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Think Pair Share-Based Learning Module for Global Warming in Grade X Chemistry

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Abstract
Teaching materials play an important role in helping students understand chemistry concepts. However, the teaching materials commonly used in schools are often limited to textbooks, which may not effectively facilitate the learning of abstract concepts such as global warming. This study aimed to develop a Think Pair Share (TPS)-based learning module on global warming for Grade X chemistry students and to evaluate its validity and practicality. The study employed a Research and Development (R&D) approach using the 4-D model, consisting of define, design, develop, and disseminate stages. The research involved one chemistry teacher and 64 Grade X students of SMAN 1 Pariangan. Data were collected through validation sheets and practicality questionnaires and analyzed descriptively using percentage analysis. The results showed that the developed module met the criteria of valid and very valid in terms of content, construct, and language aspects. In addition, the module was categorized as very practical based on both teacher and student responses. These findings indicate that the TPS-based learning module is suitable for use in chemistry learning and can serve as an alternative teaching material to enhance students' understanding of global warming concepts while promoting active learning.

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INTRODUCTION

Chemistry is a branch of science that studies the properties, structure, composition, changes, and energy associated with matter. In chemistry learning, teaching materials play an important role in helping students achieve learning objectives. Well-designed teaching materials can improve students' motivation, engagement, and conceptual understanding by providing structured learning experiences that support competency achievement (Agustina & Suriani, n.d.; Nurhayati, 2023).

However, teaching materials commonly used in schools are often limited to textbooks that present information in a general and less contextual manner. This condition may hinder students' understanding of abstract chemistry concepts that require visualization, discussion, and active participation during learning. One topic that students frequently find difficult is global warming, which involves abstract concepts such as the greenhouse effect, climate change mechanisms, and environmental impacts.

Previous studies have shown that students experience difficulties in understanding global warming concepts because learning activities are often teacher-centered and provide limited opportunities for active participation (Putri, 2024). In addition, the use of less innovative teaching materials has been reported to contribute to low student engagement and learning outcomes on global warming topics (Melani et al., 2023). These findings indicate the need for learning resources that actively engage students and facilitate conceptual understanding.

Similar problems were identified at SMAN 1 Pariangan through observations and interviews with chemistry teachers and Grade X students.

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The findings revealed that learning resources were still dominated by textbooks, while classroom activities mainly consisted of lectures and note-taking. Consequently, students tended to be passive and encountered difficulties in understanding abstract concepts. Daily assessment results on the global warming topic also showed that many students had not achieved the Minimum Learning Achievement Criteria of 80.

Various studies have explored the implementation of Think Pair Share (TPS) in improving student participation and learning outcomes. TPS is a cooperative learning model consisting of three stages: thinking individually (think), discussing ideas with a partner (pair), and sharing discussion results with the class (share). Through these stages, students are encouraged to construct knowledge independently and collaboratively, which can enhance participation, communication skills, confidence, and conceptual understanding (Alfiyah et al., 2019).

Compared with other cooperative learning models such as Problem Based Learning (PBL), Student Teams Achievement Division (STAD), and Jigsaw, TPS provides more structured interaction and is particularly suitable for students who require gradual guidance in understanding concepts (Rosita & Leonard, 2015).

Although previous studies have demonstrated the effectiveness of TPS in various learning contexts, studies focusing on the development of TPS-based learning modules for global warming material in senior high school chemistry are still limited. Most previous studies emphasized the implementation of TPS as a teaching strategy rather than the development of instructional materials that systematically integrate TPS activities into independent learning resources. Therefore, a gap remains regarding the availability of validated and practical TPS-based learning modules specifically designed for global warming material.

Based on this gap, this study aimed to develop a Think Pair Share (TPS)-based learning module on global warming material for Grade X chemistry students and to evaluate its validity and practicality. The developed module is expected to provide an innovative learning resource that supports students' understanding of abstract chemistry concepts and promotes active learning.

METHOD

This study employed a Research and Development (R&D) approach to develop a Think Pair Share (TPS)-based learning module on global warming for Grade X senior high school students and to evaluate its validity and practicality. The development process followed the 4-D model proposed by Thiagarajan, which consists of four stages: define, design, develop, and disseminate.

Define Stage

The define stage aimed to identify learning needs and problems related to global warming instruction. This stage included front-end analysis, student analysis, material analysis, teaching material analysis, and analysis of Learning Outcomes and Learning Objectives.

Observations and interviews conducted at SMAN 1 Pariangan revealed that learning activities were still dominated by textbooks and lecture-based instruction, resulting in limited student participation and difficulties in understanding abstract concepts.

Design Stage

At the design stage, a prototype of the TPS-based learning module was developed. The module was designed by integrating the Think, Pair, and Share stages into learning activities and was supported by illustrations, discussion activities, exercises, and evaluation tasks to facilitate students' understanding of global warming concepts.

Develop Stage

The develop stage focused on evaluating the validity and practicality of the module. Validation was conducted by three experts consisting of a content expert, a construct expert, and a language expert. The validation process assessed content, construct, and language aspects. Suggestions from the validators were used to revise and improve the module before field testing.

The practicality test involved one chemistry teacher and 64 Grade X students of SMAN 1 Pariangan. The assessment focused on ease of use, time efficiency, attractiveness, and usefulness of the module during classroom implementation.

Disseminate Stage

The disseminate stage was conducted on a limited scale by introducing the validated and practical module to chemistry teachers and students at SMAN 1 Pariangan for classroom use.

Research Subjects

The subjects of this study were one chemistry teacher and 64 students from classes X.E.5 and X.E.6 at SMAN 1 Pariangan. The participants were selected purposively based on the recommendation of the chemistry teacher and the suitability of the classes for field testing.

Data Collection Instruments

Data were collected using validation sheets and practicality questionnaires. The validation sheets were used to evaluate the content, construct, and language validity of the module, while the practicality questionnaires were administered to the teacher and students to obtain responses regarding the usability of the developed module.

Data Analysis

The data obtained were analyzed using descriptive quantitative analysis. The validity and practicality scores were calculated using the following formula:

$$V = \frac{f}{n} x\ 100\%$$

Where *V/P* is the validity or practicality score, *f* is the obtained score, and *n* is the maximum score.

Table 1. The Interpretation Criteria for Validity and Practicality

Percentage Interval	Category
0%–20%	Invalid / Impractical
21%–40%	Less Valid / Less Practical
41%–60%	Fairly Valid / Fairly Practical
61%–80%	Valid / Practical
81%–100%	Very Valid / Very Practical

Source : (Atik & Prasetyo, 2021).

In addition to quantitative data, qualitative feedback in the form of comments and suggestions from validators, teachers, and students was used to support the revision and improvement of the module.

RESULTS AND DISCUSSION

This research used the Research and Development (R&D) method with the 4D development model consisting of define, design, develop, and disseminate stages. The product developed was a Think Pair Share (TPS)-based learning module on global warming material for tenth-grade students at SMAN 1 Pariangan. The research was limited to the disseminate stage due to limitations in time, cost, and manpower.

Define Stage

The define stage was conducted to identify learning needs and problems related to global warming instruction at SMAN 1 Pariangan. The results of interviews and observations revealed that learning activities were still dominated by textbooks and lecture-based instruction. Consequently, students experienced difficulties in understanding abstract concepts and showed limited participation during learning activities.

In addition, global warming was identified as one of the topics that students found difficult to understand because it involves abstract concepts such as the greenhouse effect and climate change mechanisms. Existing teaching materials were considered insufficient to support independent learning and active student participation. Therefore, the development of a TPS-based learning module was considered necessary to support student-centered learning and improve conceptual understanding. These findings are consistent with (Putri, 2024), who reported that students often experience difficulties in understanding global warming concepts when learning is predominantly teacher-centered. Furthermore, (Nurhayati, 2023), stated that teaching materials should be systematically designed to accommodate students' learning needs and support the achievement of learning objectives.

Design Stage

Based on the findings from the define stage, a Think Pair Share (TPS)-based learning module was designed. The module integrated the TPS learning stages (Think, Pair, and Share) into learning activities and was developed systematically according to the Learning Outcomes and Learning Objectives of the Merdeka Curriculum.

The module consisted of an introduction section, learning activities, evaluation activities, and supporting components such as concept maps, summaries, and references. Visual elements and contextual examples were also included to help students understand global warming concepts more effectively. The integration of TPS activities was intended to encourage active participation, collaborative learning, and critical thinking skills. According

to (Rosita & Leonard, 2015), the TPS model provides opportunities for students to construct knowledge through individual reflection and peer discussion. Similarly, (Rukmini, 2020) emphasized that TPS can improve communication skills and create a collaborative learning environment.

Develop Stage

The develop stage aimed to produce a Think Pair Share (TPS)-based learning module on global warming material for Grade X students. The developed module was expected to have valid characteristics, align with learning outcomes, and be practical for use in the learning process. At this stage, validation of the research instruments, validation of the learning module, and practicality testing were conducted to determine the feasibility of the developed module.

At the validation stage, assessments were conducted on the research instruments and the Think Pair Share (TPS)-based learning module on global warming material.

Table 2. Analysis of Validity Test Instrument Validation Results

Validation Aspect	Total Score	Maximum Score	%	Cate-gory
Questionnaire Format	7	8	88%	Very Valid
Language Used	14	16	88%	Very Valid
Questionnaire Items	20	24	83%	Very Valid
Total	**41**	**48**	**86%**	**Very Valid**

Table 3. Analysis of Practicality Test Instrument Validation Results

Validation Aspect	Total Score	Maximum Score	%	Cate-gory
Questionnaire Format	7	8	88%	Very Valid
Language Used	14	16	88%	Very Valid
Questionnaire Item Statements	21	24	88%	Very Valid
Total	**42**	**48**	**88%**	**Very Valid**

The validation process involved three lecturers from UIN Mahmud Yunus Batusangkar who had expertise in their respective fields, namely material experts, construct experts, and language experts. Before validating the learning module, the first step was validating the research instruments, including the validity test instrument and the practicality questionnaire using validation sheets.

The validation results indicate that both the validity instrument and the practicality questionnaire met the criteria of very valid. These findings suggest that the instruments were appropriate for collecting research data and evaluating the quality of the developed module. Valid research instruments are essential to ensure that the collected data accurately represent the characteristics of the product being evaluated (Atik & Prasetyo, 2021).

Table 4. Results of Material Expert Validation

Validation Aspect	Total Score	Maximum Score	%	Category
Suitability with Learning Outcomes	6	8	75%	Valid
Material Accuracy	18	24	75%	Valid
Material Up-to-dateness	6	8	75%	Valid
Curiosity Stimulation	6	8	75%	Valid
Material Depth	6	8	75%	Valid
Total	**42**	**56**	**75%**	**Valid**

Content validation showed that the module was aligned with the Learning Outcomes and Learning Objectives and presented global warming concepts systematically.

Table 5. Results of Construct Expert Validation

Validation Aspect	Total Score	Maximum Score	%	Category
Module Size	4	4	100%	Very Valid
Module Design (Cover and Content)	48	48	100%	Very Valid
Total	**52**	**52**	**100%**	**Very Valid**

The validators' suggestions, including improving activity instructions and adding contextual information, were incorporated to enhance the module quality. This finding supports (Bait et al., 2025), who stated that instructional materials aligned with curriculum objectives can facilitate students in achieving expected competencies. Furthermore, the

integration of TPS activities within the module encourages active participation and collaborative learning, which are important for understanding abstract chemistry concepts (Damayanti et al., 2023). Construct validation (Table 5) indicated that the module had an appropriate layout, organization, and visual design. The systematic presentation of learning activities and attractive appearance are important factors in supporting independent learning and maintaining students' engagement. According to (Sugianto et al., 2018), a well-designed module should present information systematically and include visual elements that facilitate students' comprehension.

Table 6. Results of Language Expert Validation

Validation Aspect	Total Score	Maximum Score	%	Category
Clarity	11	12	92%	Very Valid
Communicativeness	12	12	100%	Very Valid
Suitability for Students	8	8	100%	Very Valid
Conformity with Indonesian Language Rules	8	8	100%	Very Valid
Total	**39**	**40**	**98%**	**Very Valid**

Language validation confirmed that the module used clear, communicative, and student-appropriate language. The validator's suggestions regarding capitalization were incorporated during the revision process. The use of understandable language is particularly important for abstract topics such as global warming because it helps students interpret scientific information more effectively. This finding is consistent with (Ummah, 2021) and (Syahputri et al., 2023), who emphasized the importance of communicative language in instructional materials.

Overall, the validation results indicate that the developed TPS-based learning module fulfills the criteria of quality instructional materials in terms of content, construct, and language aspects. Therefore, the module is feasible for implementation in chemistry learning on global warming material.

Teacher responses indicated that the module was easy to use, supported classroom learning activities, and could be implemented effectively within the allocated learning time.

Table 7. Teacher Practicality Test Results

Validation Aspect	Total Score	Maximum Score	%	Category
Ease of Use	14	16	88%	Very Practical
Time Efficiency	14	16	88%	Very Practical
Level of Attractiveness	8	8	100%	Very Practical
Benefits	11	12	92%	Very Practical
Total	**47**	**52**	**92%**	**Very Practical**

The TPS learning activities encouraged greater student participation and facilitated the teaching of global warming concepts. These findings support (Magdalena et al., 2020), who stated that practical teaching materials should be easy to use and capable of supporting the achievement of learning objectives effectively. Furthermore, practical modules contribute to more efficient classroom learning processes (Ekadina et al., 2025).

Next, the practicality test was also conducted with students from classes X E5 and X E6.

Table 8. Practicality Test Results of Students in Class X E5

Validation Aspect	Total Score	Maximum Score	%	Category
Ease of Use	461	496	93%	Very Practical
Time Efficiency	333	372	90%	Very Practical
Benefits	355	372	95%	Very Practical
Total	**1149**	**1240**	**93%**	**Very Practical**

Table 9. Practicality Test Results of Students in Class X E6

Validation Aspect	Total Score	Maximum Score	%	Category
Ease of Use	478	528	91%	Very Practical
Time Efficiency	351	396	89%	Very Practical
Benefits	365	396	92%	Very Practical
Total	**1194**	**1320**	**90%**	**Very Practical**

Student responses demonstrated that the module was useful, easy to understand, and supportive of independent learning. Through the Think, Pair, and Share activities, students were encouraged to discuss concepts actively, exchange ideas with peers, and strengthen their conceptual understanding through collaborative learning. This finding is consistent with (Alfiyah et al., 2019), who reported that TPS learning can improve participation, communication skills, confidence, and conceptual understanding.

Overall, the practicality findings indicate that the TPS-based learning module not only functions as a learning resource but also supports active learning and student-centered instruction. The collaborative nature of TPS enables students to construct knowledge through discussion and interaction, thereby facilitating a deeper understanding of global warming concepts (Lastri, 2023).

Disseminate Stage

The disseminate stage was conducted on a limited scale at SMAN 1 Pariangan. The validated and practical module was distributed to chemistry teachers and students in PDF format through class WhatsApp groups.

This limited dissemination provided teachers and students with access to an alternative learning resource that supports independent learning and active participation. The results indicate that the developed module has the potential to be implemented more widely in chemistry learning, particularly for teaching abstract topics such as global warming. According to Thiagarajan et al. (1974), the dissemination stage aims to introduce validated educational products to potential users so that they can be utilized more broadly in educational settings.

CONCLUSION

This study successfully developed a Think Pair Share (TPS)-based learning module on global warming material for Grade X students using the 4D development model. The validation and practicality results indicate that the developed module is valid and highly practical for use in chemistry learning.

The integration of TPS learning activities within the module supports active participation, collaborative learning, and independent knowledge construction. Therefore, the module can serve as an alternative learning resource to help students understand abstract global warming concepts more effectively.

This study contributes to chemistry education by providing a student-centered learning module that combines global warming content with the TPS learning model, thereby supporting the implementation of active learning in senior high schools.

RECOMMENDATION

Based on the findings of this study, it is recommended that chemistry teachers consider using the Think Pair Share (TPS)-based learning module as an alternative teaching material to enhance student engagement and understanding, particularly on abstract topics such as global warming. It is also recommended that future researchers develop similar modules for other chemistry topics and test them on a wider population to obtain more comprehensive results regarding their effectiveness. In addition, further studies may improve the module by integrating more interactive digital features and conducting repeated trials in different schools to strengthen the generalizability of the findings.

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