Shodh Sari-An International Multidisciplinary Journal

2023, Vol. 02, Issue 04, 73-88
ISSN: 2959-1376
DOI: https://doi.org/10.59231/SARI7625

REMEDIATING STUDENTS' MISCONCEPTION AND ACHIEVEMENT IN CHEMISTRY VIA SCIENCE WRITING HEURISTICS AND PEER REVIEW INSTRUCTIONAL STRATEGIES IN DELTA STATE

Ovie, Adarighofua Faith
Department of Curriculum and Instruction, Delta State College of Education, Mosogar. Delta State, Nigeria

Abstract

The study looked at remediating students' students' misconception and achievement in chemistry via science writing heuristics and peer review instructional strategies in Delta State using quasi-experimental design. The population comprised 18,879 Delta State's public secondary schools. 328 SSII chemistry students were sampled for the study. 3 experts validated Two-Tier Chemistry Test (TTCT) with reliability values of 0.79 (for achievement) and 0.72 (for misconception) was used for data collection. The outcome of ANCOVA analysis indicated that students taught chemistry via science writing heuristics, peer review and lecture approach had significantly different mean misconception and achievement scores; in favor of science writing heuristics and peer review strategies. The study came to the conclusion that peer review and science writing heuristics are useful instructional strategies for remediating students' misconceptions, and improving students' achievement in chemistry. The adoption of science writing heuristics and peer review strategies by chemistry teachers in teaching chemistry was recommended.

Keywords: *Misconception, Academic Achievement, Science Writing Heuristics Strategy, Peer Review Strategy*

Introduction:

Chemistry is taught in both the secondary and post-secondary education levels of the Nigerian educational system. At the senior secondary school level, students are first exposed to chemistry. Chemistry investigates the characteristics, make-up, processes and applications of matter.

@2023 International Council for Education Research and Training
ISSN: 2959-1376
2023, Vol. 02, Issue 04, 73-88
DOI: https://doi.org/10.59231/SARI7625

Students' comprehension of the composition, characteristics, transformations and applications of matter that make up our surroundings should be improved by their exposure to chemistry. The chemistry curriculum at the secondary school level according to Nwanze and Okoli (2021), presents chemistry as a practical subject structured around; chemical world, chemistry and environment, chemistry and industry, and chemistry and life. These four themes depict that the study of chemistry cuts across nearly all the fields of human endeavor. Biochemistry, organic chemistry, inorganic chemistry, physical chemistry, medical chemistry, nuclear chemistry, and environmental chemistry are only a few of the branches that make up the study of chemistry.

The effort to promote sustainable economic growth worldwide is centered on chemistry. Chemistry is important in many industries, including food, clothes, housing, medicine, transportation, and a variety of other products including cosmetics, paint and soap. The health industry, food processing industries, extractive industries, petroleum and petrochemical sectors, among other fields, all provide numerous job opportunities in chemistry. Owing of chemistry's importance, secondary school science students are now required to take the course, which will assist them pursue higher education in chemistry and related fields of study. Despite the importance of chemistry, senior secondary students struggle to learn it as seen by their poor performance on external exams (See Appendix I for students' performance in 2015-2019 WASSCE chemistry).

The chief examiner for WAEC found that students' fundamental knowledge of straightforward chemistry principles was their greatest area of difficulty. This could be attributable to the traditional lecture method that chemistry teachers tend to employ the most. At secondary schools in Nigeria, the lecture method is the most popular form of instruction. This approach motivates students to master course material by having them practice facts and drills continuously (Anyafulude, 2014). The approach ensures timely completion of the course outline, but it also encourages students to retain and assimilate information by memorization rather than by digesting

@2023 International Council for Education Research and Training
ISSN: 2959-1376
2023, Vol. 02, Issue 04, 73-88
DOI: https://doi.org/10.59231/SARI7625

and assimilation (Emerhiona, Ijeh & Ajaja, 2022). Moreover, the lecture mode of learning does not acknowledge divergent thinking among students. The lecture method disregards the fact that students develop ideas about natural occurrences before getting formal instruction in the classroom. Some of these alternative ideas differ from what is generally accepted in the scientific community. These alternative conceptions when formed from improper understanding of the learning contents may lead to misconceptions.

According to Mondal (2013), a misconception is described as students' incorrect responses to a specific situation, students' ideas that lead to incorrect responses to a specific situation and students' views about the world that vary from those of scientists. For misconceptions to arise, there are a variety of potential sources. First of all, not every encounter prompt student to draw the right conclusions or exposes them to every conceivable result. Second, rather than acknowledging that they don't know the answer when asked by their children, parents or other family members frequently give a false response. Resources, the media, and teachers are additional sources of misunderstandings. The primary problem is that since all of the aforementioned sources are seen as "reliable," students readily accept what they are taught. Being misinformed about facts or receiving contradictory information from reliable sources like parents or instructors are only two examples of how misconceptions themselves might be related to these things. Research has shown that these misconceptions of students are very strong and deeply rooted and if neglected hinder effective teaching and learning. Therefore, the conceptual change approach that promotes students' reconstruction of past experiences (alternative conceptions) in order to accommodate new ideas or conceptions that are acceptable in scientific community could be an alternative teaching method to the lecture method.

Based on Piaget's assimilation, accommodation, and homeostatic principles, the conceptual transformation technique assists students to move from erroneous beliefs to scientific notions (Emerhiona, Naiho & Chukwunalu, 2022). According to this method, students cannot absorb

@2023 International Council for Education Research and Training 2023, Vol. 02, Issue 04, 73-88
ISSN: 2959-1376 DOI: https://doi.org/10.59231/SARI7625

scientific concepts successfully if their preconceptions—which they may have generated themselves or were imparted to them in this manner—are not dispelled. It is essential to show both the fallacy's incorrectness and its inefficiency in problem-solving in order to replace a misperception that has become ingrained in a learner's mental construct with the proper one. The conceptual change strategy proposed by Posner, Strike, Hewson and Gertzog (1982) to help students overcome their misunderstandings (misconceptions) includes instructional techniques such as conceptual change texts, concept maps, analogy, use of models, science writing heuristics, peer review among others. However, this study only focused on science writing heuristics and peer review instructional approaches.

Science writing heuristics, which have their roots in constructivism, are viewed as a method to argument-based enquiry (Nam, Choi & Hand, 2010). The two elements of science writing heuristics are a teacher framework and a student framework. A number of suggested tasks that show what teachers must do when employing enquiry activities are included in the teacher framework. The student framework, the second component of the science writing heuristics, consists of a series of questions that encourage students to acquire scientific information. Students can build scientific arguments using the questions as a framework. While discussing or defending their choices after answering their test questions, students utilize the phrases claims and evidence.

The exercises that are given in science writing heuristics classes keep the students' minds and bodies very busy. Students develop the experiment and ask testable questions in a group at the start of the learning sessions. They conduct research, gather information, and make observations after that. The students engage in intra- and inter-group conversations to determine the significance of the data and observations after finishing the inquiry job. They generate knowledge by making assertions and substantiating those assertions using data derived from their experiments. Ultimately, they make an effort to combine new knowledge with their prior knowledge through reflection. The teacher acts as a

@2023 International Council for Education Research and Training 2023, Vol. 02, Issue 04, 73-88
ISSN: 2959-1376 DOI: https://doi.org/10.59231/SARI7625

facilitator, allowing students to create their own groups, giving them the chance to discuss opening questions, creating the conditions for student-centered learning, and requiring them to organize their data, produce knowledge claims, and offer proof (Cavagnetto, Hand & Norton-Meier, 2010). The researcher believed that science writing heuristics have the potential of remedying students' misconception and boosting students' achievement. However, the superiority of science writing heuristics over peer review in remediating students' misconception and achievement in chemistry is yet to be established. This is the major rationale for the study.

Peer review, sometimes referred to as peer evaluation or peer assessment, is a teaching technique that entails a student actively participating in the formative assessment of another student's work (Odom, Glenn, Sanner & Cannella, 2019). In the literature on higher education, peer review's use as a method of assessment to gauge learning is well documented. According to Prins, Sluijsmans, Kirschner and Strijbos (2015), formative peer assessment helps students acquire the ability to offer insightful criticism and recommendations for performance enhancement to another individual or group in any circumstance. They compare various evaluation methods utilized in higher education that are solely summative with the formative peer assessment procedure. Formative peer evaluation assists learners in identifying their areas of strength and weakness, developing and managing their learning processes, and working towards the desired learning outcomes while still in the learning process (Nicol & Macfarlane-Dick, 2016).

Peer evaluation is a useful technique for group assessment. It aids in preparing students for forthcoming, in-person encounters with providing and getting criticism at work (Nicol & Macfarlane-Dick, 2016). Students must be aware of who will assess them, what will be evaluated, when the evaluation will take place, why peer evaluations are conducted, and how these peer evaluations will affect their grades in order to participate in peer evaluations effectively. Prior to the collaborative experience, evaluation tools that outline the assignment's requirements are essential to ensuring that the peer review experience is

@2023 International Council for Education Research and Training 2023, Vol. 02, Issue 04, 73-88
ISSN: 2959-1376 DOI: https://doi.org/10.59231/SARI7625

useful for students. So, it is necessary to provide students with evaluation tools so they are aware of how they will be evaluated. Peer review as a teaching strategy has been shown to improve students' achievement in science (Odom, Glenn, Sanner & Cannella, 2019).

Academic achievement is the state of a student's education. Academic achievement is the sum of the knowledge and skills that a student has learned and developed over their academic career, as determined by school administrators through the use of teacher-created or standardized exams. Academic achievement, according to Sheoran and Sethi (2016), is the whole of the knowledge acquired after finishing a course of instruction (wholly or partially), as measured by the grade received on an achievement test. It is a quantitative depiction of a student's performance in a particular subject. A student's success or failure is determined on their academic performance. The teacher's chosen teaching strategy may improve the academic performance of the students. Thus, this study set out to investigate if the use of science writing heuristics and peer review strategies enhance students' reduction of misconception and promote students' achievement in chemistry in Delta State.

Statement of the Problem

Students' performance in chemistry has continued to be subpar, according to an analysis of the WAEC Chief Examiner's findings from 2015 to 2019 (See Appendix I). Students' conceptual ignorance of fundamental chemistry topics was specifically mentioned in the Examiner's report. The lack of proper understanding of chemistry concepts by students, who frequently approach exams with misconceptions, is thought to be one factor contributing to the low achievement in chemistry. Because chemistry teachers frequently use the lecture mode of instruction, this conceptual understanding gap of fundamental chemistry topics may be explained. This is due to the fact that the lecture technique does not consider the students' alternative ideas and instead encourages memorization and regurgitation of previously learned concepts as a result of passive participation from the students during instruction. For there to be genuine learning, there is the need for identification

@2023 International Council for Education Research and Training
ISSN: 2959-1376
2023, Vol. 02, Issue 04, 73-88
DOI: https://doi.org/10.59231/SARI7625

and eradication of students' misconceptions about chemistry concepts during instruction. Therefore, conceptual change strategies such as science writing heuristics and peer review instructional strategies that promote students' reconstruction of past experiences (alternative conceptions) in order to accommodate new ideas or conceptions that are acceptable in the scientific community could be an alternative teaching method to the lecture method. Therefore, will science writing heuristics and peer review instructional strategies enhance students' reduction of misconception about chemistry concepts and achievement in chemistry than the lecture method?

Purpose of the Study

The primary goal of the study was to determine how science writing heuristics and peer review instructional strategies can improve secondary school students' understanding of and performance in chemistry in Delta State. Particularly, the study sought to:

1. determine the difference between the mean misconception scores of students taught chemistry using science writing heuristics, peer review, and lecture method;
2. determine the difference between the mean achievement scores of students taught chemistry using science writing heuristics, peer review and lecture method.

Hypotheses

Two hypotheses guided the study as follows:

1. There is no discernible difference between the mean misconception scores of students taught chemistry using science writing heuristics, peer review and lecture method.
2. There is no discernible difference between the mean achievement scores of students taught chemistry using science writing heuristics, peer review and lecture method.

Methodology

The study used a planned variation quasi-experimental design with pre-test and post-test, with a population of 18,879 public secondary schools' chemistry students in Delta State. 328 SSII chemistry students participated in the study. Data were gathered using the Two-Tier Chemistry Test (TTCT). Three experts, including a science educator for chemistry at Delta State University Abraka, an experienced teacher of chemistry

@2023 International Council for Education Research and Training
ISSN: 2959-1376
2023, Vol. 02, Issue 04, 73-88
DOI: https://doi.org/10.59231/SARI7625

from Adeje Secondary School in the Okpe Local Government Area of Delta State, and a measurement and evaluation specialist from Delta State University, face-validated TTCT. Using Kuder-Richardson formula 21, the reliability of TTCT was determined. 35 SSII Chemistry students from a secondary school outside the study's sampling schools in Sapele Local Government Area received the TTCT. The 35 students' performance was evaluated using Kuder-Richardson formula 21 and originally rated for just the first stage (for achievement), then for both the first and second stage (for misconception). Following investigation, a reliability coefficient of 0.79 for achievement and 0.72 for misperception was found. In this study, the treatment entailed teaching students a few specific chemistry concepts using lecture, peer review, and science writing heuristics strategy. Using TTCT, pre- and post-tests were given prior to and following treatment. The hypotheses were tested using ANCOVA with a 0.05 level of significance.

Results

The outcomes of the data analysis are displayed as follows:

- There is no substantial difference between the mean misconception scores of students taught chemistry using science writing heuristics, peer review and lecture method.

Table 1

ANCOVA Summary Table on Misconception Scores of Students Taught Chemistry Using Science Writing Heuristics, Peer Review and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5313.182[a]	3	1771.061	10.638	.000
Intercept	112731.360	1	112731.360	677.105	.000
Pretest	66.482	1	66.482	.399	.528
Methods	5178.289	2	2589.144	15.551	.000
Error	53942.806	324	166.490		
Total	1069356.000	328			
Corrected Total	59255.988	327			

@2023 International Council for Education Research and Training
ISSN: 2959-1376
2023, Vol. 02, Issue 04, 73-88
DOI: https://doi.org/10.59231/SARI7625

F (2,324) = 15.551, P (0.000) < 0.05, table 1 demonstrates a substantial difference in the mean misconception scores among students taught chemistry using science writing heuristics, peer review, and lecture. The difference's direction was ascertained using a post-hoc test as shown in table 2.

Table 2

Scheffe's Post-hoc Test Summary on Misconception

(I) Teaching methods	(J) Teaching methods	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Science writing	Peer Review	3.304	1.831	.072	-.299	6.907
	Lecture	9.237*	1.688	.000	5.916	12.558
Peer Review	Science Writing	-3.304	1.831	.072	-6.907	.299
	Lecture	5.933*	1.764	.001	2.463	9.403
Lecture	Science Writing	-9.237*	1.688	.000	-12.558	-5.916
	Peer Review	-5.933*	1.764	.001	-9.403	-2.463

Table 2 shows a non-substantial difference between the mean misconception scores of students taught chemistry using peer review strategy and science writing heuristics; a substantial difference between the mean misconception scores of students taught chemistry using science writing heuristics and lecture method, favoring science writing heuristics; and a substantial difference between the mean misconception scores of students taught chemistry using peer review and lecture method, favoring peer review. As shown in table 2, peer review and science writing heuristics are more successful than lectures at reducing students' misconceptions about chemistry.

- There is no substantial difference between the mean achievement scores of students taught chemistry using science writing heuristics, peer review and lecture method.

@2023 International Council for Education Research and Training
ISSN: 2959-1376
2023, Vol. 02, Issue 04, 73-88
DOI: https://doi.org/10.59231/SARI7625

Table 3

ANCOVA Summary Table on Achievement Scores of Students Taught Chemistry Using Science Writing Heuristics, Peer Review and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8385.564[a]	3	2795.188	16.457	.000
Intercept	111645.199	1	111645.199	657.330	.000
Pretest	17.937	1	17.937	.106	.745
Methods	8385.525	2	4192.762	24.686	.000
Error	55030.241	324	169.846		
Total	1130000.000	328			
Corrected Total	63415.805	327			

a. R Squared = .132 (Adjusted R Squared = .124)

Students taught chemistry using science writing heuristics, peer review and lecture methods showed substantially different mean achievement scores in table 3, with F (2,324) = 24.686, P (0.000) < 0.05 being the significance level. Table 4 shows the direction of the difference.

Table 4

Scheffe's Post-hoc Test Summary on Achievement

(I) Teaching methods	(J) Teaching methods	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Science writing	Peer Review	1.724	1.850	.352	-1.915	5.363
	Lecture	11.077*	1.705	.000	7.723	14.431
Peer Review	Science Writing	-1.724	1.850	.352	-5.363	1.915
	Lecture	9.353*	1.782	.000	5.848	12.858

@2023 International Council for Education Research and Training
ISSN: 2959-1376
2023, Vol. 02, Issue 04, 73-88
DOI: https://doi.org/10.59231/SARI7625

Lecture	Science Writing	-11.077*	1.705	.000	-14.431	-7.723
	Peer Review	-9.353*	1.782	.000	-12.858	-5.848

Table 4 shows no substantial difference between the mean achievement scores of students taught chemistry using peer review and science writing heuristics; a substantial difference between the mean achievement scores of students taught chemistry using science writing heuristics and lecture method, favoring science writing heuristics; and a substantial difference between the mean achievement scores of students who were taught chemistry using peer review and lecture, favor peer review. Table 4 shows that peer review and science writing heuristics are more successful than lectures at enhancing students' chemistry achievement.

Discussion

The results of the study revealed a substantial difference in the mean misconception scores among students taught chemistry using the lecture method, peer review and science writing heuristics. The post-hoc test showed that peer review and science writing heuristics are more successful than lectures at reducing students' misconception of chemistry. As shown in table 2, the post-hoc test revealed that students taught chemistry using peer review and science writing heuristics scored higher than those who were taught chemistry using lecture. This observation may be related to the degree of engagement and interaction that students had with the course resources made available by the science writing heuristics, peer review and lecture. Compared to students who learned chemistry through lectures, students who learned the subject utilizing peer review and science writing heuristics may have been more engaged in the learning process. Science writing heuristics and peer review strategies ensured that students' misconceptions are identified and remedied during instruction thereby enhancing students understanding of basic chemistry concepts. This is not true of the lecture method, in which students are given information on chemistry concepts without consideration for their misconceptions. This may be the cause of why students who

@2023 International Council for Education Research and Training 2023, Vol. 02, Issue 04, 73-88
ISSN: 2959-1376 DOI: https://doi.org/10.59231/SARI7625

studied chemistry through peer review and science writing heuristics scored substantially higher on misconceptions than those who learned it through lectures. This finding agrees with that of Lai Yee and Karpudewan (2022) and Yucel, Bird, Young and Blanksby (2014). Lai Yee and Karpudewan (2022), reported statistically substantial difference between the posttest scores of the science writing heuristics group and the lecture group in favor of the science writing heuristics. As they offered complete justifications for how energy transfer occurs, the students in the science writing heuristics group gained a thorough comprehension of the subject. Students were able to write strong arguments using the science writing heuristics method. According to the study, using science writing heuristics to teach and acquire abstract topics like energy transfer in ecosystems, which essentially call on students to make connections between and relate discrete ideas in order to develop comprehensive viewpoints, is a viable strategy. Yucel, Bird, Young and Blanksby (2014) reported that peer review strategy discussions allowed the assessors to offer more emotive and metacognitive comments while also allowing the assessed to explain misunderstandings and consider their writing process.

Another finding from the study's findings showed that there is a substantial difference in the mean achievement scores among students taught chemistry using peer-review, science writing heuristics and lecture, favoring students taught using science writing heuristics, followed by students taught using peer review and lecture method, respectively. The post-hoc test found that peer review and science writing heuristics are more effective than the lecture technique at raising students' achievement in chemistry. Students who learned chemistry through peer review and science writing heuristics scored more highly on achievement posttests than students who learned chemistry through lectures. This observation might be the outcome of the students' participation in class. Students who learned chemistry through the use of peer review and science writing heuristics may have been more engaged in the subject than those who learned the subject through lectures. Peer review and science writing heuristics ensured that students engaged in active learning and engaged with the

@2023 International Council for Education Research and Training 2023, Vol. 02, Issue 04, 73-88
ISSN: 2959-1376 DOI: https://doi.org/10.59231/SARI7625

learning contents. This is not true of the lecture method, in which students are made passive throughout instruction by the final transmission of chemistry concepts. This could be the reason why students who learned chemistry through peer review and science writing heuristics scored significantly more on achievement tests than those who learned it through lectures. This finding corroborates that of Kingir, Geban and Gunel (2012) and Alade and Olagunju (2014). Kingir, Geban, and Gunel (2012) found that science writing heuristic promotes conceptual understanding more effectively than the conventional lecture. Similarly, Alade and Olagunju (2014) reported a substantial difference in the mean achievement scores of students taught using a peer-assessment technique and those taught using a lecture method, favoring the peer-assessment strategy.

Conclusion

Based on the study's findings, it was concluded that science writing heuristics and peer review strategies are more effective instructional strategies for remediating students' misconceptions and achievement in chemistry. The study concludes that both science writing heuristics and peer review strategies have the capacity to correct students' misconception in chemistry. The study also concluded that science writing heuristics and peer review strategies facilitate students' active role in the learning process in a way that results in improved achievement.

Recommendations

The study recommended:

1. Chemistry teachers using peer review and science writing heuristics to teach chemistry at the secondary school level.
2. To help students understand chemistry, teachers should make an effort to pay close attention to the misconceptions of their students while teaching the subject.

References

1. Alade, O. M., & Olagunju, A. M. (2014). The effect of peer-assessment strategy on students' achievement in senior secondary school economics. *International Journal of Education and Research,* 2(11), 95-104.
2. Anyafulude, J. (2014). Effect of problem-based learning strategy on students' achievement in senior

@2023 International Council for Education Research and Training
ISSN: 2959-1376
2023, Vol. 02, Issue 04, 73-88
DOI: https://doi.org/10.59231/SARI7625

secondary schools' chemistry in Enugu State. *IOSR Journal of Research and Method in Education (IOSR-JRME)*, 4(3), 27-31.

3. Cavagnetto A., Hand, B., & Norton-Meier, L. (2010). The nature of elementary student science discourse in the context of the science writing heuristic approach, *Int. J. Sci. Educ.*, 32(4), 427–449.

4. Emerhiona, F., Naiho, O. I., & Chukwunalu, L. E. (2022). Effects of conceptual change texts and concept mapping in remediating students' attitude towards chemistry in Delta State. *International Journal of Academic Pedagogical Research (IJAPR)*, 6(8), 12-17.

5. Emerhiona, F., Ijeh, S. B., & Ajaja, O. P. (2022). Effects of conceptual change texts and concept mapping on students' achievement in chemistry. *ABSU Journal of Educational Studies*, 9(3), 181-190.

6. Kingir, S., Geban, O., & Gunel, M. (2012). How does the science writing heuristic approach affect students' performance of different academic levels? A case for school chemistry. *Chem. Educ. Res. Pract.*, 13, 428-436.

7. Lai Yee, Y., & Karpudewan, K. (2022). Science writing heuristics improve pre-university students' understanding of energy transfer in an ecosystem and argumentation ability. *Journal of Turkish Science Education*, 19(1), 82-96.

8. Mondal, B. C. (2013). *Misconceptions in chemistry: Its identification and remedial measures.* Germany: LAP Lambert Academic Publishing. Retrieved 3rd March, 2023 from https://www.academia.edu/4075698/Misconceptions_in_Chemistry_Its_identificationa_and_remedial_measures.

9. Nam J., Choi, A., & Hand, B. (2010). Implementation of the

@2023 International Council for Education Research and Training
ISSN: 2959-1376
2023, Vol. 02, Issue 04, 73-88
DOI: https://doi.org/10.59231/SARI7625

science writing heuristic (SWH) approach in 8th grade science classrooms, *Int. J. Sci. Math. Educ.*, 9(5), 1111–1133.

10. Nicol, D. J., & Macfarlane-Dick, D. (2016). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education*, 31(2), 199-218.

11. Nwanze, A. C., & Okoli, J. N. (2021). Path analysis of factors affecting academic achievement of tertiary education students in chemistry in Delta State. *African Journal of Science, Technology & Mathematics Education*, 6(1), 75-88.

12. Odom, S., Glenn, B., Sanner, S., & Cannella, K. A. S. (2019). Group peer review as an activie learning strategy in a research course. *International Journal of Teaching and Learning in Higher Education*, 21(1), 108-117.

13. Posner, G. J., Strike, K. A., Hewson, P.W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, 66, 211-227.

14. Prins, F. J., Sluijsmans, D., Kirschner, P., & Strijbos, J. (2015). Formative peer assessment in a CSCL environment: A case study. *Assessment & Evaluation in Higher Education*, 40(4), 417-444.

15. Sheoran, S. M., & Sethi, S. S. (2016). *A study of academic achievement in mathematics of 7th class students of Sirsa District.* International Conference on Reecent Innovations in Sciences, Management, Education and Technology, Haryana, India.

16. Yucel, R., Bird, F., Young, J., & Blanksby, T. (2014). The road to self-assessment: Exemplar marking before peer review develops first-year students' capacity to judge the quality of a scientific report.

@2023 International Council for Education Research and Training 2023, Vol. 02, Issue 04, 73-88
ISSN: 2959-1376 DOI: https://doi.org/10.59231/SARI7625

Assessment & Evaluation in Higher Education, 39(8), 971-986.

Appendix VI

Students' Performance in WASSCE Chemistry (2015-2019)

Year	Population of Students	Paper 2 (practical)		Paper 3 (Essay)	
		Raw Mean Score	SD	Raw Mean Score	SD
2015	691, 407	27.00	8.83	36.00	15.62
2016	667, 412	25.00	7.81	43.00	15.36
2017	704, 494	26.00	8.37	47.00	16.00
2018	728, 988	24.00	9.95	29.00	13.78
2019	762,595	40.0	14.46	27.0	9.22

Source: https://www.waeconline.org.ng/e-learning/Chemistry/chemmain.html

Received on March 09, 2023

Accepted on June 21, 2023

Published on Oct 01, 2023