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Understanding Students' Perceptions of Gamified Science Learning: A Descriptive Analysis of Teams Games Tournament in Environmental Pollution Education

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Abstract

Students' perceptions provide important insights into how cooperative game-based learning is experienced in science classrooms; however, descriptive evidence concerning these perceptions in environmental pollution education remains limited, particularly in Indonesian junior high schools. This study examined Grade VII students' perceptions of science learning through the Teams Games Tournament (TGT) model, focusing on instructional attractiveness, group participation, game-based activities, perceived ease of assessment tasks, and the relevance of learning content to everyday life. A descriptive quantitative survey with a cross-sectional, post-instruction design was conducted involving 120 students from four Grade VII classes at SMP Negeri 1 Turi, Lamongan, during the second semester of the 2021/2022 academic year. Data were collected using a ten-item questionnaire with a five-point Likert scale and analysed using descriptive statistics. Expert evaluation indicated that the questionnaire achieved a validity score of 91.13%, categorized as highly valid. The findings revealed generally positive student perceptions of TGT-based science learning. The highest proportion of agreement (74.17%) was observed for the statement concerning the attractiveness of group work and game activities, followed by the perceived relevance of environmental pollution content to everyday life (70.00%). These findings suggest that students particularly appreciated the interactive and contextual features of TGT-based instruction. This study contributes descriptive evidence of students' perceptions that can inform the design of cooperative and game-based science learning. Nevertheless, the findings should be interpreted as self-reported perceptions rather than evidence of improvements in learning outcomes, student engagement, or environmental behaviour.

Keywords: Student Perceptions; Teams Games Tournament; Cooperative Learning; Game-Based Learning; Environmental Pollution.

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INTRODUCTION

Environmental pollution presents a relevant context for science learning because it involves environmental problems that students can observe in their immediate surroundings, including air contamination, water pollution, and improper waste disposal. Understanding these problems requires students not only to recognize

scientific concepts but also to examine their causes, consequences, and connections to human activities. In junior high school classrooms, however, discussing environmental issues may become limited to recalling definitions and identifying types of pollution when learning activities provide insufficient opportunities for students to examine and discuss these phenomena. Students therefore need instructional experiences that allow them to articulate their understanding, compare perspectives, and construct explanations through interaction with their peers. This consideration highlights the need for learning activities that connect environmental science content with active classroom participation rather than relying primarily on teacher explanations.

In this context, students' experiences during classroom instruction deserve attention as an important source of information for evaluating the learning process. Opportunities to contribute ideas, participate in group discussions, interact with classmates, and respond to learning tasks are among the features that students may consider when evaluating an instructional approach. However, students' perceptions of these experiences should not be equated with their actual level of engagement or learning achievement. A questionnaire measuring students' responses can indicate whether particular learning activities, instructional materials, and opportunities for participation are perceived positively or negatively. It cannot, by itself, establish whether students demonstrate sustained engagement, develop a deeper understanding of scientific concepts, or achieve better learning outcomes. Accordingly, examining students' perceptions provides a complementary perspective for evaluating classroom instruction, particularly when the purpose is to understand how learners experience a specific teaching model.Cooperative learning is one instructional approach that can be employed to organize meaningful interactions among students. In cooperative learning, students work together to achieve shared academic goals while making individual contributions to the completion of group tasks. Teams Games Tournament (TGT) is a cooperative learning model that combines team-based learning with academic games and tournament activities. This model is designed to provide students with opportunities to support one another, share responsibilities, participate actively, and engage in healthy competition. These characteristics have the potential to make learning activities more engaging, particularly when the questions and tasks are related to authentic problems. Recent syntheses have also discussed the educational value of structured cooperative games and collaborative instruction (Katsantonis, 2025; Vembye et al., 2024).

Cooperative learning provides an instructional framework for organizing interaction and shared academic responsibility among students. Through cooperative learning, students work in groups to achieve common learning objectives while contributing individually to group activities. One model that incorporates cooperative learning and academic competition is Teams Games Tournament (TGT). TGT integrates teacher presentations, team-based learning, academic games, tournament activities, and team recognition into a structured instructional process. These components provide opportunities for students to discuss learning materials, support their teammates, apply their understanding through academic questions, and participate in a competitive yet collaborative learning environment. The combination of group interaction and game-based activities may offer an engaging learning

experience, particularly when instructional tasks are connected to relevant scientific problems. Previous reviews have discussed the educational potential of cooperative and structured game-based approaches, emphasizing the importance of collaboration and instructional design in learning activities (Katsantonis, 2025; Vembye et al., 2024).

Previous research has examined the implementation of TGT in science education, particularly in relation to student collaboration, motivation, engagement, and learning outcomes. Arif et al. (2026) reported positive findings concerning collaboration and science learning motivation among junior high school students implementing TGT. Similarly, Usnia and Anandita (2026) found improvements in science learning outcomes and student engagement through the integration of TGT with Discovery Learning in Grade VII classrooms. These findings indicate the relevance of TGT as a cooperative instructional model in science education. However, learning outcomes, motivation, engagement, and students' perceptions represent different dimensions of the learning process. Evidence of improved achievement or engagement does not necessarily explain how students evaluate specific instructional components, such as learning materials, group activities, academic games, and the relevance of instructional content. Consequently, investigating students' perceptions provides a complementary perspective for understanding the instructional experience associated with TGT.

The broader literature on game-based learning also highlights its potential contribution to science education. Othman et al. (2025), through a systematic review of 76 studies involving paper-based and digital board games in collaborative science learning, identified potential contributions to science knowledge, student engagement, and collaborative skills. However, their review also emphasized methodological limitations in the existing literature, particularly the need for further investigation of the mechanisms underlying specific game designs. Similarly, meta-analytic and systematic-review studies have examined the contributions of game-based learning to science achievement and students' understanding of chemistry concepts (Lei et al., 2022; Byusa et al., 2022; Safitri et al., 2025). Rizki and Yates (2026) further discussed factors influencing the implementation of digital game-based learning in secondary science classrooms. Collectively, these studies demonstrate the growing interest in game-based approaches while indicating that the instructional characteristics and students' experiences of particular learning models remain important areas of investigation. In environmental education, Talavera-Mendoza et al. (2025) reported an association between students' perceptions of gamified serious-game experiences and their self-reported ecological awareness. Nevertheless, ecological awareness and environmental behaviour are distinct from students' immediate perceptions of classroom instruction and therefore require separate measurements.

Environmental pollution provides a relevant instructional context for cooperative and game-assisted science learning because its concepts can be connected to situations that students encounter in their daily lives. Through group discussions and academic games, students can examine the sources and consequences of pollution, identify human activities contributing to environmental degradation, and discuss possible approaches to pollution prevention and mitigation. Previous studies in Indonesia have investigated various instructional approaches to improve science

learning on environmental issues. Dianti et al. (2025), for example, implemented Problem-Based Learning (PBL) supported by Smart Box media and reported an instructional implementation rate of 89.67% and a moderate improvement in scientific literacy, with an N-gain score of 0.59. Indahyana et al. (2024) reported an improvement in students' critical thinking skills through contextual learning on environmental pollution using small-group discussions, with an N-gain score of 0.75. Furthermore, Rismayanti et al. (2026) demonstrated improvements in junior high school students' scientific argumentation skills through Socio-Scientific Issues (SSI)-based PBL incorporating debate activities on global warming, with an N-gain score of 0.74. These findings demonstrate the relevance of interactive and contextual instructional approaches for addressing environmental issues in science education. Related research has also examined the development of learning resources specifically addressing environmental pollution (Wahyuni et al., 2023). In addition, scientific and technological applications addressing emission-related issues, such as polysulfone-based mixed-matrix membranes incorporating zeolite fillers for CO_2/CH_4 gas separation, illustrate how environmental problems can be connected to technological developments in science (Susanti, 2019). These studies provide a broader contextual foundation for environmental science instruction, although their measured outcomes differ from the student perceptions examined in the present study.

Despite the growing body of research on cooperative learning, TGT, and game-based science instruction, an important distinction remains between evaluating the effectiveness of an instructional model and understanding how students perceive their learning experiences. Previous studies have predominantly examined learning achievement, motivation, collaboration, scientific literacy, critical thinking, or scientific argumentation (Arif et al., 2026; Usnia & Anandita, 2026; Dianti et al., 2025; Indahyana et al., 2024; Rismayanti et al., 2026). Although these outcomes provide important evidence regarding instructional performance, they do not necessarily describe students' evaluations of the specific components of TGT-based learning. In particular, descriptive evidence concerning students' perceptions of instructional attractiveness, learning materials, participation in group activities, game-based activities, perceived ease of assessment tasks, and the relevance of science content to everyday life remains valuable in the context of environmental pollution education at the junior high school level. Such evidence can complement outcome-based evaluations by identifying instructional features that students perceive positively and aspects that may require further improvement.

The present study addresses this gap by examining Grade VII students' perceptions of science learning through the Teams Games Tournament model on the topic of environmental pollution. Using a descriptive quantitative approach and a ten-item Likert-scale questionnaire, the study provides an item-based account of students' perceptions across several aspects of the learning experience. The study offers three contributions. First, it provides descriptive evidence of students' perceptions of TGT-based science instruction in the context of environmental pollution. Second, it complements previous research focusing on learning outcomes and other educational variables by documenting students' evaluations of specific instructional components. Third, it provides practical information that may assist science teachers in reflecting on the design of group activities, academic games, instructional materials, and

contextual learning tasks. Accordingly, the study addresses the following research question: How do Grade VII students perceive TGT-based science learning on environmental pollution in terms of learning attractiveness, instructional materials, group participation, game activities, perceived ease of assessment tasks, and the relevance of science content to everyday life? Importantly, this study focuses on students' self-reported perceptions rather than the causal effectiveness of TGT. Therefore, its findings are not intended to establish improvements in learning achievement, objective student engagement, motivation, critical thinking, ecological awareness, or environmental behaviour.

METHOD

This study employed a descriptive quantitative design to examine students' perceptions of science learning using the Teams Games Tournament (TGT) model on the topic of environmental pollution. A descriptive survey approach was considered appropriate because the study aimed to describe students' responses after they had experienced the instructional activities. The study used a cross-sectional, post-instruction data collection procedure: students completed the questionnaire after the learning activities had been implemented. No control group or pre-intervention measurement was included. Therefore, the findings represent students' self-reported perceptions and are not intended to establish a causal relationship between TGT implementation and students' learning outcomes. The research procedure is presented in Figure 1.

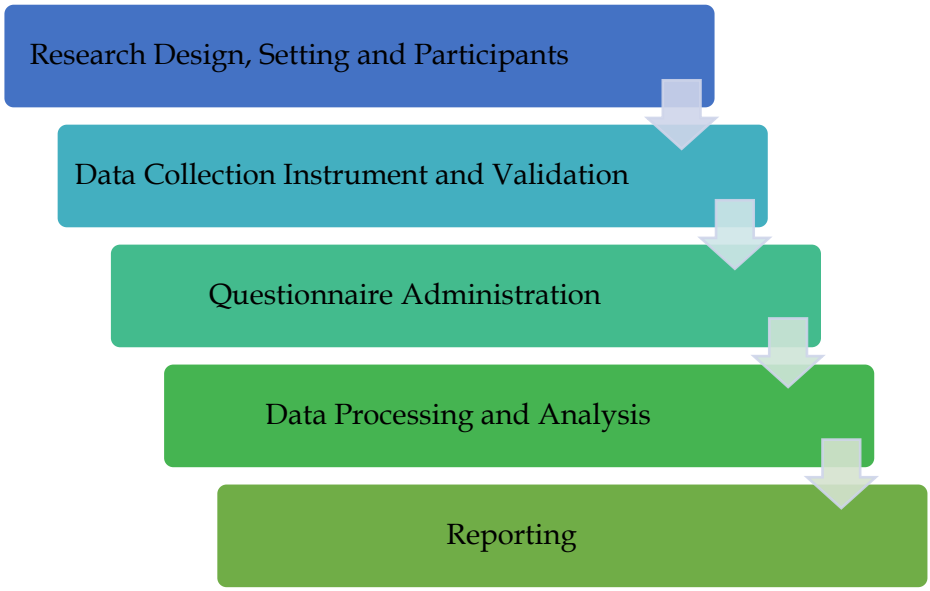


Figure 1. Research Procedure

The study was conducted at SMP Negeri 1 Turi, Lamongan, East Java, Indonesia, during the second semester of the 2021/2022 academic year. The participants were 120 seventh-grade students from four classes: VII B, VII E, VII F, and VII G, with 30 students in each class. The participants were between 12 and 13 years old. The sample consisted of 57 male students and 63 female students. The participants were selected using a simple random sampling technique from the seventh-grade

student population at SMP Negeri 1 Turi. A total of 120 students participated in the study, comprising 30 students from each of four classes: VII B, VII E, VII F, and VII G.

Table 1. Characteristics of the Research Participants

Class	Number of Students	Age Range	Male	Female
VII B	30	12-13 years	16	14
VII E	30	12-13 years	15	15
VII F	30	12-13 years	15	15
VII G	30	12-13 years	11	19

The instructional context involved science learning on environmental pollution using the TGT cooperative learning model. The learning activities included team-based tasks and educational games. These activities provided the context for students to evaluate their learning experiences, particularly in relation to group participation, game activities, the attractiveness of learning, assessment tasks, and the relevance of the instructional content to everyday life.

The questionnaire was administered after the learning activities had been completed. Thus, students' responses reflected their perceptions of the instructional experience they had received rather than their perceptions before the implementation of the model.

The TGT-based instruction was implemented in science learning on the topic of environmental pollution. The learning activities incorporated team-based tasks and educational games designed to provide students with opportunities to participate in group work and engage with the instructional content through game-based activities. The teacher facilitated the learning process, while students participated in the activities collaboratively within their respective groups. Following the completion of the instructional activities, students were asked to complete the questionnaire to report their perceptions of the learning experience.

The research instrument was a student-response questionnaire consisting of ten statements. The items addressed six aspects of students' learning experiences: (1) the attractiveness of the science learning process; (2) the attractiveness of the instructional materials; (3) students' participation in group activities; (4) the attractiveness and perceived benefits of the TGT learning model; (5) students' perceptions of group games and assessment tasks; and (6) the relevance of the instructional content to everyday life.

The questionnaire used a five-point Likert scale with the following response categories: Strongly Disagree (SD), Disagree (D), Neither Agree nor Disagree (N), Agree (A), and Strongly Agree (SA). The instrument was reviewed by experts to obtain content-validity evidence. The expert evaluation resulted in a validity score of 91.13%, which was categorized as highly valid. Expert review is an established source of content-validity evidence in questionnaire development (Artino et al., 2014; Hill et al., 2022).

The questionnaire was administered to the 120 participants after they had completed the TGT-based science learning activities on environmental pollution. Each participant was asked to respond to all ten questionnaire statements using a five-point Likert scale, ranging from Strongly Disagree (SD) to Strongly Agree (SA). The

completed questionnaires were collected and examined to ensure that the responses could be included in the analysis.

The data were analyzed descriptively by calculating the frequency and percentage of responses in each Likert-scale category for every questionnaire item. The percentage was calculated using the following formula:

$$P = \frac{f}{N} \, x \, 100\%$$

where (P) represents the percentage of responses, (f) represents the frequency of responses in a particular category, and (N) represents the total number of participants (120). The frequency and percentage distributions were used to describe students' responses to each statement and to identify the aspects of TGT-based science learning that received the most positive responses.

The results were presented in tables 4 and interpreted according to the distribution of responses across the five categories based on tables 2. The analysis focused on students' self-reported perceptions of the learning process, instructional materials, group participation, game-based activities, assessment tasks, and the relevance of environmental pollution content to everyday life. Accordingly, the findings describe how students perceived the learning experience and should not be interpreted as evidence of improvements in learning achievement, actual classroom engagement, or causal effects of the TGT model.

Table 2. descriptive analysis focused on aspects of students' perceptions

Perception aspect	Items	Item focus in the original instrument
Attractiveness of learning process and materials	1, 2, 8	Interest in the science lesson, instructional materials, and introductory activity
Participation in group work	3	Perceived opportunity to express opinions during group work
TGT model and game activities	4, 6, 10	Perceived attractiveness of the model, group games, and suitability for the topic
Manageability of assessment tasks	5, 9	Perceived ease of evaluation/post-test questions and assignments
Relevance to everyday life	7	Perceived connection between content and everyday life

RESULTS AND DISCUSSION

Questionnaire Validation

The student response questionnaire obtained an expert validation score of 91.13% and was classified as highly valid. This result indicates that the questionnaire was rated favorably by the validators based on the validation procedure. The validation score was presented on the Table 3.

Table 3. Questionnaire Validation Score

Instrument	Validation Score	Category
Student response questionnaire	91.13%	Highly valid

Students' Perceptions of TGT-Based Learning on Environmental Pollution

The student response questionnaire consisted of ten statements concerning students' perceptions of the learning process. The response categories reported in the questionnaire results were Neither Agree nor Disagree, Agree, and Strongly Agree. The students' responses are presented in Table 4.

Table 4. Distribution of Students' Responses to the Questionnaire Items

No.	Questionnaire Statement	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)
1	The science learning process implemented by the teacher was very interesting.	9.17	60.00	30.83
2	The instructional materials presented were very interesting.	11.67	58.33	30.00
3	Students actively expressed their opinions during group work.	8.33	57.50	34.17
4	The learning model used by the teacher was very interesting.	11.67	65.00	23.33
5	The learning model made the evaluation questions/post-test easier to complete.	8.33	68.33	23.33
6	Group work and games in this learning activity were very interesting and unexpected.	11.67	74.17	14.17
7	Students were able to relate the learning materials to everyday life.	10.00	70.00	20.00
8	The introductory stage of the lesson included interesting activities.	10.00	63.33	26.67
9	The assignments and post-test questions were easy to complete.	10.83	59.17	30.00
10	The learning model implemented by the teacher was highly appropriate for the subject matter.	10.00	62.50	27.50

Based on the response distributions presented in Table 3, students generally expressed positive perceptions of the TGT-based science learning activities. The Agree category represented the highest proportion of responses across all ten questionnaire items, indicating that students tended to respond positively to the learning process, instructional materials, group activities, and other components of the TGT model. In particular, the item concerning group work and game activities received the highest

proportion of agreement (74.17%), followed by the item addressing the relevance of environmental pollution materials to everyday life (70.00%). These findings suggest that students particularly appreciated the collaborative and contextual features of the learning activities.

Students also reported positive perceptions of their participation in group work. For this item, the combined proportion of Agree and Strongly Agree responses reached 91.67% (57.50% and 34.17%, respectively). This result indicates that students perceived group activities as providing opportunities to express their opinions and participate in collaborative learning. Furthermore, the introductory learning activities (Item 8) received 63.33% Agree and 26.67% Strongly Agree responses, suggesting that students generally found the initial learning activities engaging. Similarly, Item 10, which addressed the suitability of the TGT model for the environmental pollution topic, received 62.50% Agree and 27.50% Strongly Agree responses. This indicates that students generally considered the learning model appropriate for the subject matter.

Regarding the perceived manageability of assessment tasks, the responses to Items 5 and 9 also showed positive tendencies. For Item 5, 68.33% of students selected Agree and 23.33% selected Strongly Agree, while Item 9 received 59.17% Agree and 30.00% Strongly Agree responses. These findings suggest that most students perceived the evaluation questions and learning assignments as manageable. However, these results reflect students' subjective evaluations of the tasks rather than objective measurements of their assessment performance.

Overall, the response distributions indicate that students viewed the TGT-based science learning experience positively, particularly in relation to group participation, game activities, and the connection between environmental pollution content and everyday life. Nevertheless, these findings should be interpreted as descriptive evidence of students' self-reported perceptions. They do not establish improvements in learning achievement, objectively observed classroom engagement, or causal effects of the TGT model.

Students' Perceptions of the Attractiveness of the Learning Process and Materials

The questionnaire examined students' perceptions of the attractiveness of the science learning process and instructional materials. These aspects represent students' subjective evaluations of the learning activities and resources provided during the TGT-based instruction. The response distributions in Table 3 show variations in students' evaluations across the questionnaire items. In particular, the proportions of Agree and Strongly Agree responses indicate that some students viewed the learning process and instructional materials positively, although the distribution of responses also reflects differences in the extent of their agreement. Therefore, the findings should be interpreted based on the response frequencies and percentages for each item rather than as a single overall measure of learning attractiveness.

The findings can be discussed in relation to previous studies on game-based and cooperative science learning. Othman et al. (2025), in a synthesis of 76 studies on board games in collaborative science learning, discussed the potential of game-based activities to support collaborative learning. Similarly, Arif et al. (2026) reported positive associations between the TGT model, collaboration, and science learning motivation among junior high school students. These studies provide a broader

context for understanding the use of games and cooperative activities in science instruction. However, their findings concern different learning-related constructs, whereas the present study specifically describes students' self-reported perceptions of the learning process and instructional materials. Thus, the present findings should not be interpreted as direct evidence of increased student engagement, motivation, or collaborative skills.

Environmental pollution learning has also been investigated through different instructional approaches. Dianti et al. (2025), for example, examined Smart Box-assisted problem-based learning and reported an implementation rate of 89.67% and an N-gain of 0.59 in scientific literacy. These results illustrate how instructional approaches can be evaluated in terms of implementation and learning outcomes. In contrast, the present study focused on students' perceptions of TGT-based learning activities. Consequently, the findings of the two studies represent different dimensions of educational evaluation and should be considered complementary rather than directly comparable. The present study contributes descriptive information about how students perceived the learning process and materials when studying environmental pollution through the TGT model.

Group Work, Peer Interaction, and Active Participation

The questionnaire item concerning students' opportunities to express their opinions during group work received 57.50% of responses in the Agree category (69 respondents) and 34.17% in the Strongly Agree category (41 respondents). Combined, these categories accounted for 91.67% of the responses (110 respondents), indicating that most respondents perceived group work as an opportunity to express their ideas during the learning activities. This finding describes students' perceived opportunities for participation rather than objectively observed levels of classroom engagement or the quality of their contributions.

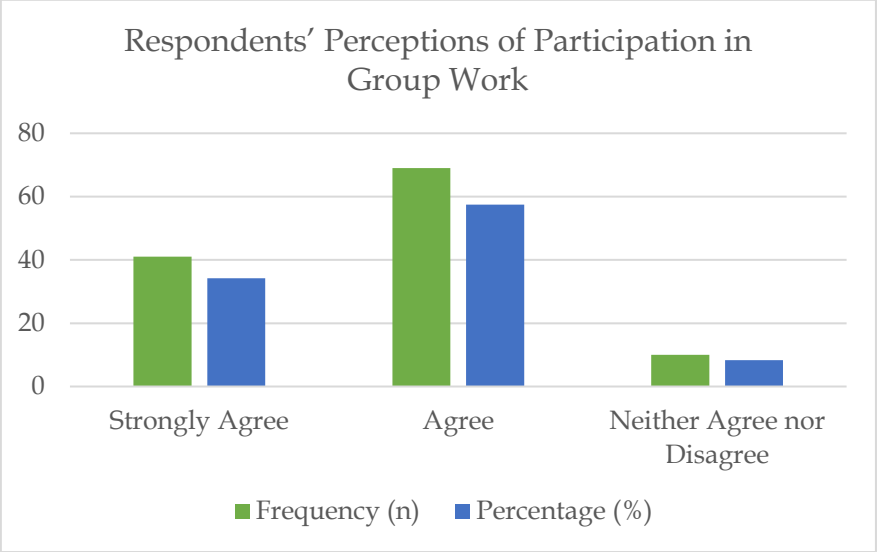


Figure 2. Respondents' Perceptions of Participation in Group Work

As illustrated in Figure 2, respondents generally expressed positive perceptions of their participation in group work. A total of 69 respondents (57.50%) selected Agree,

while 41 respondents (34.17%) selected Strongly Agree. Together, these responses accounted for 91.67% of the respondents (110 out of 120), indicating that most students perceived group work as providing opportunities to express their opinions during science learning activities. This finding highlights the perceived value of group interaction within the TGT-based learning process. However, it reflects students' self-reported perceptions of participation opportunities rather than objectively measured classroom engagement or the quality of their contributions to group discussions.

This result can be understood through the theoretical perspective of cooperative learning, particularly the principles of positive interdependence and promotive interaction. Positive interdependence emphasizes that group members rely on one another to achieve shared learning goals, while promotive interaction involves supporting peers, exchanging ideas, and explaining information during collaborative tasks. Within the TGT model, team-based learning and tournament activities provide opportunities for students to discuss questions, compare answers, and support their peers. These features offer a theoretical explanation for why respondents may perceive group work positively. However, the present questionnaire measured students' perceptions of participation opportunities and did not directly assess the quality of peer interaction or the extent to which positive interdependence was achieved.

Previous studies have also discussed students' experiences with cooperative and game-based learning. Arif et al. (2026) identified collaboration as an outcome associated with TGT implementation in junior high school science learning. Usnia and Anandita (2026) likewise reported increased engagement and participation in a study combining TGT with Discovery Learning. In addition, research on gamified and cooperative learning experiences, such as Thompson et al. (2025) and Wijaya et al. (2025), can provide a relevant basis for discussing how students perceive interaction and participation during game-based learning. These studies offer complementary perspectives for understanding the role of collaborative activities in science instruction. Nevertheless, differences in research design, instruments, and measured constructs should be considered when interpreting the findings. The present study contributes descriptive evidence concerning respondents' perceived opportunities to participate in group work rather than demonstrating improvements in collaboration, engagement, or learning achievement.

The relevance of peer interaction is also evident in studies addressing environmental science learning. Indahyana et al. (2024) employed contextual learning and small-group discussions on environmental pollution and reported improvements in critical thinking skills. Similarly, Rismayanti et al. (2026) demonstrated the potential of discussion based on socio-scientific issues and debate to develop students' scientific argumentation. These studies highlight the educational value of discussion and interaction when addressing environmental issues. However, the outcomes reported in those studies differ from the perception data examined in the present research. A questionnaire indicating that respondents felt they had opportunities to express their opinions does not establish that their critical thinking or scientific argumentation skills improved. Such outcomes require separate assessment using appropriate performance-based instruments.

Perceptions of Games and the TGT Learning Model

Students' responses to the statements concerning the attractiveness of the learning model and group games provide information about the game-supported aspects of TGT-based learning. For the statement that the learning model was very interesting, 65.00% of students selected Agree and 23.33% selected Strongly Agree. For the statement that group work and games were interesting and unexpected, 74.17% selected Agree and 14.17% selected Strongly Agree. This distribution indicates that the game and group-work components were positively received by many students.

Game elements can provide structure, challenge, feedback, and a sense of progress. However, the educational value of games depends on their alignment with the learning objectives and the subject matter. Othman et al. (2025) noted that board games can support collaborative science learning while emphasizing the need for stronger research into the specific mechanisms through which games influence learning. This is important when implementing TGT: the mere presence of games does not guarantee meaningful learning. Tournament questions and tasks need to be aligned with scientific concepts and encourage students to explain their reasoning, rather than focusing solely on speed or competition.

The present study provides evidence that students reported positive perceptions of TGT activities, but it does not identify the specific game mechanisms used or the aspects that students considered most helpful. Future studies should document the tournament procedures, task design, feedback mechanisms, team composition, and student participation at each stage. Such information could help explain why students provide positive responses and how teachers can replicate these learning experiences.

Relevance of Environmental Pollution Content to Everyday Life

The statement concerning students' ability to relate the learning materials to everyday life received 70.00% in the Agree category and 20.00% in the Strongly Agree category. This pattern indicates that, in general, students perceived a connection between environmental pollution content and their everyday experiences. Such relevance is important in science education because environmental problems are not limited to textbook examples; they can also be observed in local water conditions, air quality, household waste, and community practices.

Environmental education can also provide a context for discussing awareness and responsible decision-making. Talavera-Mendoza et al. (2025) reported a positive association between students' perceptions of gamified learning experiences and their self-reported ecological awareness. Their study employed a different intervention and correlational design; therefore, it does not demonstrate that TGT produces environmental awareness. Nevertheless, it supports the relevance of examining students' experiences with game-based learning in environmental contexts. In the present study, the questionnaire measured perceptions of the relevance of the subject matter to everyday life, not ecological awareness, environmental attitudes, or actual pro-environmental behavior. These constructs must therefore remain distinct in the interpretation of the findings.

Perceived Ease of Assessment Tasks and Model Suitability

The findings indicate that respondents generally perceived the assessment tasks as manageable and the TGT model as suitable for learning environmental pollution. For the perceived ease of evaluation or post-test questions (Item 5), 68.33% of respondents selected Agree, while 23.33% selected Strongly Agree. Similarly, for the perceived ease of assignments and post-test questions (Item 9), 59.17% selected Agree and 30.00% selected Strongly Agree. These response patterns suggest that most respondents considered the assessment-related activities manageable within the TGT-based learning experience. However, these findings represent students' subjective evaluations of task difficulty and do not demonstrate that the assessment questions were objectively easy or that students achieved higher test scores.

Regarding model suitability (Item 10), 62.50% of respondents selected Agree and 27.50% selected Strongly Agree that the TGT model was appropriate for the environmental pollution topic. This pattern suggests that most respondents viewed the instructional model as suitable for the subject matter. One possible explanation is that the team-based and game-based activities provided a learning structure through which students could discuss environmental pollution concepts and participate in learning tasks collaboratively. Nevertheless, the questionnaire measured students' perceived suitability of the model; it did not directly assess the alignment between the instructional design and curriculum objectives or the effectiveness of the model in improving conceptual understanding.

These findings contribute to the limited descriptive evidence on how junior high school students perceive specific components of TGT-based science learning, particularly assessment-related activities and the suitability of the model for an environmental science topic. While previous studies have often examined learning outcomes, motivation, or engagement, the present study provides complementary information about students' evaluations of the learning tasks and instructional approach. From a theoretical perspective, the findings suggest that students' perceptions of task manageability and instructional suitability are relevant dimensions to consider when examining their experiences of cooperative game-based learning. However, the results do not establish that perceived task manageability leads to improved achievement or that perceived model suitability guarantees effective learning.

In practical terms, the findings may inform science teachers when designing TGT-based activities for environmental pollution lessons. Teachers may consider providing clear instructions, appropriately structured assessment tasks, and learning activities that connect team discussions and games with the scientific concepts being taught. The students' responses can serve as formative feedback for reviewing the learning experience, although they should be considered alongside assessment results and classroom observations when evaluating instructional effectiveness.

Contributions and Limitations of the Study

The main contribution of this study is its descriptive account of students' responses to TGT-based science learning on the topic of environmental pollution. It adds a learner-perspective dimension to studies that have primarily focused on test scores, collaborative outcomes, or motivation. The findings indicate that students

generally viewed the learning activities positively, particularly group work, games, and the relevance of the subject matter to everyday life. This information can help teachers reflect on the design of cooperative science learning. Furthermore, the study data were obtained from one school and one grade level during the 2021/2022 academic year; therefore, generalization to other schools, grade levels, and curriculum contexts should be undertaken cautiously.

Accordingly, the findings should be interpreted as preliminary descriptive evidence of students' self-reported perceptions. They do not demonstrate that TGT causes improvements in student engagement, motivation, higher-order thinking skills (HOTS), learning outcomes, ecological awareness, or environmental behavior. Future research should report raw response frequencies, instrument reliability, detailed intervention procedures, classroom observations, and complementary outcome measures.

CONCLUSION

This study examined seventh-grade students' perceptions of science learning using the Teams Games Tournament (TGT) model on the topic of environmental pollution. Overall, the findings indicate that respondents generally perceived the TGT-based learning experience positively, particularly in relation to group participation, game-based activities, and the relevance of learning content to everyday life. Among the aspects examined, participation in group work received a combined 91.67% of Agree and Strongly Agree responses, indicating that most respondents perceived group activities as providing opportunities to express their opinions. Positive responses were also observed regarding the attractiveness of group work and game activities (74.17% Agree) and the relevance of environmental pollution content to everyday life (70.00% Agree). Meanwhile, students' evaluations of instructional materials and assessment tasks provide additional information for teachers to review and improve the learning experience.

The main contribution of this study is its descriptive account of students' perceptions across specific components of TGT-based science learning, complementing previous studies that have focused more extensively on learning outcomes, motivation, and other educational variables. These findings provide insight into how students experienced cooperative and game-based activities in environmental pollution education. However, the results reflect self-reported perceptions and do not establish that TGT caused improvements in learning achievement, classroom engagement, higher-order thinking skills, motivation, or environmental behavior.

RECOMMENDATION

Based on the findings, science teachers may consider incorporating TGT activities into environmental pollution lessons while paying particular attention to the aspects identified in this study. Since group participation received a high proportion of positive responses, teachers may maintain structured team activities that give every student opportunities to express opinions, exchange ideas, and contribute to group tasks. Game and tournament questions should be closely aligned with the learning

objectives and require students to explain their answers rather than simply recall factual information. Furthermore, because students also responded positively to the relevance of environmental pollution content to everyday life, teachers may use examples of local environmental issues, such as waste disposal, water pollution, and air pollution, to connect scientific concepts with students' experiences. Instructional materials and assessment tasks should also be reviewed to ensure that they are clear, accessible, and appropriate for students' learning needs.

Future research should examine students' perceptions of TGT-based science learning across different schools, grade levels, and educational contexts. Researchers are also encouraged to investigate differences in perceptions across student groups and to combine questionnaires with classroom observations and student interviews to obtain a more comprehensive understanding of learning experiences. In addition, studies employing pre-test and post-test measurements or appropriate experimental and quasi-experimental designs are needed to investigate whether TGT implementation is associated with improvements in learning achievement, engagement, scientific reasoning, or environmental literacy. Future studies should also report evidence of instrument reliability and provide detailed descriptions of the TGT implementation procedures to strengthen the transparency and replicability of the research

Author Contributions

The conceptualization of this research was carried out by Desi Zulfa Eka Cahayati, Indri Susanti, and Silvi Rosiva Rosdiana. The methodology was developed by Desi Zulfa Eka Cahayati and Silvi Rosiva Rosdiana, while Indri Susanti contributed to the development of research materials and instruments. Data collection and analysis were conducted by Indri Susanti and Silvi Rosiva Rosdiana. Desi Zulfa Eka Cahayati oversaw the implementation of the TGT (Teams-Games-Tournament) method and provided critical input throughout the drafting and execution phases. All authors have read and approved the final manuscript.

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Conflict of interests

The authors declare that there is no conflict of interest regarding the publication of this manuscript. This research was conducted impartially, and there are no financial or personal relationships that influenced the results or the interpretation of the data.

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