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# Improving Students Understanding of Thermochemistry Concepts through Guided Peer Discussions among Selected First Year Students at Batangas State University Alangilan Campus

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***Abstract:*** ***This study assessed the usefulness of Guided Peer Discussions in improving the knowledge of thermochemistry concepts among selected first-year students at Batangas State University – Alangilan Campus. The researchers used a pre-test and post-test design together with a structured Likert-scale questionnaire to assess students' conceptual knowledge, problem-solving abilities, and learning experiences using a quantitative method supported by qualitative insights. The mean score increased from 3.2 in the pre-test to 9.0 in the post-test, indicating a significant improvement in academic performance. Survey responses further suggested that Guided Peer Discussions generated better confidence in participation, stronger communication skills, clearer comprehension of complicated concepts, and enhanced involvement throughout training. The findings demonstrate that Guided Peer Discussions provide an effective instructional strategy that supports deeper learning and promotes collaborative interactions among students. Consequently, the study concludes that integrating guided peer discussion into thermochemistry instruction can significantly strengthen students' conceptual mastery and overall academic development.***
***Keywords: thermochemistry, guided peer discussion, peer learning, student understanding, chemistry education, problem-solving skills, first-year students.***

## I. INTRODUCTION

According to Shyiramunda (2025), chemistry's vital contribution to scientific innovation, technological progress, and numerous industries, it is essential and urgent to address the existing gaps in chemistry education to support national development. Having prior knowledge of concepts like the particulate nature of matter, atoms, elements, compounds, molecules, physical and chemical changes, and chemical bonds is essential for gaining a deeper understanding of thermochemistry (Ofori-Ahenkan, 2022). The section of thermodynamics that focuses on the changes that take place during chemical reactions is referred to as thermochemistry.

Chemical reactions are described for thermochemical purposes as those that produce a physical change in the aggregate state of a chemical entity, such as vaporization, sublimation, melting, or a phase transition between two distinct crystalline states, furthermore to those in which the products have a different chemical composition than the initial reactants.

According to the study of Ofori A. (2022), in studying thermochemistry, students must explain whether the energy involved in chemical reactions is endothermic or exothermic and measure the amount of energy released or absorbed during these reactions. This clearly highlights the focus on heat energy in thermochemistry. However, over the years, students have struggled to distinguish between heat and temperature. Leinonen et al. (2017), stated that engaging in peer discussions can also enhance critical thinking skills by allowing students to consider and understand topics from different perspectives. Alternatively, discussion groups offer an effective approach to strengthen conceptual understanding, critical thinking, and collaborative learning in chemistry education.

Through peer interaction, shared knowledge construction, and argumentation, these groups encourage students to engage more deeply with complex scientific ideas. Moreover, they promote active reasoning and concept clarification, consistent with socio-constructivist principles.

According to Double (2020), peer evaluation's effectiveness was impressively consistent across a variety of contexts. Peer assessment as a developmental practice is supported by different findings, which also raise a number of potential considerations for its introduction into the classroom.

 

## II. OBJECTIVES

This study investigates the effectiveness of a Guided Peer Discussions Strategy in improving the students understanding and problem-solving skills in Thermochemistry among selected first year students at Batangas State University. Specifically, this study seeks to answer the following questions:

*1)* Prepare an instructional plan integrating guided peer discussions in thermochemistry concepts.
*2)* Determine the effect of Guided Peer Discussions on first year students' understanding and problem-solving skills in thermochemistry.
*3)* Identify the experiences of first-year students in using Guided Peer Discussions in learning thermochemistry.

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## III. MATERIALS AND METHODS

### A. *Research Design*

The research design that was used is a quantitative method with a qualitative research design. Through this study, researchers identified that guided peer discussion improve students understanding of thermochemistry. This analysis give a structured guided type of the discussions facilitated learning by students to actively participate and clarifying common thermochemistry conceptions among peers, boosting cognitive awareness on their knowledge gaps that essential process for deep conceptual understanding in complex chemistry topics. This design is the most effective approach for obtaining answers to questions about these variables. Additionally, the study was appropriate for analyzing the responses of first-year student at Batangas State University using the research instrument designed to analyze the improvement on understanding in thermochemistry through guided peer discussion.

A research design also called a research strategy, is a plan to answer a set of questions (McCombes, 2019). It is a framework that includes the methods and procedures to collect, analyze, and interpret data. In other words, the research design describes how the researcher will investigate the central problem of the research and is, thus part of the research proposal. Qualitative research involves the quality of data and aims to understand the explanations and motives for actions, and also the way individuals perceive their experiences and the world around them. Qualitative research creates perceptions into a problem's context and provides ideas and hypotheses Quantitative research aims to quantify the data and generalize findings from a sample of a study from varied perspectives. It requires collecting data, analyzing, and interpreting quantifiable data to prove the hypothesis produced in a specific study (Ghanad, 2023).

### B. *Subjects of the Study*

The study was conducted at Batangas State University – Alangilan Campus in the College of Engineering. The lessons and Guided Peer Discussions took place in a regular classroom where the thermochemistry topic System, Surroundings, and State Functions was taught. The participants were ten (10) first-year students enrolled in a general chemistry course from BS Geodetic Engineering 1102. Purposive sampling was used, and only students who were present and agreed to participate were included. They answered the pre-test, post-test, and the Likert-scale questionnaire after the Guided Peer Discussions.

Table 1. Respondetns

| Program | Population | Sample |
|---|---|---|
| BS Geodetic Engineering | 44 | 10 |

### C. *Data Gathering Instrument*

This research was conducted using three research instruments to collect the needed data, namely likert scale questionnaire questionnaire, an achievement test, and a purposive sampling technique in selecting the respondents. This research was conducted using three research instruments to collect the needed data, namely likert scale questionnaire, an achievement test, and a purposive sampling technique in selecting the respondents. These instruments were prepared systematically to measure the effectiveness of guided peer discussion in improving the understanding of thermochemistry concepts. This study will use an achievement test as the main research instrument to measure how well selected first-year students understand thermochemistry concepts. The test will be created to match the lessons covered in the study, ensuring that each item reflects the key topics in thermochemistry. It will include questions that check students' knowledge, problm-solving skills, and ability to apply concepts.

 

Likert Scale Questionnaire A structured four-point likert scale questionnaire was used to determine students' perceptions about their understanding of thermochemistry concepts and the effectiveness of guided peer discussion.

The likert scale is a psychometric tool in which respondents indicate their level of agreement to a series of statements. The scale used in this study contained four options: 4- Strongly Agree, 3- Agree, 2- Disagree, 1- Strongly Disagree.

Purposive sampling will be used in selecting the participants. This means that only first-year students who agreed to participate and currently taking lessons related to thermochemistry and who are involved in guided peer discussions will be chosen for the study.

The achievement test will be given before and after the peer discussions to see if there is an improvement in the students' understanding. Before it is administered, the test will be reviewed and validated by research advisers and subject experts to make sure the questions are clear, appropriate, and aligned with the objectives of the study.

| Scale Range | Interpretation |
|---|---|
| 10 – 12 | Very Good / Excellent Understanding |
| 8 – 9 | Good/ High Understanding |
| 5 – 7 | Fair Understanding |
| 0. – 4 | Poor / Low Understanding |

*D. Data Gathering Procedure*

The researchers used purposive sampling to choose students who were already studying thermochemistry and could join the guided peer discussion activity. First, the researchers gave a pre-test to check the students' initial knowledge about thermochemistry topics like system, surroundings, state functions, heat and work, and basic calculations. This helped the researchers see what the students already knew and what they still found difficult. After the pre-test, the researchers proceeded with the peer discussion among the selected student who participated in the pre-test. The researchers alongside the participants discussed the focused thermochemistry topics such as system, surroundings, state functions, heat and work. Within the discussion, the researchers shared their known knowledge of the topics with the participants utilizing peer interactions. When all the guided peer interactions were finished, the researchers distributed a post-test. This test had similar topics and difficulty as the pre-test. Its purpose was to see if the students improved after the discussions. The scores from the pre-test and post-test were compared to find out if guided peer discussion helped the students understand thermochemistry more.

## IV. RESULTS AND DISCUSSION

*A. Prepare An Instructional Plan Integrating Guided Peer Discussions In Thermochemistry Concepts*

This part presents the results of Pre-test and Post-Test, the summary of Pre-Test and Post-Test performance and improvement in students understanding of thermochemistry concepts after the implementation of Guided Peer Discussions.

*1) Scores of respondents in Pre-Test and Post-Test.*

Table 2. Pre-Test and Post-Test Scores of Respondents

| Respondents | Pre-Test (12) | Post-Test (12) | Gain |
|---|---|---|---|
| 1 | 4 | 10 | +6 |
| 2 | 2 | 10 | +8 |
| 3 | 4 | 10 | +6 |
| 4 | 4 | 7 | +3 |
| 5 | 1 | 8 | +7 |
| 6 | 4 | 9 | +5 |
| 7 | 3 | 7 | +4 |
| 8 | 2 | 9 | +7 |
| 9 | 3 | 9 | +6 |
| 10 | 5 | 11 | +6 |
| Mean | 3.2 | 9.0 | +5.8 |

 

The results presented in Table 2 show a clear improvement in students understanding of thermochemistry concepts after the implementation of Guided Peer Discussions. The mean Pre-Test score of 3.2 out of 12 indicates that students had low to fair initial understanding of the lesson. This suggests that before the discussion, most respondents struggled with identifying types of systems, state functions, heat flow, and interpreting problem-solving situations involving internal energy. According to Hornbuckle (2022), Pre-Test help students in learning what students should know and be able to do.

According to Hornbuckle (2022), a pre-test helps students understand what they should know and be able to do. When students take a pre-test, it is normal for them to get a low score since it is meant to measure whether they have background knowledge of the subject.

On the other hand, the students achieved a mean Post-Test score of 9.0 out of 12, which reflects a high level of understanding. This significant increase demonstrates that peer-supported learning helped students clarify misconceptions, strengthen conceptual knowledge, and improve their ability to solve thermochemistry problems. Similarly, Acar & Tarhan (2006), got the same result, the students who were trained using cooperative learning had significantly higher scores in terms of achievement. Overall, all respondents increased their scores, resulting in a mean gain score of +5.8. Gains ranged from +3 to +8, showing consistent improvement across all participants. This suggests that the students benefitted from discussing concepts collaboratively, exchanging ideas, and explaining solutions to their peers.

*2) Summary of Pre-Test and Post-Test*

Table 3. Summary of Pre-Test and Post-Test

| Test | Mean Score | Interpretation |
|---|---|---|
| Pre-Test | 3.2 | Poor/Low Understanding |
| Post-Test | 9.0 | Good/High Understanding |

The data presented in table 3 indicates the difference between the pre-test mean (3.2) and the post-test mean (9.0), along with the average gain of +5.8, indicates that Guided Peer Discussions were highly effective in enhancing first-year students understanding and problem-solving performance in thermochemistry. The study of Smith et al. (2011), also found that peer discussion combined with instructor explanation significantly improved student performance compared to either method alone.

Peer discussion helped students clarify concepts through active engagement, leading to higher learning gains even before instructor feedback. The intervention contributed significantly to deeper learning and better mastery of foundational concepts.

*B. Determine the effect of Guided Peer Discussions on first year students' understanding and problem-solving skills in thermochemistry.*

Table 4 presents the effect of guided peer discussion in first year students.

Table 4. Effects of Guided Peer Discussion in First Year Students

| Effects of Guided Peer Discussion | WM | VI |
|---|---|---|
| 1. Peer Discussion increase my confidence in speaking up to ask and answer questions. | 3.40 | Agree |
| 2. Peer Discussion helps me discover different perspectives from my peers. | 3.30 | Agree |
| 3. Peer discussion improves my comprehension of difficult concepts. | 3.20 | Agree |
| 4. I become more open minded when I hear other students' viewpoints. | 3.10 | Agree |
| 5. Peer discussion help me develop stronger communication skills. | 3.10 | Agree |
| Composite Mean | 3.20 | Agree |

 

As can be seen on table 4, the first-year students perceive that guided peer discussion is important as it helps develop communication skills, such as expressing ideas clearly, asking questions, and giving constructive feedback. It strengthens collaboration because students work together to build knowledge instead of learning alone. The obtained weighted mean of 3.40, with a verbal interpretation of Agree, indicates that peer discussion increases first-year students' confidence in speaking up to ask and answer questions. This implies that the opportunity to interact with classmates helps reduce hesitation, build communicative, self-assurance, and make students more comfortable expressing their ideas in class.

According to studies, peer discussion allows students to arrive at the correct answer by encouraging them to construct new understanding together. When students talk through their ideas with a partner, the improvement in their accuracy reflects a process gain—meaning that the group performs better than what either student could have achieved individually (Tullis, J. G., & Goldstone, R. L. 2020).

However, the second weighted mean of 3.20, with a verbal interpretation of Agree, indicates that peer discussion enhances first-year students' comprehension of difficult concepts. This implies to help them discover diverse viewpoints. Exposure to different interpretations deepens understanding and supports critical thinking. Based on the study of Vickrey, et al., (2015), students developed a deeper understanding of the concepts following peer discussion. However, while their explanations
improved, the overall quality of the discussions is variable.

The weighted mean of 3.10 shows that students agree peer discussion helps strengthen their communication skills. Although slightly lower than other indicators, it still reflects a positive perception of its benefits. Peer discussion gives students opportunities to express ideas, listen effectively, and respond appropriately, helping them communicate more clearly and engage in respectful academic dialogue—skills essential for both academic and future professional success. This follows to the idea of Ningsih, T. Z., et al. (2025), by engaging in teamwork and group discussions, students develop active listening abilities and learn to express their ideas clearly, enhancing their interpersonal communication.

Overall, the composite mean of 3.20 indicates that, overall, students agree that guided peer discussion has a positive impact and effect on their learning and communication abilities. This result indicates that peer discussions effectively help students build confidence, deepen their understanding of concepts, exposure to different perspectives, and development of communication skills. This aligns with Tullis, J. G., & Goldstone, R. L. (2020), who emphasized that when the students discuss together, they form better ideas and evaluate answers more accurately. This shared reasoning makes the correct answer clearer and guides them away from incorrect choices, even if they were confident at first.

*C. Identify the experiences of first-year students in using Guided Peer Discussions in learning thermochemistry*

Table 5 presents the first-year students experiences in guided peer discussion.

Table 5. First Year Students experiences in Guided Peer Discussion

| Experiences in Guided Peer Discussion | WM | VI |
|---|---|---|
| 1. Peer Discussion encourage me to think critically | 3.30 | Agree |
| 2. I can Confidently contribute my ideas when talking with my peers. | 3.20 | Agree |
| 3. Peer Discussion make learning more enjoyable and interactive. | 3.20 | Agree |
| 4. My communication skills improve through peer discussions. | 3.20 | Agree |
| 5. Peer Discussion are an effective learning method for me. | 3.00 | Agree |
| Composite Mean | 3.18 | Agree |

The data presented in table 5 indicates that first year students perceive guided peer discussion as an effective and impactful learning tool. The statement "peer discussion encourage me to think critically" with mean score of 3.30, also with a verbal interpretation of agree find that students overwhelm feeling in the process of discussing topics with their peers from analyze, evaluate and synthesize the lesson and information. This interaction with peer and the development of thinking skills highlights its value as a tool for encourage academic competencies.

On the other hand, the statement "Peer Discussion are an effective learning method for me" got the mean score of 3.00 with the verbal interpretation of Agree. Although this still falls with the Agree range, its slightly lower score compared to the others could imply that while students recognize the specific benefits like critical thinking, confidence, enjoyment and communication, they are slightly less emphatic about its overall effectiveness compared to other learning methods. This difference between statements

identify that students feel specific subjects or contexts are less suited for this method, or they still value the traditional instruction alongside peer learning.

In conclusion, the overall verbal interpretation of Agree demonstrate the unity among first year students that guided peer discussions is a beneficial and enriching part of their learning environment. The collective agreement on all statements range from the benefits like critical thinking to affective and social aspects like enjoyment, confidence and communication skills confirm its implementation. The Peer interaction provides opportunities and positive feedback and contributions, thus promoting a practice of higher level of thinking skills (deNoyelles & Reyes-Foster, 2015).

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## V. CONCLUSIONS

In connection with the findings of the study, the following conclusions were drawn:

*1)* The instructional plan serves as a guide to implement the study in Guided peer discussion strategy in improving the students' understanding and problem-solving skills in thermochemistry. It provides a clear structure for our intervention and it makes our plan more systematic. Moreover, the instructional plan helps us to monitor the progress and make immediate adjustments. Furthermore, it aligns activities to our objectives and ensures consistency.

*2)* Students became more interactive and more anticipated on the topic as they are relaxed during discussion and this lessens their pressure on immediate understanding in thermochemistry instead they slowly learn and improve through guided peer discussion.

*3)* The experiences of these students demonstrate that guided peer discussion offers a far more supportive and engaging learning environment than traditional classroom interaction. Because the students are less intimidated to speak with their classmates, they become far more open to asking questions, sharing confusion, and participating in the discussion. This comfort and openness help to build their confidence, especially in those usually shy or hesitant to speak in front of a professor. Students learn through peer interaction how to express themselves clearly, substantiate their reasonings, and respond graciously to alternative perspectives. Their active participation enhances their comprehension of the concepts since they are not only passive recipients of information but are rather called upon to present and defend ideas. In this respect, guided peer discussion encourages effective learning through communication and collaboration.

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## VI. RECOMMENDATIONS

In light of the findings and conclusions of the study, the following recommendations are hereby presented:

*1)* Integrate guided peer discussion into thermochemistry lessons. Since the study showed a clear improvement from pre-test to post-test scores, teachers are encouraged to use guided peer discussions regularly. Short group activities where students explain concepts to each other should also be included to improve understanding.

*2)* Provide training and demonstration sessions for teachers. Schools and administrators should offer simple training to help teachers apply guided peer discussion effectively. This may include techniques such as using small groups, preparing question prompts, and giving practice problems to guide student discussions.

*3)* Use guided peer discussion to enhance student confidence and problem-solving skills. Because students showed better performance and increased confidence, educators are encouraged to continue using this method. Regular use is expected to strengthen understanding, improve analytical skills, and create a more active and supportive learning environment.

*4)* Expand future research on guided peer discussion. Future studies are recommended to test this strategy on other chemistry topics or compare it with different teaching methods to determine which approach produces the best learning outcomes.

*5)* Adjust the strategy when applying to different groups. Since the results came from a specific section or group of students, modifications may be needed when using this method in larger classes or classes with different learning needs.

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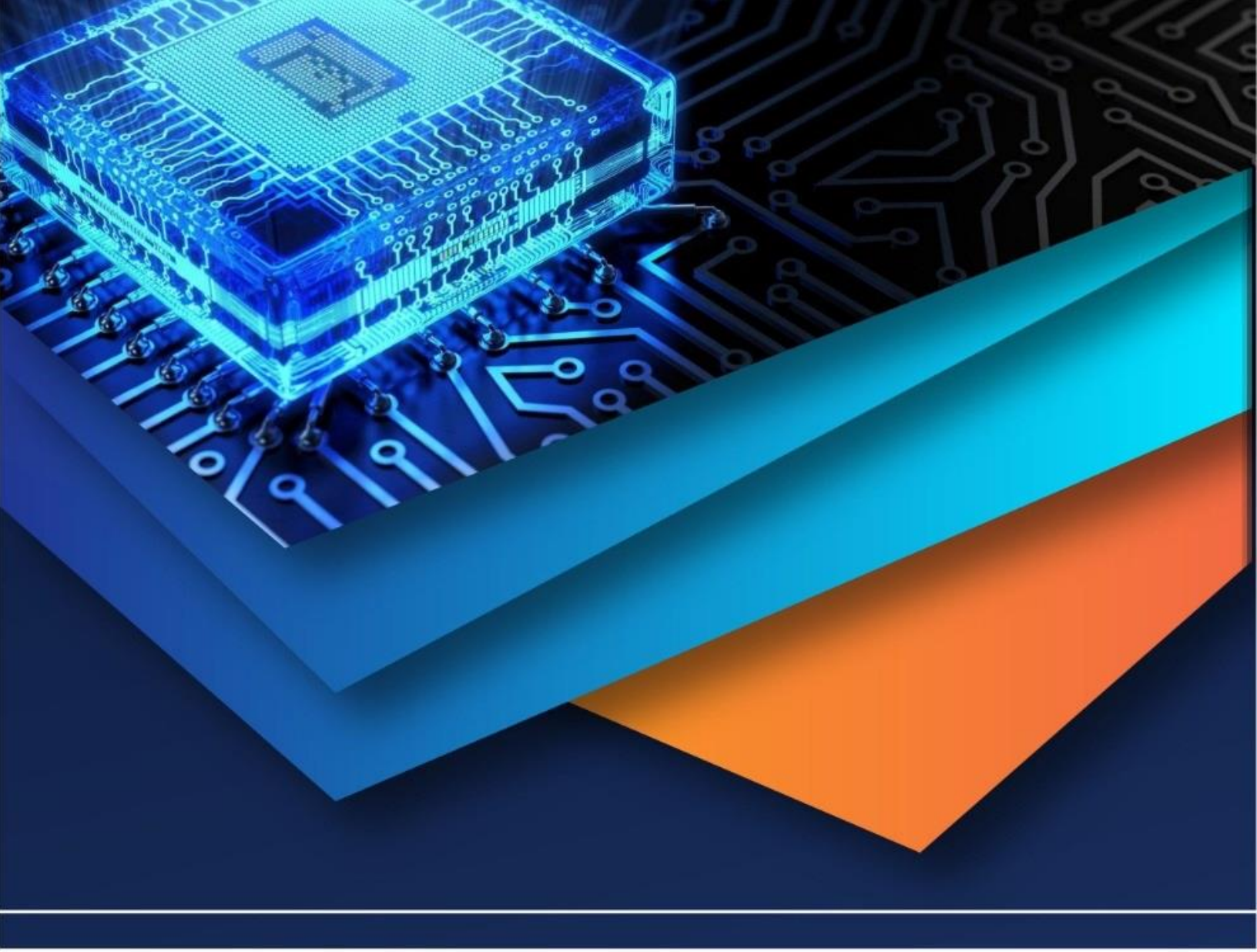
## REFERENCES

[1] Acar, B., Tarhan, L. Effect of Cooperative Learning Strategies on Students' Understanding of Concepts in Electrochemistry. Int J Sci Math Educ 5, 349–373 (2007).
[2] Accounting research module: Discussion forums, peer review and group work. The nternational Journal of Management Education, 22(3), 101057.
[3] Barus, M. A., & Purba, J. (2025). Development of Problem-Based Integrated Student Worksheets (LKPD) in Thermochemistry Class XI High School. Jurnal Multidisiplin Indonesia, 4(3), 212–229.
[4] Cigdemoglu, C., & Geban, O. (2015). Improving students' chemical literacy levels on thermochemical and thermodynamics concepts through a context-based approach. Chemistry Education Research and Practice, 16(2), 302–317. https://doi.org/10.1039/c5rp00007f
[5] Eddy, S. L., Brownell, S. E., Thummaphan, P., Lan, M., & Wenderoth, M. P. (2015). Caution, student experience may vary: Social identities impact a student's experience in peer discussions. CBE—Life Sciences Education, 14(4), ar45. https://doi.org/10.1187/cbe.15-05-0108
[6] Eddy, S. L., Brownell, S. E., Thummaphan, P., Lan, M.-C., & Wenderoth, M. P. (2015). Caution, student experience may vary: Social identities impact a student's experience in peer discussions. CBE — Life Sciences Education, 14(4), Article ar45.
[7] Ghanad, (2023) Series: Practical guidance to qualitative research. Part 2: Context, research questions and designs
[8] Hornbuckle, M. (2024b, August 29). 5 reasons pretests and posttests in education matter. YouScience. https://doi.org/10.1007/s10763-006-9046-7
[9] McCombes, (2019) Research Design: Research Methodology in Social Sciences (A Short Manual) (pp.175)
[10] Ningsih, T. Z., et al. (2025). Enhancing communication and collaboration skills through discovery, cooperative, and problem-based learning models in Social Studies education. Cogent Education, 12(1).
[11] Shaikh S. (2024) Peer Teaching for Peer Learning and Sharing: A study on students' attitudes towards implementing peer teaching and learning in the ESL classroom at the University of Technology and Applied Sciences, International Journal of English Language Teaching, 12 (5), 1-17
[12] Shyiramunda, T. (2025). Group discussions in secondary school chemistry: Unveiling pedagogical alchemy for academic advancement. Journal of Pedagogical Research, 9(3), 1-24
[13] Smith, M., Wood, W., Krauter, K., & Knight, J. (2011b). Combining Peer Discussion with Instructor Explanation Increases Student Learning from In-Class Concept Questions. CBE—Life Sciences Education, 10(1), 55–63.
[14] Steenkamp, G., & Brink, S. M. (2024). Students' experiences of peer learning in an accounting research module: Discussion forums, peer review and group work. The International Journal of Management Education, 22(3), 10157.
[15] Tullis, J. G., & Goldstone, R. L. (2020). Why does peer instruction benefit student learning? Cognitive Research Principles and Implications, 5(1), 15. https://doi.org/10.1186/s41235-020-00218-5
[16] Vickrey, T., Rosploch, K., Rahmanian, R., Pilarz, M., & Stains, M. (2015). Research-Based Implementation of Peer Instruction: A Literature review. CBE—Life Sciences Education, 14(1),es3. https://doi.org/10.1187/cbe.14-11-0198
[17] Zhai, (2021), Garcia-Carmona (2020)The Analysis Effectiveness of Guided Inquiry Implementation to Improve Students' Science Process Skills: IJORER International Journal of Recent Educational Research 3(6):672-687
[18] Acar, B., & Tarhan, L. (2007). Effect of cooperative learning strategies on students' understanding of concepts in electrochemistry. International Journal of Science and Mathematics Education, 5, 349–373.
[19] Ansari, Z., & Naseer, S. (2024). Collaborative learning benefits and its role in critical thinking. In Massive Open Online Courses – Learning Frontiers and Novel Innovations. IntechOpen.
[20] Ansari, Z., & Naseer, S. (2024). Perspective Chapter: Collaborative Learning Benefits and Its Role in Critical Thinking. In IntechOpen eBooks. https://doi.org/10.5772/intechopen.1007316
[21] Budini, N., Marino, L., Carreri, R., Cámara, C., & Giorgi, S. (2019). Perceptions of students after implementing peer instruction in an introductory physics course. Smart Learning Environments, 6(1).
[22] Budini, N., Marino, L., Carreri, R., Cámara, C., & Giorgi, S. (2019). Perceptions of students after implementing peer instruction in an introductory physics course. Smart Learning Environments, 6(1), Article 20.
[23] Eda Oz (2023)Effects of peer instruction on academic achievement: a meta-analysis

[24] Eddy, S. L., Converse, M., & Wenderoth, M. P. (2013). Peer-led team learning helps minority students succeed — even when courses are high-stakes and fast-paced. CBE — Life Sciences Education, 12*(3), 317–327.
[25] Hornbuckle, M. (2022, January 25). Why pretests and posttests in education matter.
[26] Kang, K. I., Lee, N., & Joung, J. (2021). Nursing students' experience of online peer tutoring based on the grow model: A qualitative study. Nurse Education Today, 107, 105131. https://doi.org/10.1016/j.nedt.2021.105131
[27] Kang, K. I., Lee, N., & Joung, J. (2021). Nursing students' experience of online peer tutoring based on the GROW model: A qualitative study. Nurse Education Today, 107, 105131.
[28] Pollock, P. H., Hamann, K., & Wilson, B. M. (2011). Learning through discussions: Comparing the benefits of Small-Group and Large-Class settings. Journal of Political Science Education, 7(1), 48



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