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Enhancing Students' Academic Performance through Advance Organizers in a Cooperative Learning Classroom at a Senior High School in the Ashanti Region, Ghana

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This study was about enhancing students' academic performance through the use of advance organisers in a cooperative learning classroom at a senior high school in the Ashanti Region of Ghana. The study employed an action-research design. A General Art Form 3 class, consisting of 44 students, at Adugyama Senior High School was selected using convenience sampling. The study utilised pre- and post-tests, weekly exercises and observation checklists as sources of data. The data gathered was analysed using descriptive statistics. The study's findings revealed a significant enhancement in students' academic performance. This improvement was attributed to the effectiveness of the instructional strategy, leading to increased skill demonstration, active student participation, improved learning and retention and an overall elevation in academic success. Based on the findings, the study recommends the integration of advance organisers in cooperative learning classrooms to improve the academic performance.

Keywords: Advance organisers; cooperative learning classroom; academic performance; integrated science.

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Introduction

Designing a teaching strategy that enhances the understanding of scientific concepts is key to the academic achievement of learners (National Research Council, 2000). However, studies conducted in Ghana revealed that students are not taken through senior high school Integrated Science practical activities properly (Amoah et al., 2021; Azure, 2015). Furthermore, it was reported that student-centered instructional strategies were not employed during Integrated Science lessons, hence limiting students' participation (Sarfo-Adu et al., 2018; Sun et al., 2014). Consequently, students find the learning of Integrated Science difficult, boring, uninteresting and abstract (Winarno et al., 2020) and perform poorly in examinations (Appiah & Beccles, 2022; Geller et al., 2014).

In the context of education at the Adugyama Senior High School in the Ashanti Region of Ghana, a concerning issue has come to light regarding the academic performance of students in practical assessments, particularly in the field of Integrated Science. An empirical observation made by the researchers, employing a comprehensive approach

that included direct classroom scrutiny, practical assessments and thorough evaluations of tests aimed at gauging students' practical skills, unveiled a significant trend of poor performance. Further reinforcing these concerns were the findings of the Chief Examiners' Reports from the West African Examinations Council (2018; 2019; 2020) which substantiated the problem by revealing a consistent trend of students struggling to provide accurate responses to Integrated Science test questions related to practical work, particularly those involving measurement of quantities and plotting of graphs. The attributed reasons for this struggle were multifaceted, encompassing both a lack of experience in handling practical tasks and the essential science process skills required for these assessments and poor students' attitudes, caused by the inadequacy of teaching aids and an absence of innovative as well as student-centered instructional methods during lessons (Amoah et al., 2021; West African Examinations Council, 2019; 2020; Appiah & Beccles, 2022; Abreh et al., 2018). The persistently low performance observed among the students in practical assessments, whether in internal or external examinations, mirrors a larger concern since Integrated Science, being a core subject, occupies a pivotal place in the school's curriculum.

The difficulties in teaching and learning practical concepts call for better and more modern instructional approaches (Mehta, 2019) such as the use of advance organisers and cooperative learning. Advance organiser is an instructional tool used by teachers to introduce the lesson topic and illustrate the relationship between what the students are about to learn and the information they have already learnt. It is a relevant material introduced to the learners before the lesson to help them understand, retain and remember the new learning material (Somashekhara & Dange, 2020). Past research, exemplified by investigations conducted by Omondi et al. (2018) and Awodun and Boris (2021) underscores the positive impact of advance organisers. These studies reveal improved student retention and participation, resulting in increased achievement across diverse contexts and secondary school settings. The integration of these significant findings not only substantiates the efficacy of advance organisers but also contributes essential insights to the existing literature, reinforcing the relevance of the proposed instructional approach. The common types of advance organisers are expository, skimming, graphic organisers and KWL charts. The expository advance organiser illustrates the new learning to be covered as the teacher gives the students key concepts and ideas to be learnt. Skimming gives students a chance to flick through content to be learnt and outline it. Graphic organisers help teachers and students identify key concepts and ideas to be learnt and link them in a visual format. KWL charts allow students to assess their prior knowledge (What they Know), express their objectives for learning (What they Want to Know) and reflect on what they acquired (What they Learnt) (Goodwin, 2020; Dawson, 2022).

Cooperative learning, on the other hand, is an instructional approach that enables students to work in small groups to accomplish a common learning goal under the guidance of the teacher (Rigacci, 2020). It is a widely recognised educational approach that promotes student engagement and peer interaction, fostering a sense of shared responsibility and collaborative problem-solving and creating a supportive learning environment. Students are encouraged to engage with one another, exchange ideas and build on one another's knowledge in this environment, which eventually results in an improved understanding of what is being taught and learned (Cavadia, 2023). A cooperative learning environment may yield more substantial improvements in academic performance when coupled with advance organisers than either method alone (Oyeniyi & Owolabi, 2020).

Previous studies have independently demonstrated the effectiveness of advance organisers (Oyeniyi & Owolabi, 2020; UzZaman et al., 2015; Karthikeyan & Denisia, 2021). These studies have consistently reported positive outcomes related to the use of advance organisers as instructional tools. Oyeniyi and Owolabi (2020) reported that advance organisers significantly enhanced students' appeal to the subject matter and understanding of it, contributing to improved comprehension and knowledge retention. Similarly, UzZaman et al. (2015) found that integrating advance organisers in class introductions positively influenced students' ability to make connections between new and previous knowledge, fostering student engagement and a deeper comprehension of the subject matter. Additionally, the study by Karthikeyan and Denisia (2021) highlighted the beneficial effects of advance organisers on the learning process by reporting improved student encouragement and enthusiasm for learning when they were applied.

Cooperative learning strategies have also shown notable effectiveness in enhancing various aspects of students' learning and achievement (Gull & Shehzad, 2015; Mendo-Lazaro et al., 2022; Keramati & Gillies, 2022). Gull and Shehzad (2015) conducted a comprehensive study which demonstrated that cooperative learning strategies substantially enhanced students' capacity of collaboration, teamwork and overall academic success. Additionally, Mendo-Lazaro et al. (2022) highlighted the benefits of cooperative learning, emphasising how it aids in creating a welcoming environment for learning and encouraging student social connections and students to create learning-focused goals. The study by Keramati and Gillies (2022) examined how cooperative learning affected students' perceptions and found that students' individual and communicative skills as well as their comprehension of quality learning, significantly improved when an empathic, secure and enjoyable learning environment was established for them.

However, there exists a notable gap in the literature, as prior research has not adequately explored the combined effects of these two strategies on students' academic performance. The existing studies focused on different aspects of learning and did not provide a comprehensive assessment of overall students' academic performance (Box & Little, 2003; Sunasuan & Songserm, 2021; Mehta, 2016). To bridge this critical gap, this study undertook an in-depth investigation into the effectiveness of employing advance organisers in a cooperative learning classroom to enhance students' academic performance. The study purposely sought to establish the impact of using advance organisers within a cooperative learning framework on students' academic performance in the context of Integrated Science education. It aimed to determine how effectively this teaching strategy enhances students' learning outcomes, which included improved test scores, active participation, demonstration of essential skills, and overall achievement. This study addressed the research question: What impacts does the use of advance organisers have on students' academic performance in Integrated Science when taught in a cooperative learning classroom?

Related Literature and Studies

This section covers reviews of relevant studies and literature. It is divided into subsections.

Theoretical Framework

This study is anchored on the theory of Meaningful Learning formulated by David Ausubel in 1963 (Ausubel, 2000). Meaningful Learning is a learning strategy which occurs when there is an interaction between potentially new knowledge and relevant ideas of the learner which results into the acquisition of new meanings in the cognitive structure of the learner (Ausubel, 2000). It emphasises that learners understand and internalise new information by connecting it to their existing knowledge, promoting a deeper comprehension of concepts (Hoffman et al., 2021). Accordingly, the theory advocates that the most important factor in learning is what the learner already knows (Ausubel, 2000) and that meaningful learning occurs when the learner solves new problems after interpreting, relating and incorporating the new information into their existing knowledge (Gonzalez et al., 2008). In the context of this study, the Theory of Meaningful Learning provides a strong theoretical framework by emphasising the importance of matching instructional strategies to students' past knowledge in order to maximise the learning process. This alignment is particularly crucial in the suggested solution, which addresses the challenges found in students' performance on practical work assessments by having advance organisers in a cooperative learning environment seek to close the gap between theoretical knowledge and practical application.

Advance Organisers

The use of advance organisers as a cognitive instructional strategy, as suggested by Ausubel (2000), proves instrumental in promoting effective learning and the retention of new information. Studies such as that of Oyeniyi and Owolabi (2020) highlight that employing advance organisers significantly aids in the acquisition and retention of scientific concepts, correlating with higher achievement scores among learners. Chen (2007) emphasises the positive influence of advance organisers on knowledge acquisition and application, facilitating the teaching and learning process. Additionally, the work of Curzon (cited in Awodun & Boris, 2021) underlines how advance organisers enrich lessons by enhancing students' direct participation in their learning, as evidenced by UzZaman et al. (2015). Furthermore, Nyabwa (2005) underscored that advance organisers not only provide suitable learning opportunities but also serve as motivational tools, inspiring students to

acquire diverse skills and knowledge. Jafari and Hashim (2012) contributed to this discourse by asserting that advance organisers contribute to improved listening comprehension, consequently enhancing students' ability to demonstrate their skills. Overall, Adebola (2011) affirms that this instructional strategy is capable of enhancing students' mastery of content at both the comprehension and achievement levels.

Cooperative Learning

Cooperative learning activities have been shown to exert a positive influence on students' academic achievement, as highlighted by Gull and Shehzad (2015). Mendo-Lazaro et al. (2022) expanded on this perspective, stating that cooperative learning not only fosters skill development but also serves as a motivating factor for more active participation in the teaching and learning process. According to these authors, cooperative learning techniques significantly contribute to the improvement of academic goals, subsequently influencing students' behaviours and leading to the achievement of learning objectives (Mendo-Lazaro et al., 2022). This collaborative approach is thus recognised for its multifaceted impact on students, positively shaping both their academic achievements and their engagement in the learning process.

The Use of Advance Organisers in Cooperative Learning Classroom

Studies have demonstrated the effectiveness of advance organisers in improving students' scores in achievement tests (Somashekhara & Dange, 2020; Karthikeyan & Denisia, 2021). It is mostly argued that advance organisers positively impact students more when used effectively with other innovative instructional strategies (Oyeniyi & Owolabi, 2020). Box and Little (2003) conducted a study to determine if cooperative small-group instruction in combination with advance organisers could positively impact the self-concept and academic achievement of elementary school students. After utilising four experimental classes and one control class, the researchers reported a substantial improvement in all classes, with the experimental groups showing most notable improvement. Furthermore, research on how using an advance organiser model can influence meaningful learning of new concepts for learners in collaborative classrooms was carried out by Sunasuan and Songserm in 2021. The findings revealed that the advance organiser model can influence meaningful learning of new concepts and improve academic achievements for learners in collaborative classrooms (Sunasuan & Songserm, 2021).

Methodology

This section offers a thorough description of the research design, population and sampling, instruments and procedure, validity and reliability, and statistical treatment of data.

Research Design

The study used the action research design. This research design deals with solving specific problems in the classroom, which improves teachers' classroom practice and enhances students learning (Leedy & Ormrod, 2010). It aimed at finding an immediate solution to students' inability to answer practical questions and improving students' learning and understanding of selected concepts in Integrated Science without disrupting the normal schedule of the school. Accordingly, five lessons were designed using advanced organisers along with cooperative learning strategies to teach some selected practical Integrated Science concepts and it was carried out for five weeks. The research process involved iterative cycles of planning, action, observation and reflection (Burns, 2015), allowing for adjustments to the use of advance organisers and cooperative learning strategies.

Population and Sampling

The study was carried out in Adugyama Senior High School in the Ashanti Region of Ghana, with a student population of over 1,200 students across various forms and disciplines. The choice of the Adugyama SHS holds particular significance as one of the researchers has a prior professional association with the institution. Having previously worked at the school, the researcher possesses valuable insights into the school's environment, academic culture and administrative procedures.

The target population of this study was all Form 3 students of the Adugyama Senior High School and the accessible population was Form 3 General Art classes. The researcher's past affiliation with the school contributes a nuanced understanding of the school's dynamics, strengthening the study's contextual relevance. The form 3 classes were targeted because they are a group of students who are unable to answer the WASSCE Integrated Science test of practical questions properly. The convenience sampling technique was used to choose the Form 3 General Art class, 3A2A, as the sample, made up of 44 students.

Instruments and Procedures

The main instruments used in this study to collect data were the pre-test, weekly exercises, post-test and class observation checklists. Data collection was done in three phases (pre-intervention, intervention and post-intervention). The pre-intervention phase consisted of the collection of pre-intervention data based on the relevant previous knowledge of the students. This was done through the researchers' interaction with the students and the administration of the pre-test. The intervention phase involved the collection of data on the five intervention lessons designed by the researchers. During this phase, students were taught selected practical concepts in Integrated Science using the intervention strategy for five weeks. Advance organisers such as KWL Chart, Concept Mapping, Brief Description with Skimming and Outline were utilised within the cooperative learning environment in teaching the concepts of measurement of physical quantities and plotting of linear graphs. The cooperative learning strategies employed were the Jigsaw Method, Think-Pair-Share, Cooperative Group Tasks and Numbered Heads Strategy. After each lesson, the students were assessed through practical tasks. The exercises were marked and recorded. In addition, the students' behaviours and essential skills were observed and recorded during the lessons using the checklists. The analysed data from each lesson enabled the researchers to check the students' progress and provide feedback to them. The post-intervention phase was the collection of post-intervention data based on the effects of the intervention strategy on academic performance through a post-test. The researchers during this phase monitored the students' output, collated the outputs and analysed them for reports.

Validity and Reliability

The content validity of the instruments was determined by subjecting them to experts, including a senior lecturer at the University of Education, Winneba, and two senior high school Integrated Science teachers who had more than five years of teaching experience, for their suggestions and corrections. The instruments were also field-pilot-tested to ascertain their reliability with twenty-three form-three General Art students at Mankranso Senior High School, which is situated in the Ahafo Ano South West District of the Ashanti Region and has similar characteristics to the school where the research was conducted. A Cronbach alpha coefficient of 0.83 indicates the strength of the group correlation between the test items, which was obtained through the use of the instruments to collect data from the selected students.

Statistical Treatment of Data

To address the research questions, the data was analysed qualitatively and quantitatively using Microsoft Excel 2016 software. The weekly exercise scores were descriptively analysed to assess students' learning progress and comprehension of the subjects being taught. The data from the observation checklists was descriptively analysed to ascertain how the students behaved and demonstrated the necessary essential skills. Descriptive statistics was used to compare the pre-test and post-test scores in order to see if there was a significant change in the academic performance of the students following the practical work interventions.

Results and Discussion

This section presents the results and discusses the findings of the study in the context of the research question that guided the study.

Pre-Intervention Assessment

Before the intervention strategy, a pre-test was administered to establish their demonstration of process skills, understanding of concepts and overall academic achievement in practical task. The results are presented in Table one.

Table 1: Students' Science process skills in the Pre-test

SN	Science process skills	Number of students	Percentage (%)
1	Observation and Reading of instruments	11	25.0
2	Measuring	9	20.4
3	Drawing and Labelling	4	9.1
4	Spelling and Communication	5	11.4
5	Inferring	3	6.8
6	Formulation of hypothesis	2	4.5
7	Experimentation	4	9.1
8	Manipulation: Controlling variables	5	11.4
9	Data collection and Recording	13	29.5
10	Interpreting data	1	2.2

In Table one, a limited number of students demonstrated the correct science process skills. For example, in Observation and Reading of Instruments, only 11 students, representing 25% exhibited this skill correctly. The majority of skills had a lower number of students displaying proficiency. This is clear evidence that most students lacked the required science process skills and did not demonstrate them effectively during previous Integrated Science practical lessons before the intervention phase, indicating a need for improvement.

Intervention Assessment

Weekly Exercises during the Intervention

During the intervention phase, data on the students' performance in each of the weekly practical lessons was gathered. Tables two through six outline the results.

Table 2: Students' Responses to Practical task in Lesson One

Task	Correct (%)	Incorrect (%)
Identification of length instruments	40 (90.9)	4 (9)
Reading of length instrument	36 (81.8)	8 (18.1)
Measurement of length	43 (97.7)	1 (2.2)

Table 3: Students' Responses to Practical Task in Lesson Two

Task	Correct (%)	Incorrect (%)
Identification of volume instruments	41 (93.1)	3 (6.8)
Determination of volume of liquids	35 (79.5)	9 (20.4)
Reading of volume instrument	39 (88.6)	5 (11.3)
Determination of volume regular objects	36 (81.8)	8 (18.1)

Table 4: Students' Responses to Practical task in Lesson Three

Task	Correct (%)	Incorrect (%)
Reading of weighing scale	36 (81.8)	8 (18.1)
Relating mass and weight	35 (79.5)	9 (20.4)
Reading of stop clock	41(93.1)	3 (6.8)

Table 5: Students' responses to practical task in lesson four

Task	Correct (%)	Incorrect (%)
Explanation of density	42 (95.4)	2 (4.5)
Performing density-related calculation	37 (84.0)	7 (15.9)
Demonstration of density	39 (88.6)	5 (11.3)

Results from Table two show that most students demonstrated correct skills in response to practical tasks in lesson one whereby 90.9% identified the length-measuring instruments, 81.8% read the instrument accurately and 97.7% measured length correctly. A small percentage of students had difficulty in these areas, with 9% failing to identify, 18.1% failing to read and 2.2% failing to use the instruments properly.

Data from Table three show that a majority of students exhibited correct skills in lesson two whereby 93.1% identified volume measuring instruments correctly, 79.5%) showed how to determine the volume of substances, 88.6% read volume measuring instruments accurately and 81.8% performed calculations related to the volume of regular objects. A smaller percentage had difficulties with these skills.

Results from Table four show that a substantial number of students exhibited the correct skills during lesson three whereby 81.8% of students were successful in reading mass measuring instruments, 79.5% related mass and weight effectively and 93.1% read stop clocks accurately. A minority encountered challenges in these skills with 18.1% being unable to read weighing scales and 6.8% were unable to read stop clocks proficiently.

Data from Table five showed that a significant number of students excelled in their skills in lesson four whereby 95.4% explained the concept of density accurately, 84% performed density-related calculations well and 88.6% demonstrated how to determine the density of objects, especially irregular ones. A few faced difficulties in these areas.

Results from Table six about the fifth lesson showed that all students (100%) recorded data accurately, 97.7% drew and labelled axes correctly, 86.3% plotted points accurately, 84% drew lines of best fit correctly and 81.8% determined the slope of the graph and explained its significance. Only a small percentage encountered challenges, mainly in plotting points and drawing lines of best fit.

In summary, table two to six collectively indicate a substantial improvement in students' demonstration of science process skills compared to Table one. The majority of students demonstrated correct skills in practical tasks during the intervention phase, signifying progress and the potential for higher academic achievement

Table 7: Students' Participation level during the Intervention lessons

SN	Observed students' Behavior	Lesson (L) and Percentage (%)				
		L1	L2	L3	L4	L5
1	Working well with teaching aids	65.9	88.6	95.4	95.4	100
2	Not sleeping and active listening	100	100	100	100	100
3	Note-taking	100	100	100	100	100
4	Complete task and working on time	52.2	86.3	97.7	100	100
5	Following along with instruction	90.9	97.7	100	100	100
6	Constructive contributions in class	56.8	68.1	72.7	79.5	81.8
7	Interacting appropriately in class	88.6	90.9	97.7	100	100

Table 8: Students' Science Process Skills in the Post-test

SN	Science process skills	Number of students	Percentage (%)
1	Observation and Reading of instruments	42	95.4
2	Measuring	40	90.9
3	Drawing and Labelling	33	75.0
4	Spelling and Communication	36	81.8
5	Inferring	31	70.4
6	Formulation of hypothesis	26	59.0
7	Experimentation	39	88.6
8	Manipulation: Controlling variables	34	77.2
9	Data collection and Recording	44	100
10	Interpreting data	30	68.1

Table 9: Mean of pre-test and post-test scores

	Mean Score	Percentage (%)
Pre-test	11.5681	33.5
Post-test	22.9545	66.5

Observations and Participation during the Intervention

During the intervention lessons, students' behaviours were observed during classroom lessons to determine their participation level. The results are presented in Table seven.

Data from Table seven show that the majority of the students exhibited positive behaviours pertaining to participation and activeness levels (active listening, note-taking, following along with instruction, working independently, working well with teaching aids and completing tasks and working on time and interacting appropriately in class) in lesson one (above 50%) and subsequently all students in lesson five (100%). Moreover, behaviours such as constructive contributions of students (responses to questions, asking of questions, and making suggestions) in class were demonstrated by the majority of the students throughout the five lessons (from 56.8% in lesson one to 81.8% in lesson five). Hence, it may be argued that the intervention strategy enhanced the students' participation levels.

Post-Intervention Assessment

At the end of the intervention session, a post-intervention test was administered to assess students' science process skills and overall achievement. Tables 8 to 9 present the results.

In Table eight, following the intervention, a noticeable improvement was observed. In Data Collection and Recording, all students demonstrated the skill correctly. Similarly, in others, a higher number of students correctly demonstrated their proficiency. Comparison of Table one and Table eight highlights the positive impact of the intervention on students' science process skills. The

findings reveal that the intervention significantly increased the number of students who correctly demonstrated these skills, particularly in key areas like observation, measurement and data collection.

Table nine shows that the students' mean post-test average, which is 22.95, representing 66.5%, is higher than their mean for the pre-test average, which is 11.56, representing 33.5%. The results indicate that using the advance organisers to teach the measurement and plotting of graph concepts in a cooperative learning classroom may have contributed to the improvement in the students' test scores.

The results, outlined in Tables 2 to 9 demonstrated enhancements in students' academic achievements, skill demonstration and active participation in learners' activities. These outcomes suggest that the incorporation of advance organisers in a cooperative learning environment contributed positively to students' practices, experiences and participation. The findings are consistent with those of Box and Little (2003) who investigated cooperative small-group instruction combined with advance organisers and reported a substantial improvement in student outcomes. Additionally, the results corroborate the study by Sunasuan and Songserm (2021), supporting the notion that using the advance organisers model in collaborative classrooms can influence meaningful learning of new concepts and improve the academic achievements. The cooperative learning environment facilitated positive interactions and manipulation of learning resources, leading to enhanced student engagement. These findings resonated with Melad's (2022) study, highlighting the significant positive relationship between attitude components and student academic achievement. Furthermore, the students' development of science process skills through active engagement in practical activities positively influenced their ability to answer measurement concept questions. This aligns with Abungu et al. (2014) suggestion that science process skills-based instruction contributes to improved academic performance.

Conclusion and Recommendations

The conclusions are presented in this section, followed by the corresponding recommendations.

Conclusions

Based on the results, it is concluded that integrating advance organisers within a cooperative learning framework significantly improves students' academic performance. The observed enhancements in skills demonstration, active student participation, learning and retention highlight the effectiveness of the strategy. These outcomes offer valuable insights for educators and contributes to the ongoing dialogue on effective pedagogical approaches, offering actionable insights for educators, aiming to elevate the quality of science education.

Recommendations

The study recommends that educational institutions and instructors should consider incorporating advance organisers and cooperative learning strategies into their teaching methods for Integrated Science. The study recommends further recommends that educators should explore the potential of incorporating similar strategies in other science subjects, broadening the application of these effective teaching techniques. Further research can be explored to determine the specific mechanisms through which advance organisers and cooperative learning influence students' academic performance, providing insights into underlying processes. Moreover, the influence of other variables such as student demographics, different types of advance organisers or cooperative learning strategies on the impact of these teaching strategies on academic performance can be explored.

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