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A Systematic Review: How the Implementation of Collaborative Learning in Chemistry?

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ABSTRAK

Penelitian ini bertujuan menentukan materi kimia apa yang biasa digunakan pada pembelajaran kolaborasi serta metode/mode/pendekatan apa yang digunakan dalam pembelajaran kolaborasi di kelas kimia. Metode penelitian yang digunakan yaitu systematic literature review (SLR) dengan menganalisis hasil penelitian relevan dari basis data Google Scholar dan ERIC sebanyak 20 artikel berdasarkan keseuaiannya dengan tema penelitian dalam kisaran waktu delapan tahun terakhir (2016-2023). Melalui metode SLR dilakukan review artikel secara sistematis dengan mengikuti langkah-langkah yang telah ditetapkan. Hasil dari systematic literature review (SLR) ini materi kimia yang biasa digunakan pada pembelajaran kolaborasi adalah kimia dasar pada jenjang sekolah menengah atas dan universitas, kemudian model/metode/pendekatan yang digunakan pada pembelajaran kolaborasi adalah pembelajaran kolaborasi berbasis inkuiri, flipped class room dan pembelajaran kolaborasi berbasis permainan.

ABSTRACT

This research aims to determine what chemical materials are commonly used in collaborative learning and what methods/modes/approaches are used in collaborative learning in chemistry classes. The research method used is a systematic literature review (SLR) by analysing relevant research results from the Google Scholar and ERIC databases of 20 articles based on their suitability with the research theme within the last eight years (2016-2023). Through the SLR method, articles are reviewed systematically by following the steps that have been determined. The results of this systematic literature review (SLR) chemical material commonly used in collaborative learning is basic chemistry at the senior high school and university level, then the models/methods/approaches used in collaborative learning are inquiry-based collaborative learning, flipped classroom, and game-based collaborative learning.

1. INTRODUCTION

The reports from various scientific publications found that learning chemistry is more often found in teacher-centred learning and is not active in students, various observations also show that teachers are not yet varied in implementing various types of learning and using conservative learning models so that the class lacks interest in learning chemistry (Munandar & Jofrishal, 2017). This is contrary to the development of learning which emphasizes student-centered learning (Dole et al., 2015). This is also related to chemistry learning in school, the implementation of student-centred learning is important to chemistry learning development (Rohaeti et al., 2020). Thus where students tend to be inactive, as a result, students lack interest and motivation in learning chemistry, have a low level of understanding of chemistry, and lack of skills students acquire (Inayah & Astuti, 2017; Supadmi et al., 2017). Students also think that Chemistry includes abstract and complex concepts symbols, structures, reactions and structured chemical processes., the methods applied also tend to be monotonous so students feel bored with learning (Ersanghono et al., 2008; Fauzi et al., 2021)

On the other hand, the 21st century is marked by the rapid development of technology, communication and information. Because life in the 21st century requires different skills to be mastered,

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education can prepare students to master these different skills to become successful individuals in life (Skagen et al., 2018). The 21st Century learning requires students to have four competencies namely communication, creativity, critical thinking, and collaboration skills (Silber-Varod et al., 2019). Collaboration skills are one of the skills that students must achieve in 21st-century skills. Collaboration skills are a learning process to plan and work together, consider different views or perspectives, and participate in discussions by brainstorming, listening, and supporting others (Greenstain, 2012). 21st-century skills pressure educational units to mould students into individuals who have critical thinking, creativity, collaboration and communication skills that can be used to solve real-world problems and as important preparation for college and future careers (Chu et al., 2016; Greenstain, 2012).

Collaboration skills are skills to work together effectively and efficiently that show respect for diverse teams, practice fluency and willingness to make decisions needed to achieve common goals (Supena et al., 2021). Collaborating with others includes (1) being able to work effectively and respecting different team members, (2) showing flexibility and a willingness to be useful in making compromises to achieve common goals, and (3) taking responsibility in collaborative work and appreciating the contribution of each team member (Redhana, 2019).

Collaboration skills can be promoted by using active learning such as Collaborative Learning (CL). Collaborative learning that focuses on processes and outcomes is an important factor for monitoring and assessing the effectiveness of contextual collaborative learning. Furthermore, in collaborative learning, students are required to work together in small groups to achieve the same academic goals, such as group assignments related to explaining phenomena observed in everyday life. emphasized that students can read, respond and participate by expressing opinions and ideas to discuss and solve problems in everyday life (Dewi et al., 2021). Collaborative learning can help students learn (Baser et al, 2017) students have the responsibility to work together to achieve learning goals, and share ideas. Students with collaborative learning have higher levels of learning achievement and students tend to have lower levels of anxiety (Yusuf, 2014). Vygotsky's theory of proximal development shows that peer collaboration can increase an individual's ability to complete their tasks optimally. The interaction process takes place in two stages, namely social interaction and internalization. Each actor in social interaction experiences a process of personal meaning, and in social interaction, there is a mutual influence between these personal processes, so that shared meaning is formed (Afrahamiryano et al., 2022)

Therefore, this scientific paper aims to examine research on collaborative learning in chemistry in schools and universities. The results of the research that has been carried out are still in the form of individual studies by certain researchers, so they need to be analyzed to further obtain more comprehensive information about collaborative learning in chemistry learning. That way, it can produce a recommendation for researchers, educators and prospective educators in the future so they can apply collaborative learning to chemistry learning. Based on this, it is deemed necessary to carry out a systematic review of the results of research that examines collaborative learning in chemistry learning. Founded that there are 124.000 articles related to collaborative learning with the years range 2016-2023. This fact is the basis for the authors to conduct a systematic review of the use of CL in the field of chemistry studies. The research questions of this research could be:

RQ 1 What chemistry subject learning uses collaborative learning
RQ 2 What models, methods and approaches used in the application of collaborative learning

2. METHOD

The method of this research is a Systematic Literature Review (SLR) by identifying and systematically reviewing journals. This SLR focuses on the implementation of collaborative learning in chemistry learning. The data collected came from the Google Scholar and ERIC databases in the last eight years, from 2016 to 2023. There were 20 articles reviewed which were obtained using the keywords "collaborative learning" and "chemistry education"

The red to answestions are national and Scopus-inded articled on the ed Inclusion Criteria (IC), while the Inclusion criteria for seecting articles reviewed are: (1) article publication in the last 8 years (2016-2023), (2) Scopus indexed journals (Q1-Q4), Sinta (S1-S2) or proceedings, (3) articles related to chemistry learning, (4) research subjects namely high school students or educational students and (5) research focus on implementation of collaborative learning.

The steps in a systematic literature review according to (Siswanto, 2010) consist of (1) formulating research questions (formulating review questions), (2) conducting a systematic literature search, (3) conducting screening and selection suitable research articles, (4) analyzing and synthesizing qualitative findings, and (5) compiling a final report and presenting findings. The process of searching the literature through the Google Scholar database and the search results ERIC is shown in Figure 1.

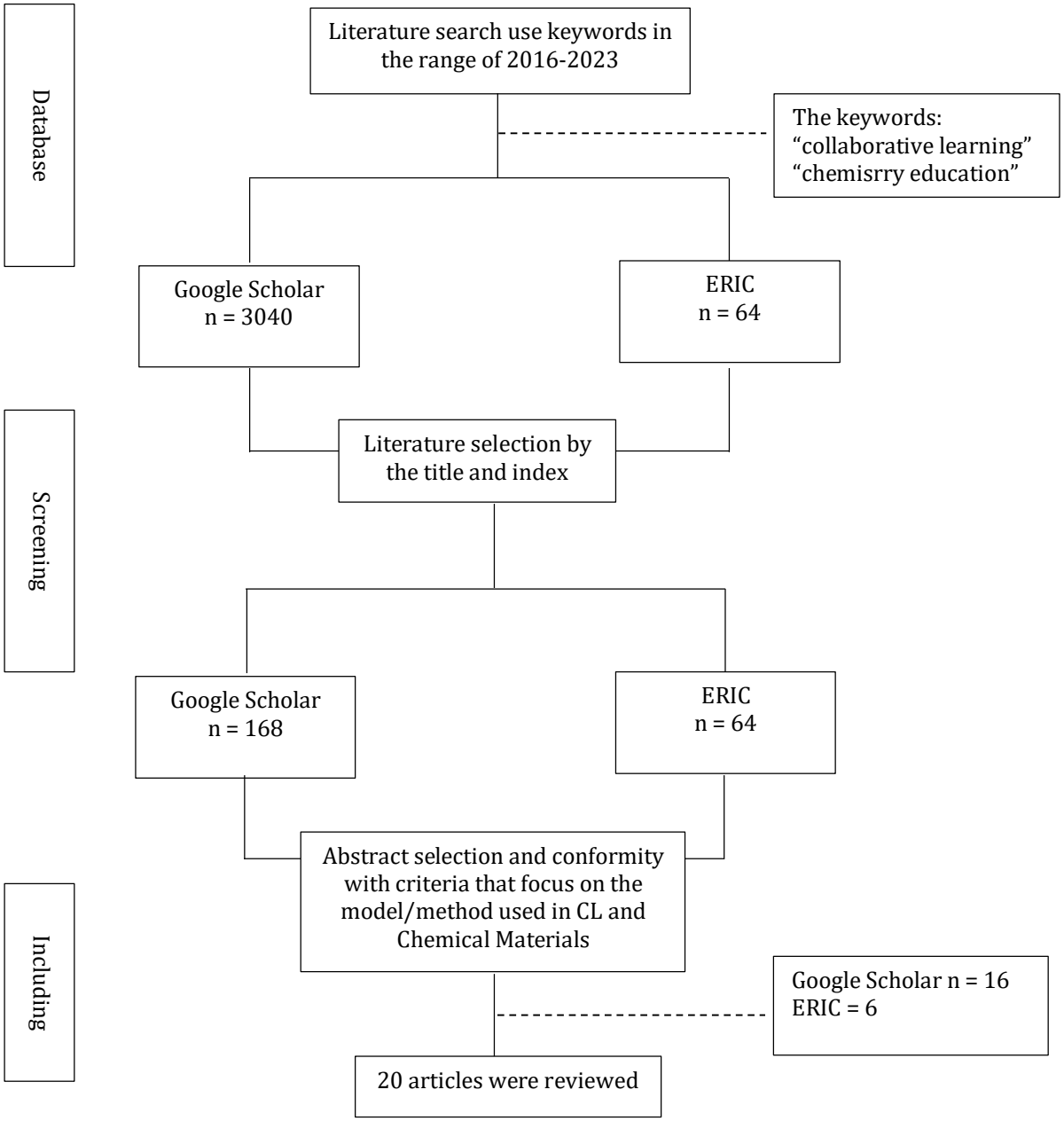

Figure 1. Article search flowchart

3. RESULT AND DISCUSSION

Result

The research was conducted using the Systematic Literature Review method by reviewing as many as 20 articles that had been screened or selected based on predetermined criteria. The following is the distribution of article publications in this systematic literature review that matches the criteria based on the range from 2016 to 2023 in Figure 2 and articles that fall into categories after screening in Figure 2.

The results of journal screening from 2016-2023 were then adjusted to the predetermined inclusion criteria and then categorized whether the article was feasible. The following presents the selected articles in Table 1.

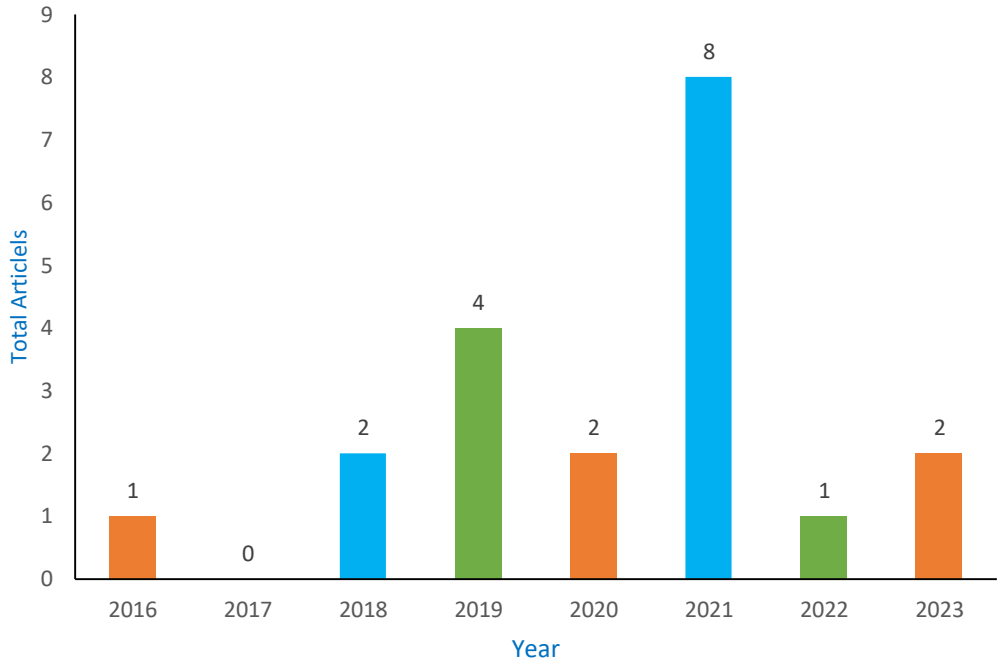

Figure 2. Publication of collaboration learning in chemistry

Tabel 1. Article Screening

No	Article	Index	IC 1	IC 2	IC 3	IC 4	IC 5	Criteria
1	Harefa, N., & Suyanti, R. D. (2019, December). Science generic skills of 'chemistry'? prospective teachers: A study on collaborative learning using Exe-media. In Journal of Physics: Conference Series (Vol. 1397, No. 1, p. 012032). IOP Publishing.	Proceeding	√	√	√	√	√	Eligible
2	Skagen, D., McCollum, B., Morsch, L., & Shokoples, B. (2018). Developing communication confidence and professional identity in chemistry through international online collaborative learning. Chemistry Education Research and Practice, 19(2), 567-582.	Q1	√	√	√	√	√	Eligible
3	Dewi, C. C. A., Erna, M., Haris, I., & Kundera, I. N. (2021). The effect of contextual collaborative learning based ethnoscience to increase student's scientific literacy ability. Journal of Turkish Science Education, 18(3), 525-541.	Q2	√	√	√	√	√	Eligible
4	Priyambodo, E., Fitriyana, N., Primastuti, M., & Artistic, F. A. D. (2021, March). The role of collaborative learning based STSE in acid base chemistry: Effects on students' motivation. In 7th International Conference on Research, Implementation, and Education of	Proceeding	√	√	√	√	√	Eligible

	Mathematics and Sciences (ICRIEMS 2020) (pp. 253-263). Atlantis Press.							
5	Husna, S. M., & Adriani, F. (2023). Analysis of the Application and Correlation of the Murder Type Collaborative Learning Model on Student Learning Outcomes at Senior High School Jambi. Journal Evaluation in Education (JEE), 4(1), 21-30.	S2	√	√	√	√	√	Eligible
6	Priyambodo, E., Sukirno, M. P., Fitriyana, N., & Randhanugraha, H. (2021). STSE Collaborative Learning: Fostering Students' Learning Motivation on Electrolyte Non-Electrolyte Chemistry Unit. Journal of Engineering Education Transformations, 35(2).	Q3	√	√	√	√	√	Eligible
7	Wentzel, M. T., Ripley, I., McCollum, B. M., & Morsch, L. A. (2019). Practicing Multimodal Chemistry Communication through Online Collaborative Learning. ACS Symposium Series, 57–74. doi:10.1021/bk-2019-1327.ch005	Q4	√	√	√	√	√	Eligible
8	Avargil, S., Shwartz, G., & Zemel, Y. (2021). Educational Escape Room: Break Dalton's Code and Escape! Journal of Chemical Education, 98(7), 2313–2322. doi:10.1021/acs.jchemed.1c00 11	Q1	√	√	√	√	√	Eligible
9	Hunter, K. H., Rodriguez, J.-M. G., & Becker, N. M. (2021). Making sense of sensemaking: using the sensemaking epistemic game to investigate student discourse during a collaborative gas law activity. Chemistry Education Research and Practice, 22(2), 328–346. doi:10.1039/d0rp00290a	Q1	√	√	√	√	√	Eligible
10	Rohaeti, E., & Prodjosantoso, A. K. (2020). Oriented Collaborative Inquiry Learning Model: Improving Students' Scientific Attitudes in General Chemistry. Journal of Baltic Science Education, 19(1), 108-120.	Q2	√	√	√	√	√	Eligible
11	Wu, H. T., Mortezaei, K., Alvelais, T., Henbest, G., Murphy, C., Yezierski, E. J., & Eichler, J. F. (2021). Incorporating concept development activities into a flipped classroom structure: using PhET simulations to put a twist on the flip. Chemistry Education Research and Practice, 22(4), 842-854.	Q1	√	√	√	√	√	Eligible
12	ÖZKANBAŞ, M., & TAŞTAN KIRIK, Ö. (2020). Implementing Collaborative Inquiry in a Middle School Science Course. Chemistry Education	Q1	√	√	√	√	√	Eligible

	Research and Practice. doi:10.1039/c9rp00231f							
13	Ryan, M. D., & Reid, S. A. (2016). Impact of the flipped classroom on student performance and retention: A parallel controlled study in general chemistry. *Journal of Chemical Education*, *93*(1), 13-23.	Q1	√	√	√	√	√	Eligible
14	de Berg, K. C. (2022). Student thinking profiles within a small group addressing problems in thermodynamics as part of a physical chemistry unit: reflections for students and instructors. *Chemistry Education Research and Practice*, *23*(3), 628-643.	Q1	√	√	√	√	√	Eligible
15	McAlpin, J. D., Kulatunga, U., & Lewis, J. E. (2023). Using social influence models to characterize student interest in a general chemistry peer-led team learning setting. *Chemistry Education Research and Practice*.	Q1	√	√	√	√	√	Eligible
16	Fauzi, F., Erna, M., & Linda, R. (2021). The effectiveness of collaborative learning throughtechniques on group investigation and think pair share students' critical thinking ability on chemical equilibrium material. *Journal of Educational Sciences*, *5*(1), 198-208.	S2	√	√	√	√	√	Eligible
17	Winarti, A., Rahmini, A., & Almubarak, A. (2019). The effectiveness of multiple intelligences based collaborative problem solving to improve critical thinking. *Jurnal Kependidikan*, *3*(2), 172-186.	S2	√	√	√	√	√	Eligible
18	Korkman, N., & Metin, M. (2021). The Effect of Inquiry-Based Collaborative Learning and Inquiry-Based Online Collaborative Learning on Success and Permanent Learning of Students. *Journal of Science Learning*, *4*(2), 151-159.	S2	√	√	√	√	√	Eligible
19	Dagnoni Huelsmann, R., Vailati, A. F., Ribeiro de Laia, L., Salvador Tessaro, P., & Xavier, F. R. (2018). Tap It Fast! Playing a Molecular Symmetry Game for Practice and Formative Assessment of Students' Understanding of Symmetry Concepts. Journal of Chemical Education, 95(7), 1151–1155. doi:10.1021/acs.jchemed.7b0084	Q1	√	√	√	√	√	Eligible
20	Vergne, M. J., Simmons, J. D., & Bowen, R. S. (2019). Escape the Lab: An Interactive Escape-Room Game as a Laboratory Experiment. Journal of Chemical Education. doi:10.1021/acs.jchemed.8b0102	Q1	√	√	√	√	√	Eligible

Chemistry Subject Matter in Collaboration Learning

Chemistry is one of the sciences that is closely related to everyday life so that in the process students already have the initial concept. Sometimes the concepts that have been constructed by students themselves through these experiences are different from the actual concepts as well as with chemical material which are interrelated to one another. Chemical materials used in collaborative learning are presented in Table 2.

Tabel 2. Chemistry Subject Matter in Collaborative Learning

Chemistry Subject	Level	Articles
Reaction rate	University	Science generic skills of 'chemistry'? prospective teachers: A study on collaborative learning using Exe-media
	High School	Analysis of the Application and Correlation of the Murder Type Collaborative Learning Model on Student Learning Outcomes at Senior High School Jambi
Organic Chemistry	University	Developing communication confidence and professional identity in chemistry through international online collaborative learning
	University	Practicing Multimodal Chemistry Communication through Online Collaborative Learning
Hydrocarbon	University	The effect of contextual collaborative learning based ethnoscience to increase student's scientific literacy ability
Acid-Based	High School	The role of collaborative learning based STSE in acid base chemistry: Effects on students' motivation
Electrolyte and Non-Electrolyte Solution	High School	STSE Collaborative Learning: Fostering Students' Learning Motivation on Electrolyte Non-Electrolyte Chemistry Unit
Basic Chemistry	High School	Impact of the flipped classroom on student performance and retention: A parallel controlled study in general chemistry
	University	Educational Escape Room: Break Dalton's Code and Escape!
		Making sense of sensemaking: using the sensemaking epistemic game to investigate student discourse during a collaborative gas law activity.
		Oriented Collaborative Inquiry Learning Model: Improving Students' Scientific Attitudes in General Chemistry
		Incorporating concept development activities into a flipped classroom structure: using PhET simulations to put a twist on the flip
		Using social influence models to characterize student interest in a general chemistry peer-led team learning setting
Particular Material	High School	Implementing Collaborative Inquiry in a Middle School Science Course
Thermodynamic	University	Student thinking profiles within a small group addressing problems in thermodynamics as part of a physical chemistry unit: reflections for students and instructors.
Chemical Equilibrium	High School	The effectiveness of collaborative learning throughtechniques on group investigation and think pair share students' critical thinking ability on chemical equilibrium material.

Salt Hydrolysis	University	Science generic skills of 'chemistry'? prospective teachers: A study on collaborative learning using Exe-media.
	High School	The effectiveness of multiple intelligences based collaborative problem solving to improve critical thinking
Chemical Bond	High School	The Effect of Inquiry-Based Collaborative Learning and Inquiry-Based Online Collaborative Learning on Success and Permanent Learning of Students
Inorganic Chemistry	University	Tap It Fast! Playing a Molecular Symmetry Game for Practice and Formative Assessment of Students' Understanding of Symmetry Concepts
Analytical Chemistry	University	Escape the Lab: An Interactive Escape-Room Game as a Laboratory Experiment.

Note :
Eligible : For articles that fulfilled all the inclusions criteria

Model/Methode/Aproach in Collaborative Learning

Tabel 3. Model/Methode/Aproach in Collaborative Learning

Model/Methode/Aproach	Levels	Article Title
Flipped Classroom	University	Developing communication confidence and professional identity in chemistry through international online collaborative learning.
		Practicing Multimodal Chemistry Communication through Online Collaborative Learning
		Incorporating concept development activities into a flipped classroom structure: using PhET simulations to put a twist on the flip
	High School	Impact of the flipped classroom on student performance and retention: A parallel controlled study in general chemistry.
Inquiry Collaborative Learning	University	Oriented Collaborative Inquiry Learning Model: Improving Students' Scientific Attitudes in General Chemistry.
		Making sense of sensemaking: using the sensemaking epistemic game to investigate student discourse during a collaborative gas law activity.
	High School	The Effect of Inquiry-Based Collaborative Learning and Inquiry-Based Online Collaborative Learning on Success and Permanent Learning of Students
		Implementing Collaborative Inquiry in a Middle School Science Course
Escape Room Game	University	Educational Escape Room: Break Dalton's Code and Escape!
		Escape the Lab: An Interactive Escape-Room Game as a Laboratory Experiment
Tap it Fast Game	University	Tap It Fast! Playing a Molecular Symmetry Game for Practice and Formative Assessment of Students' Understanding of Symmetry Concepts.
STSE	High School	The role of collaborative learning based STSE in acid base chemistry: Effects on students' motivation.
		STSE Collaborative Learning: Fostering Students' Learning Motivation on Electrolyte Non-Electrolyte Chemistry Unit

Collaboration Learning using EXE-Media	University	Science generic skills of 'chemistry'? prospective teachers: A study on collaborative learning using Exe-media.
Contextual Collaborative Learning	University	The effect of contextual collaborative learning based ethnoscience to increase student's scientific literacy ability.
MURDER	High School	Analysis of the Application and Correlation of the Murder Type Collaborative Learning Model on Student Learning Outcomes at Senior High School Jambi.
Collaborative small group conversation	University	Student thinking profiles within a small group addressing problems in thermodynamics as part of a physical chemistry unit: reflections for students and instructors
Peer-led team learning	University	Using social influence models to characterize student interest in a general chemistry peer-led team learning setting
Think-Pair-Share and Group Investigation	High School	The effectiveness of collaborative learning through techniques on group investigation and think pair share students' critical thinking ability on chemical equilibrium material.
Multiple Intelligences based Collaborative Problem-Solving (MI-CPS)	High School	The effectiveness of multiple intelligences based collaborative problem solving to improve critical thinking.

Discussion

Research related to collaborative learning in chemistry has been widely researched both outside and within the country. There were 3074 articles obtained using the keywords "collaborative learning" "chemistry education". And after screening and determining journals that match the inclusion criteria, 20 articles were analyzed. Based on Figure 1 on the research results, it shows that research related to collaborative learning in chemistry education is the most common in 2021. Some of the 20 articles have an index of Q1 (50%), Q2 (10%), Q3 (5%), Q4 (5 %), Sinta 2 (20%) and from the proceeding (10%).

Chemistry Material Taught using Collaborative Learning

Based on Table 2, it shows that the most chemistry material taught using collaborative learning is basic chemistry material at the university level (Avargil et al., 2021; Hunter et al., 2021; McAlpin et al., 2023; Rohaeti et al., 2020; Ryan & Reid, 2016; Wu et al., 2021), this is because basic chemistry becomes material at the beginning of the lecture semester which makes it difficult for students to understand concepts, also students are not familiar with the equipment and laboratory materials used in chemical material students' basic knowledge and lack of science skills (Rohaeti et al., 2020). In addition, the chemistry materials taught using collaborative learning at the university level are thermodynamics, reaction rates, salt hydrolysis, analytical chemistry, inorganic chemistry, and organic chemistry.

Meanwhile, at the senior high school level, the materials taught using collaborative learning varied, namely reaction rates, acid-base, salt hydrolysis, chemical equilibrium, chemical bonds, particular properties of matter, and electrolytic and non-electrolyte solutions. Students tend to have difficulty understanding chemical concepts because chemistry includes abstract and complex concepts, including symbols, structures, reactions, and chemical processes. The methods applied also tend to be monotonous so students feel bored in learning (Ersanghono et al., 2008; Fauzi et al., 2021). For this reason, the application of collaborative learning to learning is needed because it is considered effective in increasing student interest in learning and also understanding students' chemistry concepts (Özkanbaş & Taştan Kırık, 2020; Vergne et al., 2019), as well as student-centered learning so that students can be active. and increasing learning interest and motivation, scientific attitude, skills such as communication, and collaboration (Priyambodo, Sukirno, et al., 2021; Rohaeti et al., 2020; Ryan & Reid, 2016; Skagen et al., 2018; Wu et al., 2021).

Collaboration Learning Models/Method/Approach

Collaboration Learning Models/Method/Approach that are used as shown in Table 3 in collaborative learning are inquiry-based collaborative learning, flipped classroomi and game-based collaborative learning. The discussion in this study includes game-based collaborative learning, inquiry-

based collaborative learning, STSE-based collaborative learning and flipped classroom-based collaborative learning.

Game-based collaborative learning. Based on the journal review, it was found that there are two types of games that can be used in collaborative learning, namely Escape Room Game and Tap it Fast!. Game-based collaborative learning can increase student motivation, build teamwork, improve conceptual understanding of chemistry and can be used as a formative assessment of students because the teacher pays attention to students while playing (Vergne et al., 2019). In addition, game-based collaborative learning makes students enjoy and is effective learning (Vergne et al., 2019) and allows the formation of peer learning (Dagnoni Huelsmann et al., 2018). The escape room game of synthesized articles can be done on chemistry in class as well as in the lab. This game invites students in heterogeneous groups to solve clues, missions, as well as arrange puzzles in a room monitored by the teacher through a hidden camera. During the game the teacher can observe student collaboration and how students understand chemistry (Vergne, et al, 2019; Avardig, et al, 2021). Whereas in the Tap it Fast! game, students are divided into several ketogenic groups and then in the card kit section containing molecules, when the game referee reads out the symmetry, group members press the molecule card that matches their symmetry (Dagnoni Huelsmann et al., 2018)

Collaborative learning based on STSE (Science, Technology, Society and Environment). The STSE learning approach is the relationship between elements, science (S) as the main focus of attention used to form technology (T) in social (S) which requires various implications for the environment (E) physically and mentally (Priyambodo, Fitriyana, et al., 2021) The implementation of STSE in chemistry learning activities begins with displaying everyday life phenomena related to chemical knowledge. This model is expected to be able to present the meaning of the topics they learn in everyday life. In STSE-based collaborative learning students are formed into groups of 3-4 students to explore and interpret related problems in daily life, through STSE-based collaborative learning can increase students' motivation and interest in learning chemistry (Priyambodo, et al., 2020; Priyambodo, et al., 2021).

Inquiry-based collaborative learning. Based on journal reviews, collaborative inquiry learning was found using POGIL (Process Oriented Guided Inquiry Learning), Inquiry-Based Collaborative Learning, and Research-Oriented Collaborative Inquiry Learning. Inquiry-based collaborative learning has both positive effects on cognitive development, success, and student learning. As well as having a positive effect on learning, student awareness and also on students' cognitive development (Korkman & Metin, 2021). Activities (POGIL) that emphasize students' reasoning about the nature and purpose of models also develop students' process skills—the processes that occur when students construct knowledge; for example, process skills include problem solving, information processing, teamwork, oral and written communication, and management, where students develop their own understanding in guided development by first analyzing trends in data (exploration), using the data to develop definition for a concept (concept discovery), and finally apply the knowledge they build (application). The collaborative aspect of POGIL is driven by small groups where students are given roles to distribute the workload of the group (Hunter et al., 2021). Meanwhile, research-oriented inquiry-based collaborative learning can improve students' scientific attitudes (Rohaeti et al., 2020).

Flipped classroom-based collaborative learning. Flipped classroom is a blended learning approach that utilizes technology and facilitates students to learn not only in the classroom. By reversing the traditional learning environment and providing learning content outside the classroom (mostly online) (Juniantari et al., 2019) Collaborative learning focuses on improving communication including symbolic, text, and verbal communication with the help of Online Collaborative Assignment (OCA) (Wentzel et al., 2019). Flipped classrooms are also considered to be able to increase confidence in communicating, professional identity in chemistry learning, increase student involvement and provide opportunities to apply content found in class, effective involvement between students and teachers and students with other students (Ryan & Reid, 2016; Skagen et al., 2018).

4. CONCLUSION

Based on the results and discussion of research on the topic of implementing collaborative learning in chemistry learning, it can be concluded that. Collaborative learning is considered effective for students' understanding of chemistry at both schools and universities. Important collaboration skills are implemented for students for future preparation, as well as following the development of 21st century skills. A total of 20 articles with indexes Q1 (50%), Q2 (10%), Q3 (5%), Q4 (5%), Sinta 2 (20%) and from the proceeding (10%). The results of this systematic literature review (SLR) chemical material commonly used in collaborative learning is basic chemistry at the university level, then the models/methods/approaches used in collaborative learning are inquiry-based collaborative learning, flipped classroom and game-based collaborative learning.

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