

Qualitative Study on Integrating Cooperative Learning Instructional Strategy for Science Education Teaching in Nigeria: A Philosophical Review

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Abstract

This chapter explores cooperative learning as a philosophically grounded instructional strategy in science education. Drawing from constructivism, pragmatism, and social learning theory, it highlights how cooperative learning fosters both cognitive and social development in learners. Cooperative learning is presented as an effective platform that supports critical thinking, communication, collaboration, and problem-solving—core competencies required for scientific inquiry and professional success. The chapter discusses key structural elements of cooperative learning, including positive interdependence, individual accountability, promotive interaction, interpersonal skills, and group processing, and aligns them with the collaborative nature of scientific practice. The philosophical foundations examined provide a robust justification for integrating cooperative learning in science classrooms. While the approach offers numerous benefits, challenges such as unequal participation, group conflicts, and assessment complexities remain. Ultimately, cooperative learning emerges as a dynamic and philosophically justified pedagogical approach that can enrich science education when applied effectively. Some recommendations were made.

Keyword: Cooperative Learning, Philosophical Analysis, Science Education

Introduction

With the promotion and emphasis on generic skills like critical thinking, creative thinking, collaboration and communication, the use of cooperative learning platform in classroom delivery has taken center stage. Cooperative learning is a platform that other instructional strategies like inquiry, and problem solving can be taught. The importance of using the cooperative learning platform abound in literature. Earlier Lord (2001) outlined the following benefits of cooperative learning, Cooperative learning creates the atmosphere for students to increase their academic achievement as they learn social skills, such as resolving disputes on their own, helping newcomers feel welcome, taking turns, listening to others, contributing ideas, explaining oneself clearly, encouraging others, and criticizing ideas not people. Cooperative learning promotes students to student interaction which is often ignored in another instructional platforms (Sadeghi, 2012). Students' critical and creative thinking is significantly improved using CL (Silva et al., 2022). Clark & Baker (2015) in their contribution, opined that cooperative learning encourages Deep learning, as opposed to surface learning, examines new facts and ideas critically, encourages students to relate ideas to one another, to previous knowledge and to their individual experience, and leads to greater retention of learning. The authors further maintained that cooperative learning ensures that students master the soft skills that are increasingly demanded by industry. If CL is implemented well, students learn to listen to others and evaluate alternative viewpoints. They develop the skills to cooperate, plan and lead, and the ability to share leadership as they work on large and/or complex projects. They begin to understand their own learning, and to evaluate their own work and the work of others, and they learn how to work with students from a range of cultures and backgrounds. These are all transferable skills that prepare students well for the transition into the workplace and life beyond study (Clark & Baker, 2015).

Philosophical theories such as constructivism, pragmatism, and social learning theory support the Cooperative learning Instructional Platform and provide deep insights into the potential strengths and weaknesses of this innovative approach. A critical examination of Cooperative learning within the various philosophical frameworks, shows cooperative learning to be a powerful pedagogical tool in science education, fostering both cognitive and social development among students. This examination shows how philosophical analysis can probe and challenge the effectiveness of cooperative learning.

Theoretical Foundations of Cooperative Learning

Cooperative learning is a method in which children work in small groups to help one another learn (Slavin, 2008). According to Abubakar (2015), Cooperative learning Instructional strategy is an instructional strategy where students work together in

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group to attain group goals that cannot be obtained by working alone or competitively while the teacher takes the role of a facilitator. Lam (2005) described Cooperative learning as a student-centred, instructor-facilitated instructional strategy in which a small group of students is responsible for its own learning and the learning of all group members. Cooperative learning (CL) is a strategy involving small groups of students working together to achieve a common learning goal (Chakyarkandiyil & Prakasha, 2023). In all the definitions reviewed, cooperative learning and individualistic learning are two poles apart.

Features of Cooperative Learning:

According to Johnson & Johnson (2009), not all groups are cooperative. The author explained that placing people in the same room, seating them together, and telling them they are a group does not mean they will cooperate effectively. Therefore Johnson & Johnson (2005) observed that, to be cooperative, and to reach the full potential of the group, five essential elements need to be carefully structured into the situation. These are:

i. Positive interdependence

The first and most importance element is positive interdependence. Teachers must give a clear task and group goal so students believe they sink or swim together (Johnson & Johnson, 1994). The authors explained that positive interdependence exists when group members perceive that they are linked with each other in a way that one cannot succeed unless every one succeeds. If one fails, all fail. Felder and Brent (2007) opined that, if any team member fail to do their part, every one suffers consequences. Group members realize, therefore, that each person's effort benefit not only him or herself, but all other group members as well. Positive interdependence create commitment to other peoples' success as well as one's own and is the heart of CLIS. If there is no positive interdependence, there is no cooperation (Johnson & Johnson, 1994). Dyson & Grineski (2001), & Krol, Janssen, Veenman, & Linden (2004), in agreement with Johnson & Johnson, stated that positive interdependence occurred when each group members learned to depend on the rest of the group to achieve shared task. Link to Science Education: Cooperative learning in science fosters active participation and collaborative problem-solving, which are essential in scientific inquiry and discovery. This approach mirrors the collaborative nature of scientific practice.

ii. Individual and group accountability

Individual and group accountability is the second important element of cooperative learning. According to Johnson and Johnson (2005), the group must be accountable for achieving its goals. Each member must be accountable for contributing his or her share of work (which ensure that no one "hitch-hikes" on the work of others). The group has to be clear about its goals and be able to measure: (a) its progress in achieving them and (b) the individual efforts of each its members. Individual accountability exist when the performance of each individual student is assessed and the results are given back to the group and the individual in order to ascertain who need more assistance, support, and encouragement in completing the assignment. Millis (2002) suggested that each individual member of the group must be individually responsible for their own academic performance.

iii. Promotive interaction

The third essential component of cooperative learning is primitive interaction, preferably face to face interaction. Promotive interaction occurs when member share resources, help, and support, encourage, and praise each other's effort to learn (Johnson 2003). Hence, cooperative learning groups are both academic support system (every student has someone who is committed to helping him or her learn) and a personal support system (every student has someone who is committed to him or her as a person). There are important cognitive activities and inter personal dynamics that can only occur when students promote each other's learning. This include orally explaining how to solve problems, discussing the nature of the concept being learned, teaching one's knowledge to classmates, and connecting present with past learning. It is through promoting each other's learning face to face that members become personally committed to each other as well as to their mutual goals (Johnson 2003).

iv. Interpersonal and group skills

The fourth essential element of cooperative learning is teaching students the required interpersonal and small group skills (Johnson & Johnson, 1994). According to Neo, Kwok, Lai & Zarina (2012), many students do not usually work in a cooperative learning environment, they may lack group and social skills. These social skills are not necessarily inherent, but can be taught and learn. In cooperative learning groups students are required to learn academic subject matter (task work) and also to learn the interpersonal and small group skills required to functions part of a group (team work). Tanner et-al. (2011), believed that explicitly addressing this as part of science education would better prepare scientists, engineers, and health care professionals for the complex social dynamics of laboratories and clinics. Group members must know how to provide effective leadership, decision-making, trust-building, communication and conflict-management, critical thinking and be motivated to use prerequisite skills. Teachers have to teach team work skills just as purposefully and precisely as teachers do academic skills.

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Science cooperation and conflict are inherently related, the procedure and skills for managing conflicts constructively are especially important for the long-term success of learning groups (Johnson & Johnson, 2009).

V. Group processing

Group processing is the fifth essential component of cooperative learning (Johnson, 2003). Group processing exists when group members discuss how well they are achieving their goals and maintaining effective working relationships. Students must have opportunity to discuss how the work in the group is going, what has been successful, and what could be improved (Tanner et al., 2011). Thus, these five elements are essential to all cooperative systems, no matter what their size.

Philosophical Frameworks Supporting Cooperative Learning

i. Constructivism

The main position of constructivism is that learners have their own choice to represent their thoughts and experiences to acquire new knowledge (Kumari & Kumar, 2022). In other words, it is not possible to transfer ideas into student's heads intact, ideas coming into the child must be integrated with what is already in the child's cognitive frame – the child only ends up seeing what he constructed. Constructivism is traceable to the contributions of Jean Piaget and Lev Vygotsky, emphasizes that learners construct knowledge through interaction with their environment and social interactions. Knowledge according to Constructivism philosophy is not received passively but is built up by the cognizing subject.

Application to Cooperative Learning:

Social constructivism is a variety of cognitive constructivism that emphasizes the collaborative nature of learning under the guidance of a facilitator or in collaboration with other students. In social constructivism children's understanding is shaped not only through adaptive encounters with the physical world but also through interactions between people (Akpan et al, 2020). Central to Vygotsky's theory of social constructivism is the concept of Zone of Proximal Development (ZPD) and the concept of scaffolding. This theory supports what takes place in a cooperative learning instructional platform, where students working in groups can support each other's learning, with more knowledgeable peers providing guidance, which helps learners advance through their ZPD. This also agreed with the earlier submission of Kelly (2012) that social constructivism could be applied in the classroom using such instructional strategies as collaborative/group work.

Traditionally science is a discipline that embraces group and teamwork, engineers and doctors work mostly in teams. The objective of science teaching according to is the development of practical ability, observation skills, decision-making skills, and scientific temperament among the students (Pathak and Verma, 2022). In science education, this means that students can engage in scientific problem-solving and experiments together, helping each other understand complex concepts.

ii. Pragmatism

Philosophical Background:

Pragmatism is an education structure built on a philosophical foundation wrought by such philosophers as Chauncey Wright, William James, Charles Peirce, and the man who best combined the roles of educator and philosopher, John Dewey (Bansal, 2015). John Dewey, one of the main proponents of pragmatism, argued that learning is most effective when it is rooted in real-world problems and experiences. Pragmatism is an educational philosophy that says education should be teaching students the things that are practical for life and encourages them to grow into better people. It idealizes the activity on the basis of its consequence over time frame (Rai & Lama, 2020)

Application to Cooperative Learning:

Cooperative learning provides an opportunity to engage students in hands-on, problem-solving activities, which is a cornerstone of Dewey's educational philosophy. In science education, students can engage in real-world scientific tasks, like designing experiments or analyzing data in groups.

The cooperative approach fosters a community of inquiry, where students contribute different ideas and perspectives, mirroring the collaborative nature of scientific research. Practically, engineers, doctors, architect and most scientist work in group

Philosophical Analysis:

Pragmatism supports cooperative learning by emphasizing learning through doing, especially through collaboration with others. *Science education can leverage on these benefits* from this by encouraging students to actively engage with scientific content and practices, thus deepening their understanding through practical and social experiences.

Social Learning Theory

Philosophical Background:

Social learning theory is generally agreed to have been developed by Albert Bandura who believed that a purely behaviourist account of learning was insufficient (Olaniran et al., 2024). The theory posits that learning is a function of interaction within

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a social context and by observing and interacting one's behaviour might change. Mcleod (2024) in his contribution opined that social learning theory emphasizes the importance of observational learning, where individuals acquire knowledge, skills, attitudes, and beliefs by watching the actions of others and the consequences that follow, leading to the modeling and adoption of observed behaviors.

In a cooperative learning setting, students' interaction offers them an array of stimuli which inevitably affect their response. Through group interaction, students can observe their peers' strategies for problem-solving, which encourages learning through imitation and constructive feedback.

In science classrooms, cooperative learning offers opportunities for peer modeling in scientific techniques, methodologies, and approaches to inquiry.

Philosophical Analysis:

Social learning theory reinforces the effectiveness of cooperative learning by focusing on how students learn by observing others, reinforcing the vicarious nature of learning. Cooperative learning environments promote mutual learning through modeling behaviors, critical in both science education and everyday life.

Practical Application in Science Education

Cooperative learning in science involves students working collaboratively to solve complex problems, such as conducting experiments or analyzing data, fostering critical thinking and analytical skills.

It also provides a platform of opportunity for students to practice inquiry: developing hypotheses, collecting data, interpreting and discussing results.

Cooperative learning emphasizes communication, teamwork, and conflict resolution—skills essential for both scientific collaboration and broader life experiences useful beyond disciplinary boundaries.

In reality, science is a teamwork and collaboration is key. In a cooperative learning setting students gain insight into how scientists work in teams to solve problems, prepare reports, and make decisions based on collective input and shared responsibility.

Challenges of Cooperative Learning in Science Education

i. Equity in Participation:

There is a risk that some students may dominate the group while others remain passive. This imbalance can hinder individual accountability and limit the benefits of cooperative learning.

ii. Group Dynamics:

Conflicts or differences in learning styles among group members can affect the effectiveness of cooperative learning.

iii. Assessment Issues:

Assessing individual contributions in group-based work can be challenging, especially in large groups. Teachers need clear strategies to evaluate both individual learning and group outcomes.

Summary of Findings

This review highlights the philosophical and practical strength of cooperative learning as an instructional platform in science education. The following key findings emerged:

- i.** Cooperative Learning promotes the development of core skills, like communication, creativity, collaboration needed in classroom science and beyond.
- ii.** Philosophical Foundations like Constructivism, Pragmatism, Social Learning Theories validate its use
- iii.** Effective cooperative learning requires five interrelated components: positive interdependence, individual accountability, promotive interaction, interpersonal skills, and group processing.
- iv.** Cooperative learning mirrors the collaborative nature of scientific inquiry and professional scientific work, making it an appropriate and authentic instructional model for science classrooms

Conclusion

In light of the philosophical and empirical evidence reviewed, cooperative learning holds significant promise for transforming science education. It not only aligns with constructivist principles but also fosters the development of critical 21st-century skills such as collaboration and communication. However, challenges such as teacher preparedness and contextual barriers must be addressed. Future research should explore implementation models tailored to the realities of resource-constrained environments.

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