

Think-Pair-Share Strategy and Achievement in Difficult Concepts in Chemistry Education: A Scoping Review

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ABSTRACT

This study aimed to examine research literature on how the think-pair-share strategy affects teaching and learning of difficult chemistry concepts for academic achievement in secondary schools. A review of about 680 published articles from 2012 to 2024 was carried out. The articles were categorized into research focus, methods, teaching strategies, article focus and subjects. The article's focus was further categorized into achievement, gender and sample size. The subject was further narrowed down to chemistry. The think-pair-share strategy has been found to improve academic achievement. The review indicated that the implementation of the think-pair-share strategy was carried out on a few chemistry concepts. It was observed that the sample sizes used in many of the studies were small and cannot be used to generalize to the population of students offering chemistry in secondary schools. The study also indicated that most of the studies did not consider that the effect of gender was significant. It is recommended that the think-pair-share strategy be recommended to education bodies, school administrators and teachers for inclusion as a teaching method in the curriculum. Table 1 provides a concise summary of the contribution of researchers to teaching strategies and thus forms a compendium for researchers to identify future research gaps and directions in teaching strategies. Analysis performed and results obtained from this study provide justification for the application of the think-pair-share strategy in secondary schools and a basis for inclusion in schools' curriculum across the globe. This would improve understanding and achievement in difficult chemistry concepts.

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Publication History

Received:

25th June, 2025

Accepted:

11th November, 2025.

Published:

30th December, 2025.

To Cite this Article:

Esiefa, Winifred Ifeoma,
and Helen Drummond.

"Think-Pair-Share

Strategy and

Achievement in Difficult

Concepts in Chemistry

Education: A Scoping

Review." *Journal of*

Education and Learning

Technology 6, no. 12

(2025): 1466 - 1485.

[https://doi.org/10.38159/](https://doi.org/10.38159/jelt.202561218)

[jelt.202561218](https://doi.org/10.38159/jelt.202561218)

Keywords: Chemistry education, Think-pair-share, Achievement, Difficult concepts in chemistry

INTRODUCTION

Chemistry education studies how chemistry is taught and learnt in schools, it seeks to assist the learners in gaining and appreciating science by comprehending chemical ideas. Education itself is a process that plays a fundamental role in the progress of humans to progress the society in which they live. It equips learners with the knowledge and abilities they need to accomplish their objectives and national growth. Learning chemistry makes it possible for one to acquire relevant knowledge and understanding in the development of a scientific attitude in learners. Chemistry is one of the important aspects of science that helps learners comprehend their environment, although, according to Wang et al., some students struggle in the learning of chemistry because they do not understand how it relates to their everyday lives.¹

¹ Ying Wang et al., "Prompts to Promote Success: Evaluating Utility Value and Growth Mindset Interventions on General Chemistry Students' Attitude and Academic Performance," *Journal of Chemical Education* 98, no. 5 (May 11, 2021): 1476–88, <https://doi.org/10.1021/acs.jchemed.0c01497>.

Since chemistry covers so many issues related to the structure of matter, many students find the subject difficult. Chemistry courses typically include a wide range of abstract concepts that are crucial to understanding more about chemistry and other sciences. Scholars have noted some concepts in chemistry that are difficult for students in secondary schools, such as electrolysis, mole concept, organic chemistry, redox reaction and stoichiometry.² Other concepts identified as difficult are benzene and its compounds, acid-base titration, solubility, nuclear chemistry, alkanols, alkanals and alkanones, chemical equilibrium, metals and their compounds, among others.³ Due to the high level of perception of chemistry concepts, teachers often do not have the required resources to concretize them through demonstrations. Fensham has stated that critical thinking skills are highly required when learning chemistry due to the abstract nature and the difficulty of learning the content.⁴ The selection of teaching methods by teachers to engage learners in imparting knowledge is vital in teaching and learning.

These approaches will help with learners' engagement, collaborative learning and technological integration, which will help in the realization of educational objectives. According to Berhe et.al., poor instructional strategies can have negative effects on students' motivation, which may lead to detachment from the subject, low academic achievement, and low self-confidence in the classroom, resulting in negative attitudes to learning.⁵ Many studies have been conducted on the foundations that are innate in teaching chemistry in secondary schools. Scholars have identified various aspects that lead to poor achievement such as poor background of science in primary school, lack of incentives for performing well in tests, lack of learners' interest, lack of hard work, unqualified teachers in primary school, large class sizes, fear of the subject, societal factors, language problems, government facility problems, home and examination related body, lack of innovative teaching approaches.⁶ High abstraction and the order of the concepts are also a thing of difficulty for the learners.⁷ Other scholars have also stated that unsuitable teaching approaches lead to learners' low achievement in chemistry.⁸

Several studies have been conducted relating to the think-pair-share strategy, but not much has been said on the impact teachers have when using it in classroom teaching, as the traditional method is still the order of the day when chemistry is taught in secondary schools. The teaching approach of chemistry should be engaging and attractive to give learners a feel for the practical nature of the subject, rather than seeing it as being only abstract and theoretical in nature and studying it through rote learning. The approaches should be such that students should be tailored towards achieving educational goals and policies which are geared to programs and strategies that will promote science subjects through student-centred approaches to increase their critical thinking skills.⁹ Approaches that emphasize student-centredness include think-pair-share, collaborative learning, problem-solving, jigsaw of cooperative learning, inquiry-based learning, the flipped classroom method etc. The teaching approach in this review is think-pair-share, which is centered on collaborative learning, and has been revealed from studies to be effective for students' learning. There is therefore a need for a review of journal articles to investigate how it has improved achievement in chemistry in senior secondary schools, especially in difficult chemistry concepts. Hence, the following research questions are asked.

² Fahd Naveed Kausar, Noreen Ghazala, and Anosha Haroon, "Causes of Students' Learning Difficulties in Secondary School Chemistry: A Study in Context of Content and Assessment Strategies," *Journal of Positive School Psychology* 6, no.10(2022):4443–63.

³ Adekunle Ibrahim Oladejo et al., "Concept Difficulty in Secondary School Chemistry: An Intra-Play of Gender, School Location and School Type," *Journal of Technology and Science Education* 13, no. 1 (February 7, 2023): 255, <https://doi.org/10.3926/jotse.1902>.

⁴ Australia. Peter Fensham Monash University, *Developments And Dilemmas In Science Education* (Routledge, 2012), <https://doi.org/10.4324/9780203064580>.

⁵ Goitom Gebreyohannes Berhe, Gebrekidan Mebrahtu Tesfemariam, and Gebrehiwot Hagos Weldemichae, "Challenges for Effective Teaching of Chemistry in Secondary Schools of Developing Countries: A Review," *African Journal of Chemical Education* 14, no. 2 (2024): 61–100.

⁶ Y K Korau, "Educational Crises Facing Nigerian Secondary Schools and Possible Solutions," *Being a Paper Presented at Faculty of Education, University of Ibadan*, 2006; J.B. Nbina, "Analysis of Poor Performance of Senior Secondary Students in Chemistry in Nigeria," *African Research Review* 6, no. 4 (December 6, 2012), <https://doi.org/10.4314/afrev.v6i4.22>.

⁷ C. Zephrius et al., "Resolving Nigerian Secondary School Students' Learning Difficulties in Nuclear Chemistry Using Computer Animation Solutions," *Procedia - Social and Behavioral Sciences* 176 (February 2015): 1034–40, <https://doi.org/10.1016/j.sbspro.2015.01.575>.

⁸ Aimable Sibomana, Claude Karegeya, and John Sentongo, "Effect of Cooperative Learning on Chemistry Students' Achievement in Rwandan Day-Upper Secondary Schools," *European Journal of Educational Research* volume-10-2021, no. volume-10-issue-4-october-2021 (October 15, 2021): 2079–88, <https://doi.org/10.12973/eu-jer.10.4.2079>.

⁹ Federal Republic of Nigeria, *National Policy on Education*, NERDC (Federal Press: Lagos, 2004).

1. How does the think-pair-share strategy affect students' achievement in difficult chemistry concepts?
2. What is the effect on gender and location?

THEORETICAL FRAMEWORK

The think-pair-share strategy is a teaching strategy used in the classroom to encourage and allow an individual to think and collaborate with others, and be able to make presentations on a given task. To do this, the teacher divides the class into smaller groups and gives them time to deliberate and come to a decision before having them present to the entire class. According to Rehman et. al., the think-pair-share strategy is a pedagogic concept used in the classroom to improve communication and interaction among peers.¹⁰ It has been found to increase the self-confidence and speaking proficiency of learners.¹¹ Think-pair-share is a deliberate teaching strategy that puts students in teams to collaborate to enhance each other's learning. It also helps students to actively participate in their learning process, leading to a positive gain in their performance.¹²

Scott and Palincsar have argued that learning in groups fosters socially shared experiences, which have been linked to benefits such as better learning and the acquisition of useful problem-solving techniques.¹³ Alsmadi et al., stated that the think-pair-share strategy generates a dynamic, collaborative, relatable and free environment for students to communicate critically on their thinking during classroom participation.¹⁴ Johnson and Johnson stated that student knowledge is enhanced by collaborative learning, for example, by think-pair-share, which entails working in small groups to achieve a shared objective.¹⁵ Reinhart, in an effort to better his teaching, conducted a study and discovered that the think-pair-share method enhanced class discussion by giving students the freedom to think on their own. It also makes students answerable and liable for learning and become involved in class, and when students shared their ideas with their partners, they were eager to share them with the entire class.¹⁶ This strategy is theoretically founded on the work of psychologists like Piaget and Vygotsky, among others, who propounded that children actively create their own knowledge in a social context.

The think-pair-share strategy is a structured collaborative learning strategy, and it is centred on social constructivism, a theory of learning promoted by Vygotsky. He also employed a social-cultural approach in a study involving children, believing that knowledge is rooted in tradition.¹⁷ Some authors use think-pair-share and collaborative strategies interchangeably, depending on how formal they want to address each of them. Moll also developed a concept of learning called "zone of proximal development" (ZPD), which is identified as an area relating to what a learner can achieve on their own and what they can achieve under the supervision of an experienced adult.¹⁸

The think-pair-share is a three-step teaching strategy developed by Lyman that helps students to think independently, collaborate, deliberate, and be able to deliver any given task.¹⁹ This strategy has three steps: think:- learners have ample time to think-; pair:- learners are paired according to their abilities and personality; and share:- they gather to share with the class as a whole. Kitaoka and Abiodun

¹⁰ Ateeq Ur Rehman, Hamid Ali Nadeem, and Muhammad Rafiq, "Effect of Think-Pair-Share Teaching Strategy on Understanding the Concept of Science in Students at Elementary Level," *Harf-o-Sukhan* 5, no. 3 (2021): 333–45.

¹¹ Utama I M Permadi, A A I N Marhaeni, and I Nyoman Adi Jaya, "The Effect of Think Pair Share Teaching Strategy to Students' Self-Confidence and Speaking Competency of the Second Grade Students of SMPN 6 Singaraja," *Jurnal Pendidikan Bahasa Inggris* 1 (2013).

¹² ETHIOPIA ASSOSA, "The Use of Active Learning Technique Think-Pair-Share in Urban Land Use Class. Fifth Year Surveying Engineering," 2022.

¹³ D. Scott and A. Palincsar, "The Role of Scaffolding in Learning," *Educational Psychology Review* 22, no. 1 (2013): 75–89.

¹⁴ Mohareb A Alsmadi et al., "The Effect of the Collaborative Discussion Strategy Think-Pair-Share on Developing Students' Skills in Solving Engineering Mathematical Problems," *European Journal of Educational Research* 12, no. 2 (2023): 1123–35.

¹⁵ David W. Johnson and Roger T. Johnson, "Making Cooperative Learning Work," *Theory Into Practice* 38, no. 2 (March 1999): 67–73, <https://doi.org/10.1080/00405849909543834>.

¹⁶ Steven C. Reinhart, "Never Say Anything a Kid Can Say!," *Mathematics Teaching in the Middle School* 5, no. 8 (April 2000): 478–83, <https://doi.org/10.5951/MTMS.5.8.0478>.

¹⁷ L S Vygotsky, "The Role of Play in Development," *Mind in Society/Harvard University Press*, 1978.

¹⁸ Luis C Moll, "Vygotsky, Education and Culture in Action/Vygotski, La Educación y La Cultura En Acción," *Studies in Psychology* 46, no. 1–3 (2025): 19–41.

¹⁹ F. Lyman, "The Responsive Classroom Discussion," in *Mainstreaming Digest* (College Park, MD: niversity of Maryland College of Education, 1981), 109–13.

et al. affirmed that think-pair-share promotes positive interdependency, individual accountability, equal opportunity for participation and simultaneous interaction.²⁰ Because chemistry is an abstract subject which involves critical thinking skills in the cognitive domain, there is a need for the utilization of innovative teaching strategies that will enhance the teaching of difficult concepts for optimal achievement, hence the need for this review on how the strategy has improved learners' achievement in various geographical locations, and the effects on gender. Despite the importance of chemistry, students still perform poorly in the subject. This is attributed to factors such as students' negative attitudes, an inadequate number of qualified teachers, a lack of materials for instruction, students' lack of interest, using inappropriate strategies for instruction, etc. Low achievement in chemistry is often attributed to the abstract nature of chemistry, which leads to difficulty in learning and assimilating the subject.²¹

LITERATURE REVIEW

A learner's achievement is determined by how well they satisfy the established learning objectives. The think-pair-share strategy has been found by several researchers to have a desired effect on chemistry achievement.²² Although not all of the difficult chemistry concepts stated above were studied, there have been studies on how the think-pair-share strategy affects achievement in chemical combination, particulate nature of matter, electrochemistry, organic chemistry and bonding.²³

The think-pair-share strategy has been applied to several subjects. It has been stated to enhance the achievement of students in mathematics.²⁴ According to Ugwuanyi, the capability of a learner to complete a task successfully is a measure of students' achievement, and it can be attained through educational experiences by the quality and quantity of students' work.²⁵ Rosalia and Candraloka have stated that think-pair-share improved students' achievement in reading skills. also stated that think-pair-share improved achievement in integrated science.²⁶

Some researchers who used think-pair-share found that it improved other affective domains such as writing, speaking, and self-confidence in other subjects. Some other contemporary researchers have compared think-pair-share with other strategies and found it effective. Bamiro found that guided

²⁰ Hisaya Kitaoka, "Teaching Methods That Help Economics Students to Be Effective Problem Solvers," *SSRN Electronic Journal*, 2011, <https://doi.org/10.2139/ssrn.1951095>; Taiwo Oluwadayo Abiodun et al., "Effect of Think-Pair-Share Strategy on Student Achievement in Senior Secondary School Mathematics," *Faculty of Natural and Applied Sciences Journal of Mathematics, and Science Education* 3, no. 2 (2022): 20–25.

²¹ Fidele Dusangumukiza, Francois Niyonzima Niyongabo, and Theoneste Hagenimana, "Factors Affecting The Performance Of Senior Two Students In Chemistry In Rutsiro District Of Rwanda," 2024.

²² Afrida Afrida, Franklin Nwanya, And Fouz M Omar, "Think Pair Share Type Cooperative Learning To Improve Chemistry Learning Outcomes On Atomic Structure Material," *Indonesian Journal Of Education Research (Ijoer)* 5, No. 3 (2024): 92–99; Adekunle Oladipupo Bamiro, "Effects Of Guided Discovery And Think-Pair-Share Strategies On Secondary School Students' Achievement In Chemistry," *Sage Open* 5, No. 1 (2015): 2158244014564754; Muhideen Abiodun Oloyede, Emmanuel Folorunso Bamidele, and Popoola Oluwasegun Oladipupo, "Relative Effectiveness of Peer Tutoring and Think-Pair-Share Strategies in Improving Senior Secondary School Students' Academic Performance in Chemistry in Osogbo," *Journal of Global Research in Education and Social Science* 13, no. 6 (2019): 228–38; Faiza Shafqat, "Enhancing Chemistry Performance and Motivation through Think-Pair-Share Strategy among Higher Secondary School Students," *Pakistan Languages And Humanities Review* 6, no. 1 (March 31, 2022), [https://doi.org/10.47205/plhr.2022\(6-1\)11](https://doi.org/10.47205/plhr.2022(6-1)11).

²³ Moses Abdullai Abukari et al., "Improving Teaching and Learning of Organic Chemistry in Senior High Schools Using Collaborative Approaches," *Online Submission* 2, no. 4 (2023): 131–49; Gloria Ngozi Eze and Peter Chidiebere Obiekwe, "Think-Pair-Share Instructional Strategy: A Variety Tool for Enhancing," *African Journal of Science, Technology and Mathematics Education (AJSTME)*, 4 (1), 2018, 64–71; Shafqat, "Enhancing Chemistry Performance and Motivation through Think-Pair-Share Strategy among Higher Secondary School Students"; Usang Friday, Peter Prof. Okoli, and Josephine Nwanneka, "Effect of Think-Pair-Share Teaching Strategy on Secondary School Students' Achievement in Chemistry in Cross River State," n.d., <https://api.semanticscholar.org/CorpusID:264291660>.

²⁴ Abiodun et al., "Effect of Think-Pair-Share Strategy on Student Achievement in Senior Secondary School Mathematics"; Adebola S Ifamuyiwa and Sunday K Onakoya, "Impact of Think-Pair-Share Instructional Strategy on Students' Achievement in Secondary School Mathematics," *Journal of Science Teachers Association of Nigeria (JSTAN)* 48, no. 1 (2013): 26–34; Rama Nida Siregar et al., "Improving Mathematical Problem-Solving Abilities through Think Pair Share Learning Using Autograph," *KnE Social Sciences*, April 3, 2024, <https://doi.org/10.18502/kss.v9i8.15583>.

²⁵ Uche Ugwuanyi, "The Interest Rate Deregulation and Bank Lending in Nigeria," *Journal of Economics and Sustainable Development* 3 (2012): 12.

²⁶ Santi Rosalia and Olyvia Revalita Candraloka, "The Effect of Using Think Pair Share to Improve Students' Reading Skills," *J-SHMIC : Journal of English for Academic* 10, no. 2 (August 31, 2023): 155–65, [https://doi.org/10.25299/jshmic.2023.vol10\(2\).13544](https://doi.org/10.25299/jshmic.2023.vol10(2).13544).

discovery and think-pair-share improved achievement.²⁷ Although Okigbo and Ezenwa found it was not effective,²⁸ Yusuf found collaborative learning to be effective for students' achievement.²⁹

Gender is a social construct that is different in every community and changes over time, and it is distinct from sex, which refers to the variations in the biological and physiological attributes between males and females. Different researchers see gender differently in relation to achievement. While some affirm that it does not affect achievement, others are of the opinion that gender affects achievement; some scholars are of the opinion that gender does not have any effect on achievement.³⁰ Hamdan found that female students achieved better than male students,³¹ while other scholars reported that males achieved better than their female counterparts.³² In order to have equality in the academic environment, teachers should assign leadership responsibilities to girls to boost their confidence. They should be asked demanding questions, as boys learn best when they are pushed by peers, but girls often learn best when they collaborate.³³ Gender disparity in students' performance in chemistry has remained a thing to worry about when it comes to achievement.

METHODOLOGY

Journal articles were searched manually on Google and Google Scholar and reviewed. This was restricted to articles written in English between 2012 and 2024, based on the keywords: think-pair-share, collaborative, achievement and difficult concepts in chemistry. This study reviewed all articles on chemistry on think-pair-share and collaborative learning strategies. The reason is that think-pair-share is embedded in a collaborative strategy, although the think-pair-share individualizes learning by first thinking out the solution, then pairing with teams before sharing with the entire class. The search was also expanded to include sample size and the research method used. About 680 journal articles were scrutinized using the exclusion criteria. The diagram below shows the inclusion and exclusion criteria used for the search to ascertain which papers are relevant to the study.

The inclusion and exclusion principles criteria.

²⁷ Bamiro, "Effects of Guided Discovery and Think-Pair-Share Strategies on Secondary School Students' Achievement in Chemistry."

²⁸ Ebele Chinelo Okigbo and Ekwe Bethrand Ezenwa, "Effectiveness of Problem-Based and Think-Pair-Share Teaching Methods in Enhancing Secondary School Students' achievement in Electrochemistry in Enugu Education Zone," *UNIZIK Journal of Educational Research and Policy Studies* 18, no. 1 (2024): 1–16.

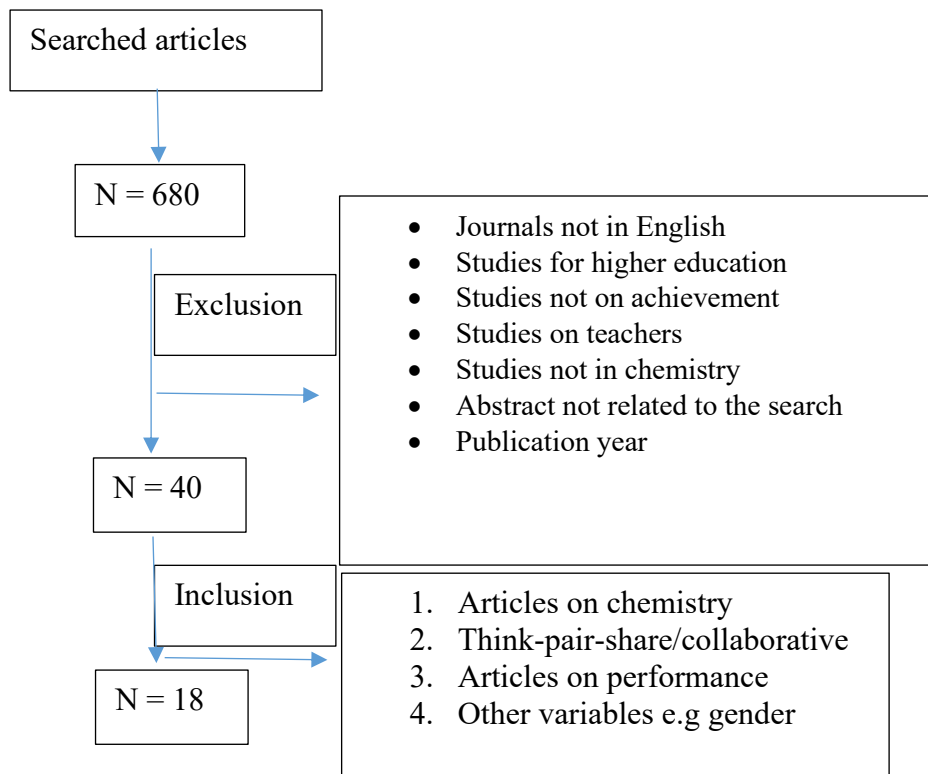
²⁹ Sabiru Dahiru Yusuf, "Effects of Collaborative Learning on Chemistry Students' Academic Achievement and Anxiety Level in Balancing Chemical Equations in Secondary School in Katsina Metropolis, Nigeria," *Journal of Education and Vocational Research* 5, no. 2 (June 30, 2014): 43–48, <https://doi.org/10.22610/jevrv.v5i2.151>.

³⁰ Morenikeji Alex Akanmu, "Effects of Think-Pair-Share on Senior School Students' Performance in Mathematics in Ilorin, Nigeria," *African Journal of Educational Studies in Mathematics and Sciences* 15, no. 2 (2019): 107–16; Bamiro, "Effects of Guided Discovery and Think-Pair-Share Strategies on Secondary School Students' Achievement in Chemistry"; B J Ogunkola, "The Relationship Between Cognitive Entry Behaviour Performance of Some Nigerian Secondary School Students.," *IFE Psychologia* 8, no. 2 (February 1, 2000), <https://doi.org/10.4314/ifep.v8i2.23587>.

³¹ Ribhi Khaleel Ahmad Hamdan, "The Effect of (Think-Pair-Share) Strategy on the Achievement of Third Grade Student in Sciences in the Educational District of Irbid.," *Journal of Education and Practice* 8, no. 9 (2017): 88–95.

³² Juliana Nkiru Nnoli, "Enhancing Senior Secondary School Students' Academic Performance in Chemistry Through the Implementation of Think-Pair-Share Strategy," *Social Education Research*, August 8, 2024, 370–79, <https://doi.org/10.37256/ser.5220244727>; Eze and Obiekwe, "Think-Pair-Share Instructional Strategy: A Variety Tool for Enhancing"; Okigbo and Ezenwa, "Effectiveness of Problem-Based and Think-Pair-Share Teaching Methods in Enhancing Secondary School Students' achievement in Electrochemistry in Enugu Education Zone."

³³ E S Gbaje, "Managing Gender in Inclusive Class," *A Paper Presented at ETF Capacity Building for Science Teachers. Plateau State Polytechnic Jos Campus, Jos, 2007.*



Selection Criteria

From the search results obtained above, not all the articles were on teaching and learning. The articles were narrowed down using exclusion criteria to eliminate articles not written in English, articles whose abstract and body was not in English, articles not published in journals, year of article as the review was focused on articles from 2012 to 2024, articles on higher levels of learning, articles on primary schools, studies on teachers and studies not on achievement were excluded. The research included articles not on chemistry and performance; articles not on chemistry were included to determine the relevance of the strategy as an innovative strategy that is student-centered. Performance was included because it is often used simultaneously with achievement by researchers to depict the measure of students' goals in any given task. Articles were categorized in terms of research focus, research method used, and article focus based on achievement, gender and the sample size and geographical location of the research of the various studies.

After the review, 18 articles met the criteria on the use of think-pair-share, collaborative, achievement and chemistry as shown below.

Table 1: showing the results for the think-pair-share, collaborative, achievement and chemistry

S/N o.	Authors/years	Journal	Titles	Country	Research focus	Research methods	Strategies used	Article focus			Results
								Achievement	Gender	Sample size	
1	“Abiodun, T.O., Asanre, A. A., Ogundeji, M.A., Odupe, T. A., & Rasaki, M. G (2022)”	Universal Journal of Educational Research	“Improving teaching and learning of organic chemistry”	Ghana	Performance and retention	Quantitative and qualitative	Collaborative	Y		180	Collaborative learning was more effective than the traditional teaching method, and gender was not considered.
2	“Achufusi, N., N. & Okpanachi, E. (2021)”	International Scholars Journal of Arts and Social Science Research	“Effects of collaborative learning strategy on students’ academic achievement in chemistry”	Nigeria	Academic achievement	Quantitative	Collaborative	Y	Y	49	There was high academic achievement, with females performing better than males.
3	“Adjei, F., Hanson, R., Sam, A., & Sedegah, S. (2022)”	Science Education International	“Use of collaborative approaches on students’ performance in redox reactions”	Ghana	Students’ performance	Quantitative	Collaborative	Y	Y	106	There was a positive performance.

4	“Bamiro, A. O (2015)”	Sage Journal	“Effects of guided discovery and think-pair-share strategies on secondary school students’ achievement in chemistry”	Nigeria	Students’ achievement	Quantitative	Guided discovery & think-pair-share	Y	Y	242	Both strategies improved students’ achievement, but think-pair-share improved more and no interaction on gender.
5	“Achor, E. E., Jack, G. & Daiko, C. (2022)”	Journal of Research in Science and Mathematics Education	“Facilitating academic achievement of students in carbohydrate: Consideration of jigsaw, think-pair-share and cooperative strategies”	Nigeria	Students’ achievement	Quantitative	Jigsaw, think-pair-share & cooperative	Y	Y	322	Students’ achievements were better when taught using the jigsaw.
6	“Eze, G. N. & Obiekwe, P. C. (2018)”	African Journal of Science, Technology and Mathematics Education	“Think-pair-share instructional strategy: A variety tool for enhancing students’ achievement in secondary school chemistry”	Nigeria	Students’ achievement	Quantitative	Think-pair-share	Y	Y	100	Students’ achievement was higher than the lecture method, and no significant difference in gender.

7	“Iji, C. O., Ochu, A. N. O., Adikwu, O., & Atamonokhai, S. E. (2017)”	International Journal of Pharmacy and Chemistry	“Effects of collaborative instructional strategy on male and female students’ achievement in secondary school chemistry”	Nigeria	Students’ achievement	Quantitative	Collaborative	Y	Y	216	There was a greater achievement
8	“Joseph. I. K., Obi, J. O & Undie, A. I (2022)”	Interdisciplinary Journal of Science Education	“Effects of collaborative learning strategy on students’ achievement and retention in chemistry”	Nigeria	Academic achievement	Quantitative	Collaborative	Y	Y	292	Enhanced students’ achievement and retention.
9	“Malama, M. & Maseka, K. (2019)”	International Journal of Research and Innovation in Social Science	“The impact of collaborative learning on learner performance when teaching the rate of chemical reactions”	Zambia	Academic performance	Quantitative & qualitative	Collaborative	Y		60	Collaborative enhanced academic performance, but the effect on gender was not considered.
10	“Muhideen A. O., Emmanuel F. B. & Popoola O. O. (2019)”	Journal of Global Research in Education and Social Science	“Relative effectiveness of peer-tutoring and think-pair-share strategies in improving	Nigeria	Improving students’ academic performance & attitude	Quantitative	Peer-tutoring & think-pair-share	Y		113	Think-pair-share improved academic achievement better with no effect on attitude. The effect on

			senior secondary school students' academic performance in chemistry"								gender was not considered.
11	"Niyonsaba, A. Nkurunziza, J. B. & Hakizimana, E. (2022)"	African Journal of Educational Studies in Mathematics and Sciences	"Impacts of collaborative learning on learners' academic performance in chemistry"	Rwanda	Academic achievement	Quantitative	Collaborative	Y		261	The academic performance of students was better using collaborative learning, but gender difference was not considered.
12	"Nwafor, S., C. Okonkwo, H., C. & Onuigwe, B. U. (2023)"	Journal of Digital Learning and Education	"Enhancing secondary school students' achievement using collaborative instructional strategy"	Nigeria	Academic achievement	Quantitative	Collaborative	Y	Y	101	It enhanced students' achievement
13	"Okeke, M. N. & Ordu, O. K. (2018)"	International Journal of Education and Evaluation	"Impact of collaborative learning strategy on the academic achievement of senior secondary school chemistry"	Nigeria	Academic achievement	Quantitative	Collaborative	Y	Y	100	Students achieved better using a collaborative strategy

14	“Okigbo, E. C. & Ezenwa, E. B. (2024)”	Unizik Journal of Educational Research and Policy Studies	“Effectiveness of problem-based and think-pair-share teaching methods in enhancing secondary school students’ achievement in electrochemistry”	Nigeria	Achievement	Quantitative	Problem-based & think-pair-share	Y	Y	126	Problem-based learning was more effective in enhancing achievement, and male students performed better.
15	“Pradhan, S. S. (2021)”	International Journal of Creative Research Thought	“Impact of collaborative learning approach on secondary students’ achievement in chemistry”	India	Achievement	Quantitative	Collaborative	Y		30	The collaborative strategy impacted positively on students’ achievement, but gender was not considered.
16	“Shafqat, F. & Habib, M. (2022)”	Pakistan Languages and Humanities Review	“Enhancing chemistry performance and motivation through the think-pair-share strategy”	Pakistan	Motivation & performance	Quantitative & qualitative	Think-pair-share	Y		25	Think-pair-share enhanced students’ motivation and achievement.
17	“Usang, F. P & Okoli, J. N. (2021)”	Journal of Research & Method in Education	“Effect of think-pair-share teaching strategy on secondary school	Nigeria	Academic achievement	Quantitative	Think-pair-share	Y		121	Think-pair-share was effective in teaching chemistry concepts.

			students' achievement"								
18	"Yusuf, S. D. (2014)"	Journal of Education and Vocational Research	"Effects of collaborative learning on chemistry students' academic achievement and anxiety level in balancing chemical equations"	Nigeria	Anxiety level & Academic achievement	Qualitative and quantitative	Collaborative	Y		80	There was a high achievement with low anxiety. Gender was not considered.

DATA ANALYSIS AND DISCUSSION

Achievement

This review aimed to explore how the think-pair-share strategy affects teaching and learning of difficult chemistry concepts for academic achievement in relation to gender and geographical location. Think-pair-share helps students remember information and affords them opportunities to discuss by building their self-efficacy with partners when they participate, through enhancing their knowledge retention with a deeper understanding.³⁴ Abiodun et al. and Idiege et al., in their discussion on collaborative strategy, stated that it was more effective and enhanced students' performance and retention,³⁵ while Abiodun et al. focused on organic chemistry, and Idiege et al focused on general chemistry. The study by Achufusi-Aka and Okapanchi on collaborative strategy in general chemistry noted that students' academic achievement was high and that students' performance in redox reactions showed a positive performance,³⁶ while the study by Bamiro used guided discovery and think-pair-share strategies, noting that students' achievement was improved using both strategies.³⁷ However, the study by Achor et al on carbohydrate using jigsaw, think-pair-share and cooperative learning stated that students achieved better when taught the concept using jigsaw.³⁸ Eze and Obiekwe, in using the think-pair-share strategy, revealed that students' achievement was higher than that of the conventional teaching method in general chemistry.³⁹ Other studies have stated that the academic performance of students was improved with the collaborative learning strategy in general chemistry.⁴⁰

Oloyede et al., using peer-tutoring and the think-pair-share strategy on general chemistry, reported that students' academic achievement was improved with the think-pair-share strategy, although there was no effect on attitude,⁴¹ while Okigbo and Ezenwa, using problem-based and think-pair-share strategies on electrochemistry, revealed that problem-based learning was more effective and enhanced academic achievement better than the think-pair-share strategy.⁴² Research studies on the think-pair-

³⁴ Cheryl Lee, Hui-Chuan Li, and Masitah Shahrill, "Utilising the Think-Pair-Share Technique in the Learning of Probability," *International Journal on Emerging Mathematics Education* 2, no. 1 (2018): 49–64.

³⁵ Abiodun et al., "Effect of Think-Pair-Share Strategy on Student Achievement in Senior Secondary School Mathematics"; Kimson Idiege, Joy Obi, and Innocent Agiande, "Effects of Collaborative Learning Strategy on Students' Achievement and Retention In Chemistry," December 1, 2022.

³⁶ Ngozi Nonye Achufusi-Aka and Elizabeth Elejo Okpanachi, "Effect of Collaborative Learning Strategy on Students' Academic Achievement in Chemistry in Onitsha Education Zone, Anambra State," *International Scholar Journal of Arts and Social Science Research* 4, no. 1 (2021): 190–99.

³⁷ Bamiro, "Effects of Guided Discovery and Think-Pair-Share Strategies on Secondary School Students' Achievement in Chemistry."

³⁸ Emmanuel Edoja Achor, Gladys U Jack, and Comfort Daiko, "Facilitating Academic Achievement of Students in Carbohydrate: Consideration of Jigsaw, Think-Pair-Share and Coop-Coop Cooperative Strategies," *Achor, EE, Jack, GU, & Daiko, C.(2022). Facilitating Academic Achievement of Students in Carbohydrate: Consideration of Jigsaw, Think-Pair-Share and Coop-Coop Cooperative Strategies. Journal of Research in Science and Mathematics Education (J-RSME)* 1, no. 2 (2022): 42–63.

³⁹ Eze and Obiekwe, "Think-Pair-Share Instructional Strategy: A Variety Tool for Enhancing."

⁴⁰ Achor, Jack, and Daiko, "Facilitating Academic Achievement of Students in Carbohydrate: Consideration of Jigsaw, Think-Pair-Share and Coop-Coop Cooperative Strategies"; Aline Niyonsaba, Jean Baptiste Nkurunziza, and Evariste Hakizimana, "Impacts of Collaborative Learning on Learners' Academic Performance in Chemistry in Three Selected Secondary Schools of Nyamasheke District," *African Journal of Educational Studies in Mathematics and Sciences* 18, no. 2 (November 26, 2022): 17–27, <https://doi.org/10.4314/ajesms.v18i2.2>; Stephen Chinedu Nwafor, Happiness C. Okonkwo, and Blessing Ukamaka Onuigwe, "Enhancing Secondary School Students' Achievement in Chemistry Using Collaborative Instructional Strategy," *Journal of Digital Learning and Education* 3, no. 3 (December 29, 2023): 210–17, <https://doi.org/10.52562/jdle.v3i3.818>; Okeke Modesta Nkechinyere and Okey Kelechi Ordu, "Impact of Collaborative Learning Strategy on the Academic Achievement of Senior Secondary School Chemistry Students in Obio-Akpor Local Government Area," *International Journal of Education and Evaluation* 4, no.2(2018):11–18.

⁴¹ Oloyede, Bamidele, and Oladipupo, "Relative Effectiveness of Peer Tutoring and Think-Pair-Share Strategies in Improving Senior Secondary School Students' Academic Performance in Chemistry in Osogbo."

⁴² Okigbo and Ezenwa, "Effectiveness of Problem-Based and Think-Pair-Share Teaching Methods in Enhancing Secondary School Students' achievement in Electrochemistry in Enugu Education Zone."

share strategy revealed that the strategy enhanced students' academic achievement,⁴³ while others showed that the strategy also enhanced the motivation of the students.⁴⁴ The study on academic achievement and anxiety level in balancing chemical equations using a collaborative strategy showed that students' achievement was high, but with low anxiety levels.⁴⁵

From the above discussion, it is evident that the collaborative strategy was mostly utilized in course content delivery compared to the think-pair share strategy combined with either guided discovery, jigsaw, coop coop cooperative, peer-tutoring or problem-based strategies. The above analysis revealed that the think-pair share strategy enhanced achievement and understanding of the subjects by students, although some studies differ, preferring the problem-based approach and jigsaw.⁴⁶

Based on the first research question on how the think-pair-share strategy affects students' achievement in difficult chemistry concepts, from the summary in Table 1, the application of the think-pair-share was carried out on a few of the difficult concepts listed earlier. Critical observations from the findings of the articles specified that the think-pair-share and collaborative strategy generally enhanced students' achievement in general chemistry not perceived as difficult. Some of the studies also tested some other domains which were either positively or negatively affected when compared to strategies such as peer-tutoring, guided discovery and problem-based learning. It was also observed that some of the studies used quantitative methods, while a few used mixed research methods. The sample sizes used in many of the studies were small and thus cannot be used to generalize to the population of students offering chemistry in secondary schools, and the effects on achievement. Figure 1 also shows that the think-pair-share and collaborative strategy is not widely used in the teaching and learning of chemistry, which is below 40% with the think-pair-share being the least used, although its use can effectively increase achievement in teaching and learning.

Gender

To answer research question 2 on the effects of gender, based on geographical locations, the general overview of the articles revealed that most of the studies did not consider that the effect of gender was significant, even when the percentage from Figure 1 shows 45%. Studies from various research works did not consider how the strategies affected gender.⁴⁷ While Idiege et al. considered gender, the report failed to state the performance of either the male or the female students.⁴⁸ Some studies, however,

⁴³ Shafqat, "Enhancing Chemistry Performance and Motivation through Think-Pair-Share Strategy among Higher Secondary School Students"; Friday, Okoli, and Nwanneka, "Effect of Think-Pair-Share Teaching Strategy on Secondary School Students' Achievement in Chemistry in Cross River State."

⁴⁴ Shafqat, "Enhancing Chemistry Performance and Motivation through Think-Pair-Share Strategy among Higher Secondary School Students."

⁴⁵ Yusuf, "Effects of Collaborative Learning on Chemistry Students' Academic Achievement and Anxiety Level in Balancing Chemical Equations in Secondary School in Katsina Metropolis, Nigeria."

⁴⁶ Okigbo and Ezenwa, "Effectiveness of Problem-Based and Think-Pair-Share Teaching Methods in Enhancing Secondary School Students' achievement in Electrochemistry in Enugu Education Zone"; Achor, Jack, and Daiko, "Facilitating Academic Achievement of Students in Carbohydrate: Consideration of Jigsaw, Think-Pair-Share and Coop-Coop Cooperative Strategies."

⁴⁷ Abiodun et al., "Effect of Think-Pair-Share Strategy on Student Achievement in Senior Secondary School Mathematics"; Francis Adjei et al., "The Use of Collaborative Approaches on Students' Performances in Redox Reactions," *Science Education International* 33, no. 2 (2022): 163–70; Oloyede, Bamidele, and Oladipupo, "Relative Effectiveness of Peer Tutoring and Think-Pair-Share Strategies in Improving Senior Secondary School Students' Academic Performance in Chemistry in Osogbo"; Nwafor, Okonkwo, and Onuigwe, "Enhancing Secondary School Students' Achievement in Chemistry Using Collaborative Instructional Strategy"; Nkechinyere and Ordu, "Impact of Collaborative Learning Strategy on the Academic Achievement of Senior Secondary School Chemistry Students in Obio-Akpor Local Government Area"; Shafqat, "Enhancing Chemistry Performance and Motivation through Think-Pair-Share Strategy among Higher Secondary School Students"; Friday, Okoli, and Nwanneka, "Effect of Think-Pair-Share Teaching Strategy on Secondary School Students' Achievement in Chemistry in Cross River State"; Yusuf, "Effects of Collaborative Learning on Chemistry Students' Academic Achievement and Anxiety Level in Balancing Chemical Equations in Secondary School in Katsina Metropolis, Nigeria."

⁴⁸ Idiege, Obi, and Agiande, "Effects of Collaborative Learning Strategy on Students' Achievement and Retention In Chemistry."

reported that female students performed better than their male counterparts,⁴⁹ while others noted that males outperformed the female students.⁵⁰ Other scholars, on the other hand, have noted that there was no interaction or significant effects on gender.⁵¹

Geographical Location

In the aspect of geographical location, the reviewed studies on think-pair-share and collaborative strategy indicated that eight of the studies were from Nigeria, two were from Ghana, while Rwanda, Zambia, Pakistan and India had one study each on the strategy, as shown in Figure 1. This indicates that the strategy is not widely used, considering that it will foster the learning process by helping the students account for and take charge of their learning. From articles reviewed, it was observed that publications from Europe and America on the think-pair-share and collaborative strategy were mainly carried out in higher institutions, and some did not fall within the years considered in this study, though their teaching strategies emphasized inquiry-based learning, visualization tools, hands-on experimentation, etc.

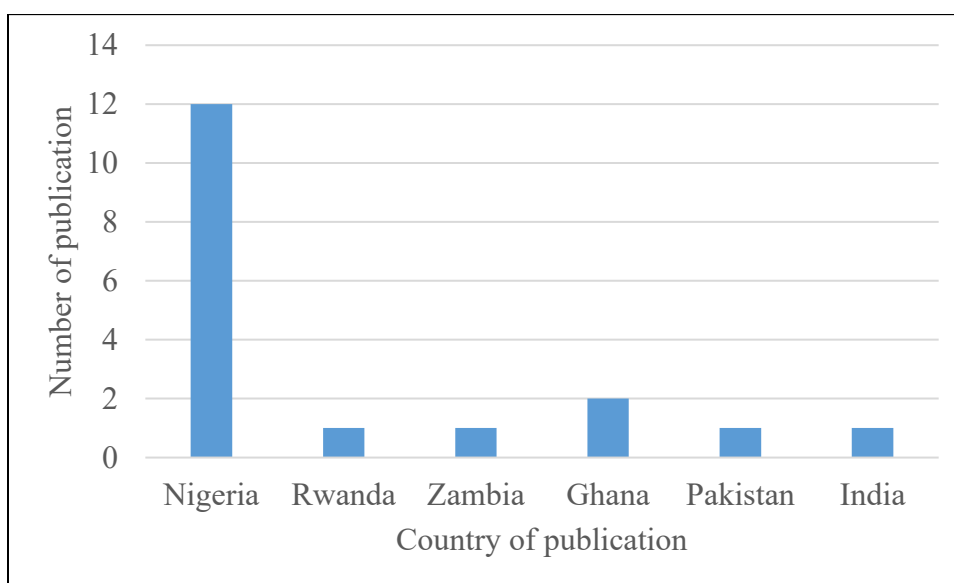


Figure 1. Number of publications on think-pair-share and collaborative learning in chemistry per year and country.

Discussion Summary

The objective of this review was to assess how the think-pair-share strategy affects chemistry achievement in difficult chemistry concepts, with emphasis on secondary school teaching and learning. From the review, it is evident that the think-pair-share strategy has been found to improve academic achievement, even though some studies reported that problem-based learning improved students' academic achievement better than think-pair-share. However, the review showed that the population

⁴⁹ Achufusi-Aka and Okpanachi, "Effect of Collaborative Learning Strategy on Students' Academic Achievement in Chemistry in Onitsha Education Zone, Anambra State"; Achor, Jack, and Daiko, "Facilitating Academic Achievement of Students in Carbohydrate: Consideration of Jigsaw, Think-Pair-Share and Coop-Coop Cooperative Strategies."

⁵⁰ Okigbo and Ezenwa, "Effectiveness of Problem-Based and Think-Pair-Share Teaching Methods in Enhancing Secondary School Students' achievement in Electrochemistry in Enugu Education Zone."

⁵¹ Bamiro, "Effects of Guided Discovery and Think-Pair-Share Strategies on Secondary School Students' Achievement in Chemistry"; Achor, Jack, and Daiko, "Facilitating Academic Achievement of Students in Carbohydrate: Consideration of Jigsaw, Think-Pair-Share and Coop-Coop Cooperative Strategies"; Eze and Obiekwe, "Think-Pair-Share Instructional Strategy: A Variety Tool for Enhancing."

sample used in most of the studies was too small to be used to draw an overall conclusion regarding all students who offer chemistry. In terms of gender, the studies did not show a significant correlation between the students' achievement and gender. The studies showed that the work was mainly carried out on the cognitive domain and in subjects other than chemistry.

RECOMMENDATION

From the findings in this study, it is recommended that:

1. The Ministry of Education should include the think-pair-share strategy in the secondary school curriculum as it offers a better approach to teaching and fosters greater understanding and teamwork among students.
2. Teachers should be trained in the use of the think-pair-share strategy in the teaching and learning of chemistry to achieve a better pass rate and understanding of the subject.
3. School administrators should be empowered with legislation to enable them to enforce the use of think-pair-share as a teaching strategy in all secondary schools in general.
4. Governments should provide the needed funds and support to schools that implement the think-pair-share strategy to boost its universal application.

CONCLUSION

This article examined how the think-pair-share strategy affects teaching and learning of difficult chemistry concepts for academic achievement in secondary schools. The think-pair-share strategy can be used in the teaching of difficult subjects such as chemistry, but can also be used for other equally difficult subjects, such as mathematics and physics, etc., as the principles behind the strategy remain the same irrespective of the application domain. Previous studies have demonstrated that the application of the strategy in secondary schools improves retention, achievement and understanding among students and fosters cooperation and teamwork. The think-pair-share strategy, when correctly implemented and supported, would improve understanding and cultivate critical thinking skills that will help build and enhance global development in chemistry education. It will also foster an interactive learning environment and insights that will promote equal learning opportunities and engagement among both male and female students. The think-pair-share strategy will optimize students' learning potential in a dynamically changing learning environment through building coherent knowledge and skill sets. The use of the think-pair-share strategy in teaching and learning chemistry cannot be over-emphasised, it fosters a learning environment that assists students to individualize their learning and achieve maximum-fulfilment in their academic journey.

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