability questionnaire, and observation sheet. The learning materials and research instruments were then validated and revised based on the validators' suggestions.

In the implementation stage, both the experimental and control classes were first administered a pretest and a collaboration ability questionnaire to determine the students' initial conditions. The experimental class was then taught using the Team Games Tournament (TGT) learning model assisted by Question Box, while the control class was taught using the Direct Instruction model. The TGT implementation consisted of five stages: class presentation, team formation, games, tournaments, and team recognition. During the class presentation, the teacher delivered the learning materials and explained the learning objectives. Students were then divided into heterogeneous teams to discuss the learning materials and prepare for the games and tournaments. During the games stage, students used the Question Box to obtain and answer questions collaboratively according to the established rules. The tournament stage also used the Question Box, in which students competed by answering questions obtained from the Question Box according to the tournament rules. The scores obtained from the games and tournaments were then used in the team recognition stage to determine team achievement and provide recognition based on the results obtained. The same procedure was implemented in two learning meetings. During the learning process, students' collaboration ability was observed by four observers using the observation sheet. After the treatment, both classes were administered a posttest and a collaboration ability questionnaire.

In the reporting stage, the questionnaire and observation data were collected, processed, and analyzed using the predetermined data analysis procedures. The results were then interpreted and discussed to formulate conclusions regarding the implementation of the Question Box-assisted TGT learning model on students' collaboration ability.

Research Data Analysis

Data analysis was conducted using Microsoft Excel and IBM SPSS Statistics 26. Descriptive analysis was used to describe students' collaboration ability based on the questionnaire and observation data by calculating the percentage scores for each collaboration indicator. The percentage was calculated using the following formula:

$$P = \frac{x}{x_{max}} \times 100\% \quad (1)$$

where P is the percentage of collaboration ability, x is the obtained score, and x_{max} is the maximum score. The resulting

percentages were categorized based on the collaboration ability criteria presented in Table 1. The Shapiro-Wilk test was then used to determine the normality of the data. Because the normality assumption was not met for all datasets, non-parametric tests were used for hypothesis testing. The Wilcoxon Signed Rank Test was used to determine differences in collaboration ability before and after treatment within each class, while the Mann-Whitney U Test was used to determine differences between the experimental and control classes. Effect Size was calculated based on the Z value obtained from the Mann-Whitney U Test to determine the magnitude of the treatment effect.

Result and Discussion

Results

Two classes participated in this study: an experimental class that used the Team Games Tournament (TGT) learning model with Question Box help and a control class that used the Direct Instruction learning model. The data analyzed included collaboration ability questionnaire scores before and after treatment, as well as observation results during two meetings. The categorization of collaboration ability referred to the II Benchmark Assessment (PAP) (Mardawati et al., 2022) as presented in Table 1.

Table 1. Categorization of Collaboration Ability Levels

Score	Categorization
81-100	Very Collaborative
61-80	Collaborative
41-60	Fairly Collaborative
20-40	Less Collaborative
0-20	Not Collaborative

Based on the result of the questionnaire, the experimental class experienced an increase in the average collaboration ability from 77.8% (collaborative) to 83.1% (very collaborative), with a difference of 5.3%. The control class increased from 86.0% to 87.7%, with a difference of 1.7%, both remaining in the very collaborative category. Details of the percentage and difference in the increase for each indicator are presented in Table 2.

The indicators of participating and contributing showed the largest rise in the experimental class (8.0%), whereas the indicators of being jointly responsible for completing tasks showed the least increase (2.5%). The indicators of being flexible and willing to compromise increased the most in the control class (3.8%), but the indicator of working productively with others did not improve (0.0%).

Table 2. Percentage and Difference in Improvement in Collaboration Ability Based on Questionnaire

Collaboration Ability Indicators	Experimental			Control		
	Before (%)	After (%)	Difference (%)	Before (%)	After (%)	Difference (%)
Working productively with others	73.9 (Collaborative)	81.5 (Very Collaborative)	7.6	84.3 (Very Collaborative)	84.3 (Very Collaborative)	0.0
Participating and contributing actively	71.3 (Collaborative)	79.3 (Collaborative)	8.0	78.2 (Collaborative)	81.7 (Very Collaborative)	3.5
Being flexible and willing to compromise	76.5 (Collaborative)	79.5 (Collaborative)	3.0	85.2 (Very Collaborative)	89.0 (Very Collaborative)	3.8
Being jointly responsible for completing tasks	82.8 (Very Collaborative)	85.3 (Very Collaborative)	2.5	89.3 (Very Collaborative)	90.3 (Very Collaborative)	1.0
Appreciating the contributions of each group member	84.5 (Very Collaborative)	89.9 (Very Collaborative)	5.4	93.1 (Very Collaborative)	93.4 (Very Collaborative)	0.3
Average	77.8 (Collaborative)	83.1 (Very Collaborative)	5.3	86.0 (Very Collaborative)	87.7 (Very Collaborative)	1.7

The observation result showed that the average collaboration ability of the experimental class was 85.5% (very collaborative) and that of the control class was 73.4% (collaborative). Details of the observation results are presented in Table 3.

In the experimental class, the highest indicator based on observation was appreciating the contributions

of each group member (92.9%), and the lowest was being jointly responsible for completing tasks (81.7%). The highest indicator in the control class was appreciating the contributions of members (90.9%), and the lowest was active participation and contribution (63.1%).

Table 3. Percentage and Categories of Collaboration Ability Based on Observations

Collaboration Ability Indicators	Experimental		Control	
	Percentage (%)	Category	Percentage (%)	Category
Working productively with others	85.0	Very Collaborative	70.3	Collaborative
Participating and contributing actively	82.0	Very Collaborative	63.1	Collaborative
Being flexible and willing to compromise	85.3	Very Collaborative	70.3	Collaborative
Being jointly responsible for completing tasks	81.7	Very Collaborative	72.5	Collaborative
Appreciating the contributions of each group member	92.9	Very Collaborative	90.9	Very Collaborative
Average	85.5	Very Collaborative	73.4	Collaborative

As shown in Table 4, the Shapiro-Wilk normality test revealed that the experimental class data was normally distributed ($p > 0.05$), whereas the control class data was not normally distributed ($p < 0.05$). Consequently, nonparametric statistics were used in hypothesis testing.

Table 4. Shapiro-Wilk Normality Test Results

Class	Data Type	Sig. (Shapiro-Wilk)	Description
Experimental	Pretest	0.275	Normally
	Posttest	0.628	
Control	Pretest	0.029	Not Normally
	Posttest	0.015	

According to Table 5, the Wilcoxon Signed Rank Test revealed a significant difference between the experimental class before and after treatment ($p = 0.037 < 0.05$), whereas there was no significant difference ($p = 0.069 > 0.05$) in the control class.

Table 5. Results of the Wilcoxon Signed Rank Test

Class	Asymp.Sig.2-tailed	Conclusion
Experimental	0.037	There is a difference
Control	0.069	No difference

The posttest scores' Mann-Whitney U Test yielded a significance value of 0.057 (> 0.05), as shown in Table 6, suggesting that there was no statistically significant difference between the experimental and control classes. Nonetheless, a tendency toward difference is indicated by the p-value approaching the 0.05 cutoff, necessitating further study with a larger sample size.

Table 6. Mann-Whitney U Test Results

	Posttest
Mann-Whitney U Test	152.000
Wilcoxon W	428.000
Z	-1.903
Asymp.Sig. (2-tailed)	0.057

The effect size calculation uses the formula:

$$r = \frac{Z}{\sqrt{N}} \quad (2)$$

with a value of $Z = -1.903$ and $\sqrt{N} = 43$, resulting in a value of $r = 0.3$, which is classified as moderate (Cohen, 1988). This value indicates that, in practical terms, the implementation of the Question Box-assisted TGT model has a meaningful effect, even though it has not reached statistical significance.

Discussion

In order to promote accountability, collaboration, and student involvement, teamwork and academic competition are combined in the Team Games Tournament (TGT) learning model (Khusaini et al., 2025). The experimental class's collaboration skills improved when the Question Box-assisted TGT model was implemented, as evidenced by the 5.3% increase in the average questionnaire score from the collaborative category to the very collaborative category. The highest increase was recorded in the indicators of participation and active contribution (8.0%), as students were actively involved in asking questions and responding to the teacher's explanations in preparation for the games and tournaments. These results support the claim made by Hikmah et al. (2025), who stated that initial student involvement encourages interaction and cooperation in the TGT model.

The formation of heterogeneous groups encourages collaborative behavior through role sharing, active discussion, and mutual respect for each other's opinions. This is consistent with the assertion made by Silvia et al. (2024) that heterogeneous groups encourage participation and interaction among members. Theoretically, this process reflects Vygotsky's social constructivism view of the Zone of Proximal Development, which is the ability to learn through the help of others (Salsabila & Suprijono, 2025). The use of a randomly selected question card in Question Box encourages students to make joint decisions within a limited time, thereby increasing collaborative involvement. The indicator of valuing each group member's contribution achieved the highest observation percentage of 92.9%.

On the other hand, the indicator of being jointly responsible for completing tasks showed the lowest increase, both in the questionnaire (2.5%) and observation (81.7%). This was due to students' inconsistency in following the rules for selecting questions and time constraints. Ningsih et al. (2025) stated that student responsibility in TGT is individual and develops gradually. Audina et al. (2025) added that the formation of a responsible character requires continuous habituation. Time constraints are also a factor that affects the optimality of the reward stage

(Wahidah & Kristin, 2023). This gradual process reflects the concept of scaffolding in social constructivism (Salsabila & Suprijono, 2025).

Statistically, the Wilcoxon test revealed a significant difference in the experimental class ($p = 0.037$), supporting the findings of Banowati et al. (2025) that TGT increases collaboration and participation in group learning. In contrast, the control class did not show a significant difference ($p = 0.069$), possibly due to the ceiling effect because of the already high initial scores (Staus et al., 2021). Although there was no significant difference between the classes according to the Mann-Whitney U Test ($p = 0.057$), the experimental class saw a larger increase descriptively. The significance value, which is close to the $\alpha = 0.05$ threshold, accompanied by a medium effect size (0.3), indicates a tendency for differences with relevant practical meaning in the context of learning. These findings are consistent with Oktavia et al. (2024) and Kulsum et al. (2025), who stated that TGT descriptively increases collaboration but is not always statistically significant. This contrasts with Rambe et al. (2025), who reported significant differences between classes ($p < 0.05$).

The difference between the questionnaire and observation results indicates the existence of self-report bias, where students assess their collaborative abilities higher than those assessed by external evaluators (Bazán-Ramírez et al., 2022). The Question Box-assisted TGT model's implementation nevertheless offers a useful contribution to the development of students' collaborative skills that are pedagogically relevant, as the moderate effect size confirms (Haddish, 2022). All things considered, this model exhibits promise in fostering the growth of 21st-century teamwork and active engagement, rewarding member contributions, and progressively increasing accountability in line with social constructivism's tenets.

Although there were no statistically significant variations between groups, the findings of this study suggest that the integration of structured question strategies in game-based cooperative learning has meaningful pedagogical value. However, some methodological considerations, such as differences in initial abilities between groups and limited duration of implementation, need to be considered in interpreting the research results. Therefore, further research is recommended to involve a larger sample count as well as apply stricter experimental controls to obtain stronger evidence.

Conclusion

Eighth-grade students' collaboration abilities on the excretory system sub-material improved after the Question Box-assisted Team Games Tournament (TGT)

learning model was implemented, as seen by the experimental class's better average collaboration score. The experimental class pretest and posttest results showed a statistically significant difference. Although there were no statistically significant differences between the classes, the moderate effect size and descriptive improvement indicate that the integration of game-based cooperative learning and structural questioning strategies can serve as an alternative pedagogical approach to fostering collaboration skills in junior high school science learning.

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Author Contributions

Conceptualization, N.A.N., E.A. and A.B.T.; methodology, N.A.N., E.A. and A.B.T.; software, N.A.N.; validation, E.A. and A.B.T.; formal analysis, N.A.N.; investigation, N.A.N.; resources, E.A.; data curation, N.A.N. E.A. and A.B.T.; writing—original draft preparation, N.A.N.; writing—review and editing, N.A.N., E.A. and A.B.T.; visualization, N.A.N.; supervision, E.A. and A.B.T.; project administration, N.A.N. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

References

- Alfaeni, D., Nurkanti, M., & Halimah, M. (2022). Kemampuan kolaborasi siswa melalui model project based learning menggunakan zoom pada materi ekosistem. *BIOEDUKASI: Jurnal Pendidikan Biologi*, 13(2), 143–149. <http://dx.doi.org/10.24127/bioedukasi.v13i2.6330>
- Audina, M., Imaningtyas, I., & Nurhasanah, N. (2025). Hubungan kepercayaan diri dengan sikap tanggung jawab peserta didik kelas IV sekolah dasar di Kelurahan Cipinang Cempedak. *Didaktik: Jurnal Ilmiah PGSD FKIP Universitas Mandiri*, 11(4), 303–313. <https://doi.org/10.36989/didaktik.v11i04.9255>
- Ayuni, I. G. A. P. A. S., Kusmariyatni, N., & Japa, I. G. N. (2017). Pengaruh model pembelajaran talking stick berbantuan media question box terhadap hasil belajar IPA kelas V. *Journal of Education Technology*, 1(2), 183–190. Retrieved from <https://ejournal.undiksha.ac.id/index.php/JET/article/view/12503>
- Banowati, R. T., Idawati, I., & Hesti, H. (2025). Implementasi pembelajaran TGT guna meningkatkan keterampilan kolaboratif siswa di SMP. *Jurnal Pendidikan Pemuda Nusantara*, 7(1), 1–9. <https://doi.org/10.56335/jppn.v7i1.229>
- Bazán-Ramírez, A., Velarde-Corrales, N. M., Rodríguez-Pérez, M. E., Guerrero-Barrios, J., & Anaya-González, R. B. (2022). Observational record and self-report of teacher-student performance in high school lessons. *International Journal of Educational Methodology*, 8(3), 479–491. <https://doi.org/10.12973/ijem.8.3.479>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Dewi, E. M. P., Qamaria, R. S., Widiastuti, A. A., Widyatno, A., Marpaung, J., Ervina, I., ... & Suprihatin, T. (2024). *Pendidikan Indonesia di era globalisasi; tantangan dan peluang*. Nas Media Pustaka.
- Fina, I. D., Mustaji, & Dewi, U. (2023). Analisis kebutuhan e-LKPD berbasis problem based learning terhadap pembelajaran IPA SMP kelas VIII. *ORYZA: Jurnal Pendidikan Biologi*, 12(2), 173–181. <https://doi.org/10.33627/0z.v2i2.1379>
- Firmayanti, D., & Fardhani, I. (2023). Analisis kemampuan kolaborasi siswa SMP pada mata pelajaran ilmu pengetahuan alam. In *Seminar Nasional Pendidikan IPA dan Matematika* (pp. 133–136). Retrieved from <http://conference.um.ac.id/index.php/LAS/article/viewFile/8212/2529>
- Greenstein, L. (2012). *Assessing 21st century skills: a guide to evaluating mastery and authentic learning*. United States of America: Corwin Press.
- Haddish, Z. (2022). Effect size measures in research and education. *Journal of Educational and Developmental Psychology*, 12(1), 18–26.
- Hamdani, M. S., Mawardi, & Wardani, K. W. (2019). Penerapan model pembelajaran Team Games Tournament (TGT) pada pembelajaran tematik terpadu kelas 5 untuk peningkatan keterampilan kolaborasi. *Jurnal Ilmiah Sekolah Dasar*, 3(4), 440–447. Retrieved from <https://ejournal.undiksha.ac.id/index.php/JISD/index>
- Hikmah, R. K., Azzahra, R. F., Surayya, S., & Tarsidi, D. Z. (2025). Analisis partisipasi aktif peserta didik dalam pembelajaran PKN melalui model pembelajaran kooperatif Teams Games Tournament (TGT). *Sindoro Cendikia Pendidikan*, 18(2), 1–8.
- Khusaini, R., Putra, J. T. M., Utama, D. T., & Budiarti, M. (2025). Upaya peningkatan hasil belajar siswa kelas 5 melalui model kooperatif tipe teams games

- tournament berbantuan PPT interaktif pada materi sudut. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 10(3), 396–410.
<https://doi.org/10.23969/jp.v10i03.30935>
- Kulsum, U., Alfian, M., & Agustyasari, R. (2025). Peningkatan kemampuan kolaborasi siswa kelas VII pada pelajaran informatika menggunakan media permainan ular dengan model kooperatif TGT. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 10(2), 470–494.
<https://doi.org/10.23969/jp.v10i02.25893>
- Mahendra, Y., Mulyawan, G., & Putri, V. K. (2023). Transformasi pembelajaran sosiologi: peran keterampilan 4C di abad 21. *Jurnal Ilmiah P2M STKIP Siliwangi*, 10(2), 120–131.
<https://doi.org/10.22460/p2m.v10i2.4188>
- Mardawati, M., Syamsuddin, A., & Rukli, R. (2022). Pengaruh model pembelajaran problem based learning berbantuan media mobile learning terhadap kemampuan kolaborasi matematika siswa kelas IV SD. *Indonesian Journal of Educational Science*, 5(1), 56–64.
<https://doi.org/10.31605/ijes.v5i1.1834>
- Masruroh, L., & Arif, S. (2021). Efektivitas model problem based learning melalui pendekatan science education for sustainability dalam meningkatkan kemampuan kolaborasi. *Jurnal Tadris IPA Indonesia*, 1(2), 179–188. Retrieved from <http://ejournal.iainponorogo.ac.id/index.php/jti>
- Miroh, M., Patonah, S., & Kaltsum, U. (2019). Pengaruh model pembelajaran Team Games Tournament (TGT) terhadap kemampuan kolaborasi siswa di SMP N 5 Ungaran. In *Prosiding Seminar Nasional Lontar Physics Forum* (pp. 113–118). Retrieved from <https://conference.upgris.ac.id/index.php/lpf/article/view/627>
- Ningsih, W., Sari, M. E., & Prasetyo, H. (2025). Penerapan model pembelajaran cooperative learning tipe Team Games Tournament (TGT) untuk menumbuhkan keaktifan belajar siswa kelas 4 pada mata pelajaran IPAS. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 10(3), 246–259.
<https://doi.org/10.23969/jp.v10i03.30466>
- Nurmayasari, K. V., Utomo, A. P., & Sulistyarningsih, H. (2023). Implementasi pembelajaran problem based learning materi perubahan lingkungan untuk meningkatkan kemampuan kolaborasi siswa SMA Negeri 1 Bangorejo. *Jurnal Biologi*, 1(2), 1–10.
<https://doi.org/10.47134/biology.v1i2.1964>
- Oktavia, A., & Darwanto, D. (2024). Pengaruh model pembelajaran teams games tournament terhadap kemampuan kolaborasi siswa kelas VII MTS Nurul Huda Madukoro. *Jurnal Griya Cendikia*, 9(2), 229–235.
<https://doi.org/10.47637/griyacendikia.v9i2.1449>
- Paramitha, A. A., & Zulherman. (2022). Pengaruh model pembelajaran TGT berbantuan media question box terhadap hasil belajar IPA kelas IV SD. *Journal of Instructional and Development Researches*, 2(2), 79–87.
<https://doi.org/10.53621/jider.v2i2.128>
- Rahmawati, S., Trisiana, A., & Mustofa, M. (2023). Analisis penerapan model pembelajaran kooperatif Team Games Tournament (TGT) pada pembelajaran tematik integratif. *Jurnal Pendidikan Tambusai*, 7(1), 3826–3831.
<https://doi.org/10.31004/jptam.v7i1.5839>
- Rambe, K. B., & Nasution, S. (2025). The influence of the cooperative learning model of the Team Game Tournament (TGT) type on students' collaborative learning abilities in the Indonesian language subject of elementary school. *Journal of Elementary Educational Research*, 5(1). Retrieved from <http://ejournal.iain-manado.ac.id/index.php/jeer>
- Rofilah, I., Lestari, W. M., & Asiani, A. (2025). Peningkatan hasil belajar peserta didik kelas V model pembelajaran Teams Games Tournament (TGT) berbantuan media ular tangga pada materi sejarah lahirnya Pancasila. *Jurnal Teori Dan Pengembangan Pendidikan*, 9(4), 138–151. Retrieved from <https://journal.fexaria.com/j/index.php/jtpb>
- Sabila, H. N., Pertiwi, N. R., & Sintawati, A. (2023). Implementasi model pembelajaran problem based learning terhadap keterampilan kolaboratif dan komunikasi sains pada materi sistem ekskresi di SMPN 1 Ciamis. *Bioed: Jurnal Pendidikan Biologi*, 11(1), 47–58.
<https://doi.org/10.25157/jpb.v11i1.10168>
- Salsabila, A., & Suprijono, A. (2025). Pengaruh model pembelajaran Teams Games Tournament (TGT) berbasis ular tangga dengan integrasi gamifikasi terhadap motivasi belajar siswa dalam pembelajaran sejarah kelas XI SMAN 12 Surabaya. *ATARA, e-Journal Pendidikan Sejarah*, 16(4), 1–10. Retrieved from <https://ejournal.unesa.ac.id/index.php/avatara/article/view/72675>
- Silvia, S., Fitri, Y., & Refnywidialistuti, R. (2024). Penerapan model pembelajaran kooperatif tipe Team Games Tournament (TGT) terhadap hasil belajar matematika siswa fase F SMA N 5 Padang. *Ekasakti Educational Scientific Journal*, 2(2), 97–107.
<https://doi.org/10.60034/eesj>
- Simbolon, W. A., Ahmad, M., Fadilla, U., & Kristanti, A. T. (2025). Menumbuhkan minat belajar matematika siswa dengan model pembelajaran kooperatif tipe Team Games Tournament (TGT). *Jurnal PKM Indonesia*, 1(1), 22–31.

- <https://doi.org/10.62567/jpi.v1i1.564>
Staus, N. L., O'Connell, K., & Storksdieck, M. (2021). Addressing the ceiling effect when assessing STEM out-of-school time experiences. *Frontiers in Education*, 6(690431).
<https://doi.org/10.3389/feduc.2021.690431>
- Wahidah, C. N., & Kristin, F. (2023). Peningkatan keaktifan belajar melalui model cooperative learning tipe Teams Games Tournament (TGT) di kelas IV sekolah dasar. *Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, 6(2), 378–388.
<https://doi.org/10.54069/attadrib.v6i2.614>