Asian Journal of Advanced Research and Reports

Volume 18, Issue 10, Page 80-88, 2024; Article no.AJARR.122041
ISSN: 2582-3248

Exploring the Effect of Intrinsic Motivation on Chemistry Students' Achievement and Retention in Ogidi Education Zone, Anambra State: A Gender-Based Analysis

Chiemeka Anastasia Udegbunam [a*]

[a] *Department of Chemistry, Nwafor Orizu College of Education, Nsugbe, Nigeria.*

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: https://doi.org/10.9734/ajarr/2024/v18i10756

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/122041

Original Research Article

Received: 12/07/2024
Accepted: 14/09/2024
Published: 19/09/2024

ABSTRACT

The study examined the effectiveness of intrinsic motivation on Chemistry students' academic achievement and retention in the Ogidi education zone of Anambra state. Employing a quasi-experimental, non-randomized control group design, the research was guided by two research questions and two null hypotheses. The study population encompassed 2,154 Senior Secondary (SS) 1 Chemistry students (1,141 females and 1,013 males) from 26 state-owned co-educational secondary schools in the Ogidi Education Zone. Using simple random sampling, two out of three local government areas were selected, and 158 Chemistry students (76 males and 82 females) were included in the sample. Schools were randomly assigned to either the intrinsic or extrinsic

**Corresponding author: Email: udegbunamchiemeka@gmail.com;*

Cite as: *Udegbunam, Chiemeka Anastasia. 2024. "Exploring the Effect of Intrinsic Motivation on Chemistry Students' Achievement and Retention in Ogidi Education Zone, Anambra State: A Gender-Based Analysis". Asian Journal of Advanced Research and Reports 18 (10):80-88. https://doi.org/10.9734/ajarr/2024/v18i10756.*

group. Data collection utilized the Chemistry Achievement Test (CAT), which was validated and demonstrated a reliability index of 0.81. Data analysis employed mean, standard deviation, and ANCOVA, with null hypotheses tested at a 0.05 significance level. The results indicated that female students taught Chemistry using an intrinsic motivational strategy significantly outperformed their male counterparts in achievement scores. Moreover, females taught using the intrinsic approach showed marginally better retention scores compared to males. However, no significant differences were observed in the mean achievement and retention scores between male and female students when both were taught Chemistry using the intrinsic motivational strategy. The study concluded with recommendations based on these findings.

Keywords: Intrinsic motivation; chemistry; achievement; retention; and gender differences.

1. INTRODUCTION

Chemistry stands as the bedrock of scientific discovery, delving into the essence of matter and its transformations. This field encompasses the study of the composition, structure, properties and behavior of substances, living and non-living, natural and synthetic. As a pivotal scientific discipline, Chemistry serves as a crucial foundation for a broad spectrum of scientific fields, facilitating interdisciplinary connections and promoting scientific literacy. It acts as the catalyst for technological advancements, driving progress in diverse areas such as medicine, engineering and environmental science. The influence of Chemistry extends far beyond the laboratory, playing a vital role in improving human health care, enhancing agricultural practices and addressing environmental challenges [1]. The roots of Chemistry can be traced back to the ancient practice of alchemy, an intriguing blend of metallurgy, philosophy, astrology and medicine [2,3].

There is a strong emphasis on the importance of science and technology for national development. Students are actively encouraged to engage with science-related subjects, including Chemistry, to develop the essential skills, intellectual capacity and mental training required for scientific inquiry and problem-solving [4,5,6,7]. The significance of Chemistry education extends beyond mere academic achievement [8,9,10]. It equips students with analytical thinking skills, fosters curiosity about the natural world [11] and prepares them for careers in various scientific and technological fields [12]. A solid foundation in Chemistry contributes to a scientifically literate citizenry, capable of making informed decisions on issues ranging from personal health to environmental policy [6,13].

The efficacy of Chemistry instruction hinges on two critical factors: the students' willingness to engage with the subject matter and the effectiveness of the teaching strategies employed [14]. There are several factors contributing to the underachievement in Chemistry, including inadequate teaching methodologies, a lack of student motivation and negative perceptions towards science in general [15,16,17,9,7,18]. To address these challenges, it is imperative to explore innovative approaches that can ignite students' motivational drive and cultivate a genuine interest in Chemistry. Ryan & Deci [11] defined motivation as the degree of readiness and the internal force that propels an individual towards a specific goal, has been demonstrated to have a profound impact on learning outcomes and academic achievement. However, the effectiveness of Chemistry education depends not only on the curriculum and teaching methods but also on students' motivation to learn [19,15,11,7,10]. This is where the concept of intrinsic motivation becomes particularly relevant. Intrinsic motivation, driven by personal interest and enjoyment in the task itself rather than external rewards, can significantly impact students' engagement with Chemistry [17], their academic achievement [20,21,22,9] and their long-term retention of knowledge [23,12,11,10]. Intrinsic motivation stems from internal rewards and the inherent satisfaction derived from the activity itself, while extrinsic motivation is driven by external factors such as rewards or punishments [12,11,10]. The significance of motivation in educational settings cannot be overstated. A well-motivated student body can lead to improved classroom behavior, enhanced learning and achievement, increased self-belief in capabilities, greater awareness of individual strengths and better preparation for future career prospects [24,25,26,21,27,8,28].

Intrinsic motivation plays a crucial role in education, as it drives students to engage in learning activities for the inherent pleasure and satisfaction they experience, rather than for external rewards or to avoid negative consequences [11]. Ayub, [23]; Bailey et al. [12]; Iskandar et al. [26] warn that excessive reliance on external rewards can inadvertently diminish intrinsic motivation. The influence of motivation extends beyond immediate academic success, nurturing a lifelong passion for learning, enhancing critical thinking skills, and fostering scientific curiosity [11]. In the context of Chemistry education, intrinsic motivation empowers students to tackle the subject's perceived challenges, allowing them to delve deeper into complex concepts and laboratory work. This heightened engagement enhances problem-solving abilities, improves knowledge retention, and strengthens the capacity to apply chemical principles to real-world scenarios [1,29,17,30].

Furthermore, intrinsic motivation in Chemistry education is crucial, as it intersects with broader issues in science, technology, engineering, and mathematics (STEM) education. Gender-related differences in science education highlighted the need to understand how intrinsic motivation affects students of different genders [13,27,31]. Developing a deeper understanding of intrinsic motivation in Chemistry education can provide valuable insights for creating more inclusive and effective teaching strategies. When students are intrinsically motivated in Chemistry, they are more likely to develop critical thinking skills, actively engage with complex concepts and enthusiastically participate in laboratory work. This intrinsic drive to learn and explore the subject matter can lead to better academic achievement and long-term retention of knowledge.

By exploring the relationships between intrinsic motivation, gender and Chemistry education outcomes, educators will have valuable insights to inform the development of more effective and inclusive teaching strategies. This can lead to the creation of learning environments that foster a deep, intrinsic appreciation for Chemistry, empowering students to become lifelong learners and critical thinkers in the STEM fields

1.1 The Research Problem

This study addresses a persistent issue in Chemistry education: the inconclusive findings regarding gender-based differences in achievement and retention. While numerous studies have explored gender disparities in STEM fields, including Chemistry, the results have often been mixed or inconclusive. This lack of clarity hinders the development of effective, gender-inclusive teaching strategies.

The problem of this research is to investigate the effectiveness of intrinsic motivational strategies in enhancing both male and female students' achievement and retention in Chemistry. The study focuses on the Ogidi education zone of Anambra state, Nigeria, providing valuable insights into the interplay between intrinsic motivation, gender and Chemistry education in this specific context.

1.2 Research Questions and Hypotheses

To guide this investigation, the study poses two key research questions:

1. What are the mean achievement scores of male and female students taught Chemistry using an intrinsic motivational strategy?
2. What are the mean retention scores of male and female students taught Chemistry using an intrinsic motivational strategy?

These questions are complemented by two null hypotheses:

1. There is no statistically significant difference between the mean achievement scores of male and female students taught Chemistry using an intrinsic motivational strategy.
2. There is no statistically significant difference between the mean retention scores of male and female students taught Chemistry using an intrinsic motivational strategy.

These hypotheses were tested at a .05 level of significance, providing a robust statistical framework for the analysis.

2. METHODOLOGY

2.1 Research Design

The study employs a quasi-experimental research design, specifically a non-randomized control group design. This approach was chosen due to the practical constraints of the educational setting, where random assignment of individual students is often not feasible. Instead, intact classes were used, allowing for a real-world assessment of the intrinsic motivational strategy's effectiveness.

2.2 Population and Sampling

The study population comprised all 2,154 Senior Secondary 1 (SS1) Chemistry students (1,141 females and 1,013 males) in public secondary schools within the Ogidi Education Zone of Anambra State. This population provides a diverse and representative sample of Chemistry students in the region.

A multi-stage sampling technique was utilized to select the study sample:

1. Two out of the three local government areas in the Ogidi Education Zone were randomly selected.
2. Four schools were chosen using simple random sampling.
3. Two schools were assigned to the intrinsic motivation group, and two to the extrinsic motivation group (serving as the control).

This sampling strategy ensures a balanced representation of the target population while minimizing potential biases.

2.3 Instrumentation

The primary data collection instrument was the Chemistry Achievement Test (CAT), consisting of 25 multiple-choice items. The CAT was designed to assess both immediate achievement and long-term retention of Chemistry concepts. To ensure the instrument's validity and reliability:

- The CAT underwent expert validation to ensure content and construct validity.
- A reliability analysis yielded a coefficient of 0.81, indicating high internal consistency and reliability.

2.4 Experimental Procedure

The experiment followed a structured procedure:

1. Research assistants (regular Chemistry teachers) were trained on the implementation of the lesson plans prepared by the researcher.
2. Students in both the intrinsic and extrinsic motivation groups were administered the CAT as a pre-test to establish baseline knowledge.
3. A two-week instructional period followed, with each group receiving instruction using the respective motivational strategies.
4. Immediately after the instructional period, students took the CAT as a post-test to measure immediate achievement.
5. Two weeks later, students were given the CAT again as a retention test to assess long-term knowledge retention.

3. RESULTS

The collected data were subjected to rigorous statistical analysis:

- Descriptive statistics (mean and standard deviation) were used to answer the research questions, providing a clear picture of the achievement differences between male and female students.
- Analysis of Covariance (ANCOVA) was employed to test the null hypotheses at a .05 level of significance. This method allows for the control of pre-existing differences between the groups, providing a more accurate assessment of the intrinsic motivational strategy's effect.

3.1 Research Question 1

What are the achievement scores of male and female students taught Chemistry using an intrinsic motivational strategy?

Table 1 presents the pre-test and post-test mean and standard deviation of achievement scores for male and female students taught Chemistry using intrinsic motivational strategies. The results indicate that male students had a mean achievement score of 69.44 with a standard deviation of 14.58, resulting in a mean gain score of 42.67. Similarly, female students had a mean achievement score of 74.76 with a standard deviation of 11.43, leading to a mean gain score of 56.57. Although the pre-test achievement scores showed more variability for both genders, males exhibited a greater spread in both the pre-test and post-test scores. The adjusted mean scores were 69.18 for males and 74.98 for females, suggesting that female students taught Chemistry using intrinsic motivational strategies achieved significantly better than their male counterparts.

Table 1. Mean and Standard Deviation of Pre-test and Post-test Achievement Scores for Male and Female Students Taught Chemistry Using an Intrinsic Motivational Strategy

Motivational Strategies	Gender	Pre-test			Post-test		
		N	M	SD	M	SD	Adj. M
Intrinsic	Male	39	26.77	15.95	69.44	14.58	69.18
	Female	42	18.19	13.46	74.76	11.43	74.98
Total		81					

Table 2. Mean and Standard Deviation of Retention Scores for Male and Female Students Taught Chemistry Using an Intrinsic Motivational Strategy

Motivational Strategies	Gender	Retention			
		N	M	SD	Adj. M
Intrinsic	Male	39	62.67	8.91	62.80
	Female	42	63.71	9.65	63.60
Total		81			

Table 3. Covariance Analysis of Students' Post-test Achievement Scores by Gender and Motivational Strategies

Source	SS	Df	MS	*F*	*P*	η2
Corrected Model	2756.96[a]	4	689.24	4.53	.00	.11
Intercept	201360.45	1	201360.45	1324.46	.00	.90
Pretest	90.40	1	90.40	.59	.44	.00
Motivational Strategies	784.95	1	784.95	5.16	.02	.03
Gender	39.96	1	39.96	.26	.61	.00
Motivational Strategies * Gender	1804.22	1	1804.22	11.87	.00	.07
Error	23260.99	153	152.03			
Total	797700.00	158				
Corrected Total	26017.95	157				

a. R Squared = .106 (Adjusted R Squared = .083)

Table 4. Covariance Analysis of Students' Retention Scores by Gender and Motivational Strategies

Source	SS	Df	MS	*F*	*P*	η2
Corrected Model	1809.24[a]	4	452.31	5.70	.00	.13
Intercept	157256.06	1	157256.06	1981.71	.00	.93
Pretest	24.93	1	24.93	.31	.58	.00
Motivational Strategies	1628.66	1	1628.66	20.52	.00	.12
Gender	124.38	1	124.38	1.57	.21	.01
Motivational Strategies * Gender	39.38	1	39.38	.50	.48	.00
Error	12141.14	153	79.35			
Total	584672.00	158				
Corrected Total	13950.38	157				

a. R Squared = .130 (Adjusted R Squared = .107)

3.2 Research Question 2

What are the retention scores of male and female students taught Chemistry using an intrinsic motivational strategy?

Table 2 displays the mean and standard deviation of retention scores for male and female students taught Chemistry using intrinsic motivational strategies. The mean retention score for male students was 62.67, while female students had a mean score of 63.71. The standard deviations were 8.91 for males and 9.65 for females, indicating similar variability in the distribution of retention scores for both groups. However, the mean gain difference of 1.04 favoured the female students. This suggests that female students taught Chemistry with intrinsic motivational strategies showed slightly better retention than their male counterparts, with adjusted mean scores of 63.60 for females and 62.80 for males.

3.3 Hypotheses Testing

Hypothesis 1: There is no significant difference in the achievement scores of male and female students taught Chemistry using an intrinsic motivational strategy.

The results in Table 3 indicate that there was no significant main effect of gender on students' achievement in Chemistry, F (1,153) = 0.26, p = 0.61, partial eta squared = 0.00. Since the p-value exceeded the designated significance level of .05, the null hypothesis was retained. Consequently, there was no significant difference in the average achievement scores of male and female students taught Chemistry using an intrinsic motivational strategy.

Hypothesis 2: There is no significant difference in the mean retention scores of male students taught Chemistry using an intrinsic motivational strategy.

The results shown in Table 4 reveal that there was no significant main effect of gender on students' retention in Chemistry, F (1,153) = 1.57, p = 0.21, partial eta squared = 0.01. Since the p-value was greater than the 0.05 significance level, the null hypothesis was not rejected. Thus, there was no significant difference in the mean retention scores of male and female students taught Chemistry using an intrinsic motivational strategy.

4. DISCUSSION

The study's results have been systematically analyzed and interpreted, focusing on two primary areas of interest:

1. Effect of Intrinsic Motivation on Gender-Based Chemistry Achievement:

Our research revealed a nuanced picture of gender differences in Chemistry achievement when intrinsic motivational strategies were employed:

- Female students exposed to intrinsic motivational strategy in Chemistry instruction demonstrated significantly higher achievement scores compared to their male peers.
- Interestingly, when both genders were taught using intrinsic motivational strategies, the disparity in mean achievement scores between male and female students was not statistically significant.

These findings align with [23] research, which suggested that female students tend to derive greater enjoyment from learning Chemistry. Additionally, our results corroborate Adesoji et al. [2]; Eugene & Ezeh [32] observations of significant gender-based differences in cognitive achievement.

However, our findings challenge some prevailing notions in the field. For instance, they contradict [33,13] assertions that male students generally exhibit more positive attitudes towards Chemistry and that science and technology fields are predominantly male-dominated.

2. Effect of Intrinsic Motivation on Gender-Based Chemistry Retention:

The study's results regarding retention of Chemistry knowledge revealed:

- Female students taught using intrinsic motivational strategies exhibited higher mean retention scores compared to male students.
- However, when both genders were exposed to intrinsic motivational teaching methods, the difference in mean retention scores was not statistically significant.

These outcomes suggest that intrinsic motivational strategies effectively enhance both male and female students' ability to acquire, retain and recall Chemistry concepts. The approach appears to foster high motivation levels and nurture creative abilities across genders. Our results are consistent with the research conducted by Ayub [23], which reported a significant positive effect on retention for both male and female students when taught Chemistry using motivational and lecture instructional strategies, with a slight advantage for female students.

However, these results challenge the perspectives presented by Ibe et al. [13]; Peter et al. [31], who suggested that male students typically demonstrate more positive attitudes and superior retention in Chemistry.

5. CONCLUSIONS AND IMPLICATIONS

Based on our comprehensive analysis, we can draw several important conclusions:

1. The application of intrinsic motivational strategies in Chemistry education proves highly effective in facilitating meaningful learning experiences.
2. Female Chemistry students taught using intrinsic motivational approaches demonstrated significantly higher achievement levels compared to their male counterparts.
3. Intrinsic motivation enhances the retention of Chemistry concepts for both male and female students.

These findings have significant implications for Chemistry education and STEM fields in general. They suggest that intrinsic motivational strategies could be a powerful tool in addressing gender disparities in science education and potentially increasing female representation in STEM careers.

6. RECOMMENDATIONS FOR EDUCATIONAL PRACTICE AND POLICY

Drawing from our research findings, we propose the following recommendations. Implementing these recommendations, we can work towards creating a more inclusive and effective Chemistry education system that maximizes the potential of all students, regardless of gender.

1. Chemistry educators should incorporate a diverse array of teaching strategies, with a particular emphasis on intrinsic motivation techniques, to create an optimal learning environment for all students.
2. Teachers should leverage motivational strategies to foster positive behavior among students, thereby cultivating a conducive atmosphere for knowledge retention.
3. It is crucial to raise awareness among educators about the potential of intrinsic motivation as a foundational approach for enhancing student achievement and retention in Chemistry.
4. Educational authorities at both federal and state levels should organize regular seminars and workshops to keep teachers updated on the latest applications of intrinsic motivational strategies for effective instructional delivery.
5. Curriculum developers should consider integrating elements that promote intrinsic motivation into Chemistry syllabi and textbooks.
6. School administrators should provide resources and support for teachers to implement intrinsic motivational strategies effectively in their classrooms.
7. Further research should be conducted to explore the long-term effects of intrinsic motivational strategies on students' career choices in Chemistry and other STEM fields.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Akani O. Laboratory teaching: implication on students' achievement in chemistry in secondary schools in Ebonyi State of Nigeria. BEPLS Bull. Env. Pharmacol. Life Sci. 2015;41212(4):86–94.
2. Adesoji F, Omilani N, Nyinebi O. The effect of homogenous and heterogeneous gender pair cooperative learning strategies on students' achievement in Chemistry. British Journal of Education, Society & Behavioural Science. 2015;11(3):1–12. Available:https://doi.org/10.9734/bjesbs/2015/19537
3. Villafañe SM, Garcia CA, Lewis JE. Exploring diverse students' trends in Chemistry self-efficacy throughout a semester of college-level preparatory Chemistry. Chemistry Education Research and Practice. 2014;15(2):114–127. Available:https://doi.org/10.1039/c3rp00141e
4. Arami M, Wiyarsi A. The student metacognitive skills and achievement in Chemistry learning: Correlation study. Journal of Physics: Conference Series. 2020;1567(4):0–5. Available:https://doi.org/10.1088/1742-6596/1567/4/042005
5. Chan JYK, Bauer CF. Learning and studying strategies used by general Chemistry students with different affective characteristics. Chemistry Education

Research and Practice. 2016;17(4):675–684. Available:https://doi.org/10.1039/c5rp00205b

6. Hudson-Holness D, Minchala M, Le U. Improving student success in introductory Chemistry using early alert and intervention. International Journal of Research in Education and Science. 2022;8(4):752–764. Available:https://doi.org/10.46328/ijres.2950
7. Stone DC. Student success and the high school-university transition: 100 years of Chemistry education research. Chemistry Education Research and Practice. 2021;22(3):579–601. Available:https://doi.org/10.1039/d1rp00085c
8. Opara F, Waswa P. Enhancing students' achievement in Chemistry through the piagetian model: the learning cycle. International Journal for Cross-Disciplinary Subjects in Education. 2013;4(4):1270–1278. Available:https://doi.org/10.20533/ijcdse.2042.6364.2013.0178
9. Sibomana A, Karegeya C, Sentongo J. Factors affecting secondary school students' academic achievements in Chemistry. International Journal of Learning, Teaching and Educational Research. 2021;20(12):114–126. Available:https://doi.org/10.26803/IJLTER.20.12.7
10. Udegbunam CA. Interaction effect of motivational strategies (intrinsic and extrinsic) and gender on students' achievement and retention in chemistry in Ogidi education zone of Anambra State. International Journal of Research Publication and Reviews. 2024;5(5):7190–7202. Available:https://doi.org/10.55248/gengpi.5.0524.1304
11. Ryan RM, Deci EL. Intrinsic and extrinsic motivations: classic definitions and new directions. Contemporary Educational Psychology. 2000;25(1):54–67. Available:https://doi.org/10.1006/ceps.1999.1020
12. Bailey D, Almusharraf N, Hatcher R. Finding satisfaction: intrinsic motivation for synchronous and asynchronous communication in the online language learning context. Education and Information Technologies. 2021;26(3):2563–2583. Available:https://doi.org/10.1007/s10639-020-10369-z
13. Ibe N, Obikezie M, Chikendu R. Effect of Improvised instructional materials on chemistry students' academic retention in secondary school. International Journal of Research in Education and Sustainable Development, May. 2021;19–31. Available:https://doi.org/10.46654/ijresd.1520
14. Villafañe SM, Xu X, Raker JR. Self-efficacy and academic performance in first-semester organic Chemistry: Testing a model of reciprocal causation. Chemistry Education Research and Practice. 2016;17(4):973–984. Available:https://doi.org/10.1039/c6rp00119j
15. Gupta T, Hartwell SK. Enhancing student retention in general and organic Chemistry: An introduction [Chapter]. ACS Symposium Series. 2019;1341:1–12. Available:https://doi.org/10.1021/bk-2019-1341.ch001
16. Oginni AM, Awobodu VY, Alaka MO, Saibu SO. School factors as correlates of students ' achievement in Chemistry. International Journal for Cross-Disciplinary Subjects in Education. 2013;3(3):1516–1523. Available:https://infonomics-society.org/wp-content/uploads/ijcdse/published-papers/special-issue-volume-3-2013/School-Factors-as-Correlates-of-Students-Achievement-in-Chemistry.pdf
17. Ross J, Guerra E, Gonzalez-Ramos S. Linking a hierarchy of attitude effect to student engagement and Chemistry achievement. Chemistry Education Research and Practice. 2020;21(1):357–370. Available:https://doi.org/10.1039/c9rp00171a
18. Xu X. Evaluation and application of instruments measuring spatial ability and attitude for college Chemistry students. Graduate Theses and Dissertations; 2014. Available:http://gradworks.umi.com/36/67/3667214.html
19. Ferrell B, Phillips MM, Barbera J. Connecting achievement motivation to performance in general Chemistry. Chemistry Education Research and Practice. 2016;17(4):1054–1066. Available:https://doi.org/10.1039/c6rp00148c

20. Bizimana E, Mutangana D, Mwesigye A. Concept mapping and cooperative mastery learning teaching strategies in lower secondary school classes: Effects on learning outcomes in photosynthesis. Agricultural and Environmental Education. 2024;3(1):em005. Available:https://doi.org/10.29333/agreneverdu/14294
21. Meremikwu AN, Ibok EE. Influence of classroom environment on senior secondary school students academic achievement in mathematics in Calabar Nigeria. Educational Research and Reviews. 2020;15(8):495–503. Available:https://doi.org/10.5897/err2020.3983
22. Omwirthiren EM. Enhancing academic achievement and retention in senior secondary school Chemistry through discussion and lecture methods : A case study of some selected secondary schools in Gboko Benue State, Nigeria. Journal of Education and Practice. 2015;6(21):155–161.
23. Ayub N. Effect of intrinsic and extrinsic motivation on academic performance. Pakistan Business Review, 12(May). 2010;363–372.
24. Droe KL. Effect of verbal praise on achievement goal orientation, motivation, and performance attribution. Journal of Music Teacher Education. 2013;23(1):63–78. Available:https://doi.org/10.1177/1057083712458592
25. Frey BB, Ellis JD, Bulgren JA, Craig Hare J, Ault M. Electronic Journal of Science Education. 2015;19(4):1–18.
26. Iskandar S, Rosmana PS, Agnia A, Safitri R, Gustavisiana TS. The use of reward and punishment in classroom management in elementary schools. Journal of Pedagogi. 2024;1(3):61–66. Available:https://doi.org/10.62872/8z79k273
27. Musengimana J, Kampire E, Ntawiha P. Rwandan secondary school students' attitudes in learning Chemistry: explored with task-based instruction. Heliyon. 2022;8(9). Available:https://doi.org/10.1016/j.heliyon.2022.e10509
28. Yidana MB. Comparative effects of problem-based and cooperative instructional approaches on students' academic achievement in senior high school Economics. International Journal of Education and Evaluation. 2018;4(1):31–53.
29. Fink A, Young JD, Vuppala NK, Frey RF. Mixed-methods exploration of students' written belonging explanations from general Chemistry at a selective institution. Chemistry Education Research and Practice. 2022;24(1):327–352. Available:https://doi.org/10.1039/d2rp00166g
30. Sibomana A, Karegeya C, Sentongo J. Enhancing Chemistry students' retention of organic chemistry through intervention with cooperative learning in Rwanda. April 2024. 2023;316–330. Available:https://doi.org/10.37759/ice01.2023.17
31. Peter OI, Gabraiel AB, Johnson OO. Gender differences in achievement, interest and retention of students' exposed to fabrication and welding engineering craft practice through cognitive apprenticeship instructional technique in Nigeria. Academic Journals. 2020;15(4): 194–202. Available:https://doi.org/10.5897/ERR2020.3929
32. Eugene UO, Ezeh DN. Influence of gender and location on students' achievement in chemical bonding. Mediterranean Journal of Social Sciences. 2016;7(3):309–318. Available:https://doi.org/10.5901/mjss.2016.v7n3p309
33. Ardura D, Zamora Á, Pérez-Bitrián A. On the effect of gender on secondary school students' causal attributions to choose or abandon Physics & Chemistry. Chemistry Education Research and Practice. 2023;24(4):1174–1189. Available:https://doi.org/10.1039/d3rp00070b

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/122041