



Success of Cooperative Education in Academic Achievement among First-Grade Female Students in Sudan

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ABSTRACT

Purpose: Cooperative education is recognized as a pedagogical approach that fosters positive learning experiences by engaging small groups of students collaboratively in tasks, facilitating interaction, information exchange, and mastery of the subject matter. This study investigates the impact of cooperative education on academic achievement in the chemistry course for first-year female secondary school students in Sudan. **Method:** The hypotheses were tested with data from 60 female students, divided into control and experimental groups. Pre and post-tests were administered using a descriptive approach. **Findings:** The findings indicate that students exposed to cooperative education achieved higher grades, enhancing their overall learning and teaching experiences.

Implications for Research and Practice: The study recommends the incorporation of innovative teaching methods, particularly cooperative education, to cultivate creativity and enhance understanding, absorption, and enthusiasm for scientific content among female students.

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Introduction

Designing curriculum, employing modern teaching methods, integrating technology, preparing teachers, and fostering an educational environment collectively balance knowledge acquisition and enhance teachers' innovation, impacting students' academic achievements (Peng & Kievit, 2020). Academic attainment holds significant importance for both individuals and institutions (Akpur, 2020). Individual academic achievement serves as a vital indicator of knowledge, skills, and personal development. Additionally, it plays a crucial role for educational institutions, reflecting their effectiveness and success. High academic achievement is associated with quality teaching, curriculum design, and support systems, attracting top-tier students and resources, elevating the institution's reputation. Various factors impact academic achievement, as argued by several authors (Akpur, 2020; Madigan & Curran, 2021; Wu et al., 2021).

Critical elements influencing academic achievement encompass the significance of teaching methodologies and learning strategies (Evans, 2020; Yildirim, Cirak-Kurt, & Sedat, 2019). Cooperative education integrates learning with practical work, promoting active engagement and collaboration among female students as a modern educational trend (Zhu et al., 2020). Nevertheless, the conventional approach is grounded in instructing students on academic content, emphasizing their capacity for information retrieval and memorization (Bores-Garcia et al., 2021; Loh & Ang, 2020). Within the Islamic faith, communal collaboration is apparent in both acts of worship and transactions, as emphasized by the Almighty's injunction: "And cooperate in righteousness and piety, but do not cooperate in sin and aggression." (Surat Al-Ma'idah, verse 2).

Educational thinkers globally stress the significance of cooperative education for teachers. It is a strategy designed to enhance educational practices, improve teachers' professional and leadership skills, and reinforce their belief in the value of cooperative education as a developmental approach (Hamadi et al., 2022; Zhu et al., 2020). Classroom management and cooperative education, contrary to popular belief, are not novel concepts; rather, they have historical roots. Throughout antiquity, individuals collaborated and coordinated efforts to accomplish various tasks, fulfilling common goals and meeting collective needs (Abd Algani & Abu Alhajja, 2021; Korkmaz & Öztürk, 2020). Enhancing the educational process through curriculum and instructional method refinement contributes to improved student learning, enabling them to adeptly address encountered challenges (Al-Khateeb, 2018; Fernandez-Perez & Martin-Rojas, 2022; Jacobs & Ivone, 2020). A prior study defines cooperative education as a teaching model. It involves students participating and learning in small groups through dialogue and interaction. They engage in social learning experiences, perform educational tasks, and acquire knowledge, skills, and attitudes under the teacher's guidance, leading to the achievement of goals.

Given the importance of cooperative education, three essential aspects must be considered within its context. Educational foundations emerge as a crucial element that influences the recurrent utilization of group methods (Zhu et al., 2020). It facilitates the convergence of individual learner development and collective advancement, thereby contributing to integrated education (Lyu, Shen, & Zhang, 2022; Schina, Esteve-González, & Usart, 2021). Among the three aspects, the first is the social foundation, deemed crucial for success. Group participation nurtures social skills and cooperative problem-solving. Group discussions not only facilitate idea exchange but also offer learning opportunities

from diverse perspectives (Millis, 2023). Furthermore, the second aspect underscores the role of group dynamics in revealing students' individual interests and strengths within collaborative endeavours. These shared experiences foster an appreciation for teamwork and interaction, ultimately augmenting their capacity for effective cooperation within peer groups (Wyman & Watson, 2020). Lastly, the third aspect pertains to psychological foundations that fulfil the mental needs of students, promoting positive interaction and elevating their activity levels (Kozanitis & Nenciovici, 2023).

According to a prior study three aspects characterize cooperative education. It emphasizes the significance of a shared objective for the group, ensuring task distribution fosters individual accountability while relying on collaborative efforts for common goals. Cooperative learning, unlike competitive approaches fostering rivalry between individuals, promotes healthy competition among groups (Faron, 2023). This method cultivates crucial skills in students—self-confidence, leadership, communication, teamwork, and a predisposition for collaboration. Moreover, it promotes critical thinking and self-assessment, allowing learners to constructively evaluate their performance. Previous literature highlights cooperative education's positive influence on student motivation and knowledge retention. In group activities requiring planning and collaboration, students gain subject knowledge and essential cooperative skills. Notably, cooperative education distinguishes itself by employing diverse strategies, setting it apart from other teaching methodologies (Abd Al Mudhafar, 2022).

Numerous studies have explored cooperative education and its implications for academic achievements. However, these investigations have primarily concentrated on the sustainability of memory, analytical thinking, and skill development, often within the context of various countries (Abd Algani & Abu Alhaja, 2021; Keramati & Gillies, 2022; Korkmaz & Öztürk, 2020; Van Ryzin, Roseth, & McClure, 2020). Despite limited attention in studies, it is noteworthy that Sudan's education system plays a significant role in both social and economic development (King, 2021). Several studies have contended that the education system in Sudan does not adequately support student achievements, leading to a decline in the overall effectiveness of the education system (Mergany, Dafalla, & Awooda, 2021; Mohammed, Elfaki, & Othman, 2023). The identified gaps and issues underscore the focus of this study on cooperative education and academic achievements within the educational context. The study aims to assess the success of cooperative education in enhancing academic achievement among first-grade female students in Sudan, building on existing research. The research addresses the following questions:

1. Is there a difference in achievement scores between female students in the pre-test for the chemical equations unit? The study also aims to empirically examine the variation in academic scores between students exposed to cooperative education and those utilizing conventional approaches.

The study on cooperative education success among first-grade female students in Sudan has significant implications. It provides empirical findings through an experimental research design, contributing to existing literature. Understanding the effectiveness of cooperative learning strategies can promote gender equality, empowering female students academically. Insights from the study may inform educational policies, leading to tailored interventions for marginalized groups. Ultimately, the findings contribute to the broader goal of promoting inclusive and equitable education systems, benefiting individual

empowerment and societal progress. The study is structured into four chapters: literature review, research methodology, data analysis and discussion, and implications and future directions.

Literature Review

Cooperative Education

Cooperative education involves integrating work experiences into university studies, allowing undergraduate students to engage in discipline-related work terms. This approach enables students to enhance their understanding beyond traditional classroom learning, integrating experiences for knowledge and skill development, as well as fostering mutual connections (Colomer et al., 2020; Nevison & Pretti, 2016).

Cooperative learning, rooted in the social interdependence theory, is a structured interactive learning approach. It emphasizes key variables such as interdependence, self-accountability, and active student participation (Emerson, McGoldrick, & Wagner, 2023; Zhao & Chan, 2014). Furthermore, Senyefia et al. (2021) argued in their study that cooperative education strategies yield higher student scores compared to traditional approaches. This method facilitates the development of critical thinking, analytical thinking, accountability, and improved communication skills among students. Ultimately, these acquired skills contribute to effective learning and higher academic grades. Cooperative education differs significantly from the conventional education system, as illustrated in the Table 1.

Table 1

Cooperative Education and Traditional Education

No	Traditional Learning	Cooperative Learning
1	He is not interested in positive interaction, as the focus is on individual performance only	It is based on positive interaction between members, members bear responsibility for their learning, and the focus is on joint performance
2	Homogenous groups are formed	Heterogeneous grouping is carried out
3	There is no potential responsibility for the individuals	Students are assigned with the potential responsibilities to accomplish
4	Tasks are discussed without members committing to learning from each other	Members increase each other's chance of success and help each other
5	Team working and dynamics are symbolized by designating a single group leader.	Groups are also created by the joint processes are promoted.
6	Group working is not attractive for the teachers	Teachers interestingly observe the group working

Cooperative Education and Academic Achievement

Cooperative education is associated with students' academic success, supported by empirical evidence in previous studies. Al-Rubaie (2022) investigated the impact of

cooperative learning on scientific achievement, comparing 30 students each from cooperative and conventional education. The results indicated that female students in cooperative education reported higher academic achievement than their counterparts in traditional education. To prepare for an uncertain future, higher education in mathematics and science must prioritize cultivating a knowledgeable and skilled workforce. Cooperative learning, recognized for enhancing academic achievement and fostering generic skills, can play a pivotal role in achieving this objective (Dyson, Howley, & Shen, 2021; Møgelvang & Nyléhn, 2023). Previous scholarly investigations have highlighted the advantageous effects of cooperative learning (CL) on academic achievement and the learning environment. However, the precise mechanisms through which these effects transpire remain insufficiently elucidated in existing research (Keramati & Gillies, 2023; Koroj, 2023; Muñoz-Martínez, Monge-López, & Torrego Seijo, 2020).

Furthermore, Rathod (2023) argued that cooperative learning yields varied learning outcomes and opportunities for students. This educational approach fosters critical thinking essential for the 21st-century workplace, contributing to enhanced learning and student retention. Similarly, Kaur and Singh (2023) asserted that cooperative learning is an effective strategy for improving English subject proficiency, proving notably superior to traditional learning methods.

Moreover, additional empirical studies have established a connection between cooperative education and academic achievement. For instance, research by Kanber, Al-Taai, and Al-Dulaimi (2023) and León et al. (2023) revealed that cooperative experience significantly contributed to students achieving higher GPAs compared to their non-participating peers. Likewise, a longitudinal study conducted by Anijah (2023) observed a positive correlation between co-op program involvement and improved academic performance over time. Furthermore, prior literature asserted that cooperative participation has a positive and significant effect on enhancing academic success. These findings suggest that cooperative education serves as a crucial factor in improving students' academic achievement. Additionally, Wyman and Watson's (2020) study demonstrated that cooperative learning strategies, commonly integrated into co-op programs, positively influence academic achievement across various subjects and grade levels, highlighting the importance of collaborative learning experiences in fostering academic success. Another study by Keramati and Gillies (2023) found a positive and significant relationship between cooperative learning and academic achievement. They argued that an increase in the level of cooperation correlates with an improvement in students' academic achievements, potentially enhancing their career opportunities.

Upon reviewing prior studies, this study aligns in methodology, employing an experimental approach focused on female students across educational levels. Consistency is observed in the statistical methods used. Findings consistently affirm the effectiveness of cooperative learning, particularly in teaching the chemical equations unit in first-year secondary school chemistry in Sudan. The significance of this study lies in presenting an alternative teaching method, cooperative education, aiming to improve traditional chemistry teaching. It investigates the impact of cooperative education on the academic achievement of first-grade female students in Sudan, addressing a gap in existing research. Cooperative education is crucial for developing students' skills, fostering group spirit and cooperation. Based on these considerations, the study formulates the following research hypothesis.

H1: *There are statistically significant differences in the achievement scores obtained by female students who studied using cooperative education and those who studied using the traditional method in favour of the experimental group in the post-test of the chemical equations unit.*

H2: *There are no statistically significant differences in the achievement scores obtained by female students in the pre-test for the chemical equations unit.*

Method and Procedure

Prior to commencing experimental research, it is imperative to select a design capable of rigorously controlling the study variables and their influence on the dependent phenomenon among the subjects. The researcher opted for the experimental method due to its appropriateness for elucidating the causal relationship between two variables—one independent and the other dependent. The researcher followed the experimental model outlined by Dr. Saleh Al-Assaf.

Study Population and Sample

The study population comprises female students enrolled in the first year of secondary school in Khartoum State - Bahri Locality. A purposive sample of 60 female students from the first year of secondary school was deliberately chosen. The sample was evenly divided into two groups, with 30 female students assigned to both the control and experimental groups.

Study Variables and Tools

The independent variable, in this study, is the chemical equations unit taught through the cooperative education method, intending to observe its impact. The dependent variable is the academic achievement of the students, influenced by the independent variable. The following tools are utilized in the present study.

1. Pre-testing is implemented.
2. The implementation of the cooperative educational strategy for academic achievement among first-year female students in Sudan.
3. An achievement test administered to both the control and experimental groups.
4. Furthermore, the t-test, arithmetic mean, and standard deviation were also employed.

Study Settings

The entire study spanned a duration of two weeks.

Equality and Teaching Methods

1. The t-testing approach was utilized to compute the students' grades, as indicated in [Table 2](#).
2. Two groups, each comprising 30 students, were formed.
3. The students' records, including age, economic and social status, and academic level, were extracted from the school records.
4. The subject teacher served as the trainer for the unit.
5. The experimental group underwent instruction using the cooperative education strategy.

6. The other group of students was instructed using conventional teaching methods.

Group Equality for the Pre-Testing

The [Table 2](#) illustrates the scores of students involved in the experimental group. Examining [Table 3](#) reveals that the student's score in the pre-testing phase is 19, with a standard deviation of 3.59.

Table 2

Comparison of Grades

Experimental Group	Control Group
20	17
20	18
20	18
20	19
21	21
21	22
22	22
22	22
23	23
23	23
24	24
24	24
24	25
25	25
26	13
14	13
13	14
14	15
19	15
14	15
15	15
15	15
15	15
16	19
16	15
17	16
17	16
17	17
18	17
19	17

[Table 3](#) compares both groups in the pre-testing phase. The arithmetic mean for the

experimental group is 19, and for the control group, it is 18.50. There is no statistical difference, indicating equality in students' academic achievement in the subject. This supports the effectiveness of the cooperative educational strategy, and the designed unit can proceed. The pre-testing used a unit test with an overall score of 30.

Table 3

Performance Comparison in Pre-test

The Two Comparison Groups	Arithmetic Mean	Standard Deviation	Degree of Freedom	T Value	T Significant
Experimental	19	3.59	58	2.005	0.034
Control	18.50	3.80			

Designing the Achievement Test (Post-Test)

Following the completion of the aforementioned steps, both groups underwent instruction. The researcher formulated questions for the achievement test, which were administered to the subjects upon the conclusion of teaching the unit.

To develop the achievement test, the researcher considered the following factors:

Identifying the domains of teaching units across various fields, with Bloom's taxonomy being the most renowned, categorized by Bloom into three distinct areas:

1. Cognitive field.
2. The affective domain or emotional sphere.
3. The skill field or psychomotor.

In formulating the achievement test, the researcher focused on delineating educational objectives for the cognitive domain, following Bloom's categorization into six levels (memorization, remembering, understanding, application, analysis, synthesis, and evaluation).

In formulating the test, the researcher took into consideration the following principles:

1. To assess proficiency levels in memorization, comprehension, application, analysis, and synthesis.
2. Questions ought to be unambiguous and aligned with behavioural objectives.
3. The questions should encompass the content of the two units under study.
4. Questions should consider individual differences among students.

Following the definition of test vocabulary, the researcher submitted it to a panel of experts for assessing apparent validity. Their feedback on instructions, language clarity, suitability for the target group, and question clarity was considered, leading to modifications based on their valuable comments.

Subsequent to the preceding steps, the psychometric properties of the test necessitate verification for both validity and reliability.

Validity and Reliability of the Test

Validity is established when a test accurately measures its intended construct; however, if it assesses a different behaviour than intended, it lacks validity. Reliability refers to the

consistency of results when the test is re-administered to the same students under identical conditions. It also implies stability or consistency when the test is re-evaluated by different individuals, yielding consistent results.

Validity and Reliability Coefficient of the Test

The test's reliability coefficient was determined using the split-half method. This involves dividing the test into two halves: the first half represents scores for odd questions (x), and the second half represents scores for even questions (y). The reliability coefficient is calculated using the Pearson correlation coefficient equation, as outlined below:

$$r = \frac{n \sum XY - \sum X \sum Y}{\sqrt{(n \sum X^2 - (\sum X)^2) \cdot (n \sum Y^2 - (\sum Y)^2)}}$$

n= 30 (Number of sample members)

X= The sum of the score numbers in the odd questions for each sample member

Y= The sum of the score numbers in the even questions for each sample member

Pearson correlation coefficient r = 0.87

Self- validity coefficient = 0.93

Data Analysis and Results

The researcher analysed the post-test results of the control and experimental groups in the chemical equations unit based on the study hypotheses. The study formulated the following two hypotheses.

1. Statistically significant differences favouring the experimental group were observed in the post-test achievement scores of female students who studied with cooperative education compared to those who used the traditional method in the chemical equations unit.
2. No statistically significant differences were found in the pre-test achievement scores of female students for the chemical equations unit.

The post-test scores of the experimental and control groups are presented as follows:

Table 4

Scores of Experimental Group

21	25	20	29	25	25	26	24	22	24	28	23	24	25	27
27	24	21	26	27	20	28	27	25	27	27	28	20	22	30

Table 4 indicates that the arithmetic mean for the experimental group in the post-test is 24.9, with a standard deviation of 2.74.

Table 5

Scores of Control Group

23	20	18	14	19	20	17	19	27	18	24	22	18	22	27
21	25	21	23	25	23	28	21	22	22	21	20	21	24	23

As evident from Table 5, the arithmetic mean of the control group in the post-test is

21.9, with a standard deviation of 3.07. The arithmetic mean of the control group is lower compared to the experimental group.

Comparing the performance of the two groups in the post-test

Table 6

Comparison of Performance

The Two Comparison Groups	t Value		The Change	The Result
	Experimental	Control		
Arithmetic Mean	24.90	21.60		There are statistically significant differences between the two groups in favour of the experimental group
Standard Deviation	2.74	3.07		
Degree of Freedom	58			
Calculated	3.79			
Tabulation	2.005			
			Statistically significant at the significance level of 05.	

Table 6 displays the comparative performance results of the two groups. It is evident that the achievement level of the experimental group surpasses that of the control group, with an arithmetic mean of 24.90 compared to 21.60 for the control group. The researcher attributes this improvement in the experimental group's performance to the utilization of the cooperative education strategy in teaching the chemical equations unit. This strategy, deviating from the traditional methods of recitation and chalkboard use, succeeded in capturing students' attention and enhancing their engagement with the presented material, highlighting the effectiveness of the teaching strategy and its presentation.

Discussion

The study examined the impact of cooperative education on students' academic achievement, comparing outcomes between cooperative and traditional education. Using an experimental research approach, data were gathered from female students in Sudan through pre-testing and post-testing techniques. The study aimed to test the hypothesis that there are statistically significant differences in achievement scores favouring the experimental group, which employed the cooperative learning strategy, over the traditional method.

Confirming the hypothesis of statistically significant differences in achievement scores between female students using cooperative learning and those using traditional methods highlights the effectiveness of cooperative learning strategies. This supports the idea that

cooperative learning contributes to higher academic achievement among female students compared to traditional instructional methods. These results are consistent with existing literature emphasizing the advantages of cooperative learning in enhancing student engagement, collaboration, and a deeper understanding of the subject matter (León et al., 2023). The observed statistically significant differences suggest that cooperative learning can function as a valuable pedagogical approach to improve academic outcomes, particularly for female learners (Artawan, 2023). Similarly, prior studies have documented that instructional methods can impact critical thinking (Wild, Rahn, & Meyer, 2023), which is prompting a need for additional investigation into this association. The study involved participants from two schools employing distinct teaching methodologies: CL & IL. Notably, a significant improvement in scores was observed among CL students compared to IL students between Test 1 (T1) and Test 2 (T2). This aligns with prior research suggesting that creative thinking tends to progress during late childhood, especially with exposure to specific teaching methods or training. These findings underscore the potential impact of instructional approaches on fostering creative skills, emphasizing the need for further exploration of this relationship. The literature reviewed in this study highlights that active learning pedagogies, such as cooperative learning, outperform traditional approaches in enhancing students' academic attainment. However, in impoverished countries, including Nigeria, instructors generally do not adopt and implement these approaches due to various impediments discussed in the literature (John, Mulwa, & Mutua, 2021).

These study findings align with previous research; for example, Senyefia et al. (2021) asserted that cooperative education is an important and widely accepted technique, contributing to higher student accomplishment. This study significantly contributes to the education literature, shedding light on the underexplored role of cooperative and collaborative learning strategies in student learning. The findings also resonate with Bassachs, Cañabate, Serra, and Colomer's (2020) study, emphasizing the vital opportunity cooperative education provides in enhancing student outcomes. Furthermore, the study underscores the importance of cooperation within educational frameworks for promoting holistic development across cognitive, socioemotional, and behavioural domains. It cultivates an environment for collaborative learning, promoting effective communication, respect for diverse perspectives, and the development of essential life skills. This approach enhances academic achievement while fostering problem-solving, teamwork, and empathy. Emphasizing cooperation in education better equips students for success in both academic and real-world settings, ensuring a well-rounded and comprehensive approach to learning and development.

Implications and Conclusion

The study contributes significantly to the existing literature by highlighting statistically significant differences in academic achievement between first-year secondary school female students in chemistry using cooperative education and those employing traditional methods. The cooperative education strategy fosters mutual dependence among group members, shifting the roles of both teacher and student. The teacher becomes a mentor, elevating expectations, strengthening student confidence, and promoting active learner participation in the learning process.

The study findings contribute to the comparison between traditional and cooperative education techniques, offering suggestions for policymakers. Addressing overcrowding in classes, especially in developing countries, is crucial. Policymakers can enhance effective education delivery by addressing institutional issues causing overcrowding and reviewing admission processes. Embedding higher stake assessments, similar to the US system, can help address cooperative education challenges in Sudanese schools for improved educational outcomes. While academic excellence is a priority, there's a need for practical measures at the school level. Although implementing cooperative education in all schools may be impractical, gradual implementation can begin with teacher training, recognizing them as key stakeholders and drivers of this educational system in Sudan.

Moreover, the study suggests that schools could facilitate peer training for teachers, where colleagues train each other on cooperative education assessment within the educational context. If schools express interest in implementing cooperative education, the study recommends establishing clear training objectives outlining desired outcomes for teachers. It emphasizes the development of a comprehensive curriculum encompassing cooperative learning strategies, group dynamics, communication skills, and assessment methods. Expert facilitators should be engaged to lead training sessions, offering valuable insights and practical examples. Hands-on workshops should enable teachers to actively engage in cooperative learning activities, enhancing their understanding of the principals involved.

Limitations and Future Directions

While the study yields significant findings, it is important to acknowledge certain limitations that could serve as avenues for future research. Firstly, the study's focus on Sudan limits its generalizability, prompting future research to explore variations in results across different countries. Secondly, educators and policymakers may consider integrating cooperative learning strategies into curriculum design and instructional practices for enhanced learning experiences and outcomes among female students. Further research could investigate the specific mechanisms by which cooperative learning contributes to improved achievement, uncovering the underlying processes driving these differences. Thirdly, the study's direct relationship approach could be expanded by exploring potential moderating variables such as classroom dynamics, teacher expertise, and student characteristics. This could provide deeper insights into the effectiveness of cooperative learning within diverse educational contexts. Lastly, the study's reliance on an experimental research design limits its generalizability. Future research could adopt mixed methods to broaden the study scope and examine variations in findings.

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