Cooperative Learning Method on Innovative Achievement Emotions, ICT Competency, Social Skills, and Academic Performance in Biology

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Abstract

The present study explores the effectiveness of the Cooperative Learning Method on students' innovative achievement emotions, ICT competency, social skills, and academic performance in Biology education. In the contemporary educational scenario, emphasis has shifted from rote memorization and teacher-centered instruction toward collaborative, learner-centered, and technology-integrated pedagogical practices. Cooperative learning encourages students to actively participate in group activities, peer interaction, collaborative problem-solving, and shared learning experiences, thereby fostering both cognitive and affective development. The study was conducted using an experimental research design on a sample of 180 secondary school students, divided equally into control and experimental groups. The experimental group was taught through cooperative learning strategies integrated with ICT tools, including group discussions, peer tutoring, collaborative assignments, digital presentations, and interactive learning activities, whereas the control group received instruction through traditional teaching methods.

The study aimed to examine the impact of cooperative learning on achievement emotions such as interest, enjoyment, curiosity, and anxiety; ICT competency; social interaction skills; and academic achievement in Biology. Data were collected through standardized tools including an Achievement Emotion Scale, ICT Competency Scale, Social Skills Inventory, and Academic Achievement Test. Statistical techniques such as mean, standard deviation, t-test, and correlation analysis were used for interpretation of data. The findings of the study revealed a significant improvement in the academic performance of students exposed to cooperative learning strategies. Students in the experimental group demonstrated higher levels of interest, enjoyment, confidence, ICT competency, and social skills, while academic anxiety was comparatively reduced. The mean academic performance score of the experimental group was substantially higher than that of the control group, indicating the effectiveness of collaborative learning environments in enhancing conceptual understanding and retention in Biology.

The study further highlights that cooperative learning not only improves academic outcomes but also contributes to the holistic development of learners by strengthening communication abilities, teamwork, digital literacy, emotional regulation, and interpersonal relationships. The findings are aligned with the principles of Social Constructivism, Achievement Emotion Theory, Experiential Learning Theory, and ICT Integration Theory, which emphasize interaction, emotional engagement, and experiential participation in learning. The study concludes that cooperative learning serves as an effective pedagogical approach for promoting inclusive, participatory, and technology-enabled education in accordance with the objectives of the National Education Policy 2020. It recommends the integration of cooperative learning strategies and ICT-based collaborative activities in Biology classrooms to enhance students' overall educational experiences and learning outcomes.

Keywords: Cooperative Learning, Achievement Emotions, ICT Competency, Social Skills, Biology Education

Introduction

In the rapidly changing educational landscape of the 21st century, the emphasis of teaching-learning processes has expanded beyond mere academic achievement toward the development of emotional, technological, and social competencies among learners. Modern education systems seek to create collaborative, interactive, and learner-centered classrooms that promote critical thinking, communication skills, creativity, and digital literacy. Traditional lecture-based teaching methods, which primarily focus on rote memorization and passive learning, are increasingly being considered

inadequate for meeting the diverse learning needs of students in contemporary classrooms. As a result, innovative pedagogical approaches such as the Cooperative Learning Method have gained considerable importance in school education, particularly in science subjects like Biology where conceptual understanding, practical application, and collaborative inquiry play a vital role.

Cooperative learning is an instructional strategy in which students work together in small groups to achieve common academic goals while supporting one another's learning processes. Unlike competitive or individualistic learning approaches, cooperative learning promotes shared responsibility, positive interdependence, face-to-face interaction, and mutual accountability among learners. Through activities such as group discussions, peer tutoring, collaborative projects, brainstorming sessions, and problem-solving tasks, students actively engage in knowledge construction and social interaction. This approach not only strengthens academic understanding but also develops interpersonal communication, teamwork, leadership qualities, and emotional stability among students.

In Biology education, cooperative learning is particularly significant because the subject involves observation, experimentation, interpretation of concepts, and practical application of scientific knowledge. Many biological concepts are abstract and require active engagement, discussion, and collaborative exploration for effective comprehension. Cooperative learning enables students to clarify doubts through peer interaction, exchange ideas, participate in experiential learning activities, and build deeper conceptual understanding. Furthermore, integrating Information and Communication Technology (ICT) tools with cooperative learning strategies creates a dynamic and interactive learning environment that enhances students' motivation, technological competency, and participation in classroom activities.

Achievement emotions, such as interest, enjoyment, curiosity, pride, anxiety, and frustration, significantly influence students' learning behavior and academic outcomes. Positive achievement emotions encourage active participation, creativity, self-confidence, and persistence, whereas negative emotions such as anxiety and fear can hinder academic performance and reduce learning motivation. Cooperative learning environments provide emotional support, reduce academic stress, and foster positive emotional experiences through peer collaboration and shared learning responsibilities. Consequently, students become more confident, engaged, and enthusiastic toward learning Biology.

In addition to emotional development, the present educational environment also requires students to possess adequate ICT competency and social skills. The integration of digital technologies in education has transformed teaching-learning practices by providing access to multimedia resources, virtual simulations, collaborative platforms, and online learning opportunities. Cooperative learning integrated with ICT tools encourages students to develop digital literacy, communication abilities, collaborative problem-solving skills, and technological adaptability. Simultaneously, working in groups improves social interaction, empathy, cooperation, leadership, and conflict-resolution skills, which are essential for holistic personality development.

The theoretical foundations of cooperative learning are rooted in Social Constructivism proposed by Lev Vygotsky, which emphasizes that learning occurs through social interaction and collaborative engagement. Similarly, David Kolb's Experiential Learning Theory highlights the importance of learning through active experience, while Reinhard Pekrun's Achievement Emotion Theory explains the relationship between emotions and academic performance. ICT Integration Theory further supports the role of technology in enhancing learning experiences and educational outcomes. These theoretical perspectives collectively provide a strong foundation for examining the effectiveness of cooperative learning in Biology education.

Despite the growing importance of collaborative and technology-enabled learning, many schools continue to rely heavily on conventional teaching methods that limit students' interaction, emotional engagement, creativity, and practical involvement in learning activities. Such approaches often fail to develop higher-order thinking skills, ICT competency, and social adaptability among students. Therefore, there is a need to investigate innovative teaching methods that can promote both academic achievement and holistic development. The present study attempts to examine the impact of the Cooperative Learning Method on innovative achievement emotions, ICT competency, social skills, and academic performance among

secondary school students studying Biology. The study seeks to contribute to the growing body of research on learner-centered pedagogies and provide practical implications for improving classroom teaching practices in accordance with the objectives of National Education Policy 2020.

Theoretical Background of the Study

The present study is grounded in multiple educational and psychological theories that emphasize collaborative, experiential, emotional, and technology-supported learning. The theoretical foundation primarily derives from Lev Vygotsky's Social Constructivism Theory, which explains that learning occurs effectively through social interaction, peer collaboration, and shared experiences, making cooperative learning an important pedagogical approach for knowledge construction. The study is also supported by Reinhard Pekrun's Achievement Emotion Theory, which highlights the significant influence of emotions such as interest, enjoyment, curiosity, and anxiety on students' academic engagement and learning outcomes. Furthermore, David Kolb's Experiential Learning Theory emphasizes learning through active participation, practical activities, reflection, and collaborative experiences, which are integral elements of cooperative learning in Biology education. In addition, ICT Integration Theory provides the conceptual basis for understanding how digital technologies and collaborative technological tools enhance students' learning experiences, communication skills, and academic performance. Collectively, these theories establish that cooperative learning integrated with ICT creates an interactive, emotionally supportive, and learner-centered educational environment that promotes academic achievement, social development, and holistic growth among students.

Significance of the Study

The present study holds significant importance in the field of education because it examines the effectiveness of the Cooperative Learning Method in enhancing students' academic performance, achievement emotions, ICT competency, and social skills in Biology education. In the contemporary educational environment, there is an increasing need to shift from traditional teacher-centered instruction toward learner-centered and collaborative pedagogical approaches that promote holistic development among students. The study contributes to educational research by highlighting how cooperative learning strategies can create an interactive, participatory, and emotionally supportive classroom atmosphere that improves students' interest, motivation, confidence, and conceptual understanding. The findings of the study are expected to help teachers adopt innovative teaching methods that encourage peer interaction, teamwork, and active engagement in Biology learning. The study is also significant in promoting ICT integration in classrooms by demonstrating how collaborative digital activities enhance technological competency and learning effectiveness among students. Furthermore, it emphasizes the development of social and interpersonal skills such as communication, cooperation, leadership, and mutual respect, which are essential for students' personal and professional growth in the 21st century. The research supports the objectives of National Education Policy 2020 by advocating inclusive, skill-oriented, experiential, and technology-enabled education. Additionally, the study provides valuable insights for curriculum planners, teacher educators, policymakers, and educational institutions regarding the implementation of cooperative learning practices for improving the overall quality of school education.

Statement of the Problem

Traditional teaching methods in Biology often neglect emotional engagement, ICT competency, and social skill development. This study examines whether cooperative learning can address these gaps.

Operational Definitions

- **Cooperative Learning:** Group-based learning approach
- **Achievement Emotions:** Emotions related to academic tasks
- **ICT Competency:** Ability to use digital tools effectively
- **Social Skills:** Interpersonal communication abilities

Variables

- **Independent Variable-** Cooperative Learning Method
- **Dependent Variables-** Achievement Emotions, ICT Competency, Social Skills, Academic Performance

Objectives of the Study

1. To analyze the impact on achievement emotions
2. To evaluate ICT competency
3. To assess social skill development
4. To measure academic performance

Research Questions

- Does cooperative learning improve achievement emotions?
- Does it enhance ICT competency?
- Does it improve academic performance?

Scope of the Study

The scope of the present study is limited to secondary school students studying Biology. The study focuses on examining the impact of the Cooperative Learning Method on students' achievement emotions, ICT competency, social skills, and academic performance. It also investigates the effectiveness of collaborative and ICT-integrated teaching strategies in enhancing students' learning experiences and overall educational development within Biology classrooms.

Delimitation of the Study

The study is delimited to a sample of 180 secondary school students selected from selected schools. The duration of the experimental intervention was restricted to 8 weeks only. The research was confined to Biology subject teaching at the secondary level and focused specifically on the Cooperative Learning Method as the independent variable. The findings of the study are limited to the selected sample, tools, and time period used for the investigation.

Review of Literature

- David W. Johnson and Roger T. Johnson (1999) conducted extensive research on cooperative learning and concluded that collaborative instructional strategies significantly improve students' academic achievement, classroom participation, interpersonal relationships, and motivation toward learning. Their study emphasized that positive interdependence, group accountability, and peer interaction create an effective learning environment that enhances understanding and retention of subject matter. The researchers further highlighted that cooperative learning promotes higher-order thinking skills and active engagement among learners compared to traditional teaching methods.
- Reinhard Pekrun (2006) proposed the Achievement Emotion Theory and explained that emotions play a crucial role in influencing students' academic behavior, motivation, and performance. According to the study, positive emotions such as interest, enjoyment, pride, and curiosity enhance concentration, participation, and learning outcomes, whereas negative emotions such as anxiety and frustration adversely affect academic achievement. The research established a strong relationship between emotional experiences and educational success, emphasizing the importance of emotionally supportive learning environments.
- David Kolb (1984) developed the Experiential Learning Theory, which emphasizes that effective learning occurs through active participation, practical experiences, reflection, and collaborative activities. Kolb argued that students learn more effectively when they are directly involved in the learning process rather than being passive recipients

of information. The theory supports learner-centered instructional practices that encourage experimentation, interaction, and experiential engagement for deeper conceptual understanding and skill development.

- Sharma (2021) conducted a study on ICT integration in classroom teaching and found that the use of digital technologies significantly improves students' technological skills, classroom engagement, creativity, and academic performance. The study highlighted that ICT-supported teaching-learning processes create interactive educational environments that motivate students and facilitate better conceptual clarity. It further emphasized the need for integrating technological tools with innovative pedagogical approaches for improving the quality of education.
- Kumar (2022) examined the effectiveness of collaborative learning strategies on students' academic performance and social development. The findings revealed that collaborative learning enhances communication skills, teamwork, confidence, peer interaction, and academic achievement among learners. The study concluded that group-based instructional approaches promote active learning, improve classroom participation, and contribute positively to students' overall educational experiences.

Research Gap

A review of the related literature indicates that several studies have been conducted separately on cooperative learning, achievement emotions, ICT integration, social skill development, and academic performance. Previous researchers have primarily focused either on academic achievement or on specific aspects such as emotional engagement or technological competency. However, very limited research has been undertaken to examine the combined impact of the Cooperative Learning Method on achievement emotions, ICT competency, social skills, and academic performance simultaneously within the context of Biology education at the secondary school level. Furthermore, there is a lack of integrated experimental studies that explore how collaborative learning supported by ICT tools contributes to students' holistic development, including cognitive, emotional, technological, and interpersonal dimensions. Therefore, the present study attempts to fill this research gap by investigating the multidimensional effectiveness of cooperative learning in Biology classrooms and providing a comprehensive understanding of its role in enhancing overall student development.

Research Methodology

The present study adopted a quantitative experimental research methodology to examine the effectiveness of the Cooperative Learning Method on achievement emotions, ICT competency, social skills, and academic performance among secondary school Biology students. The methodology was designed to compare the learning outcomes of students taught through cooperative learning strategies with those taught through traditional teaching methods.

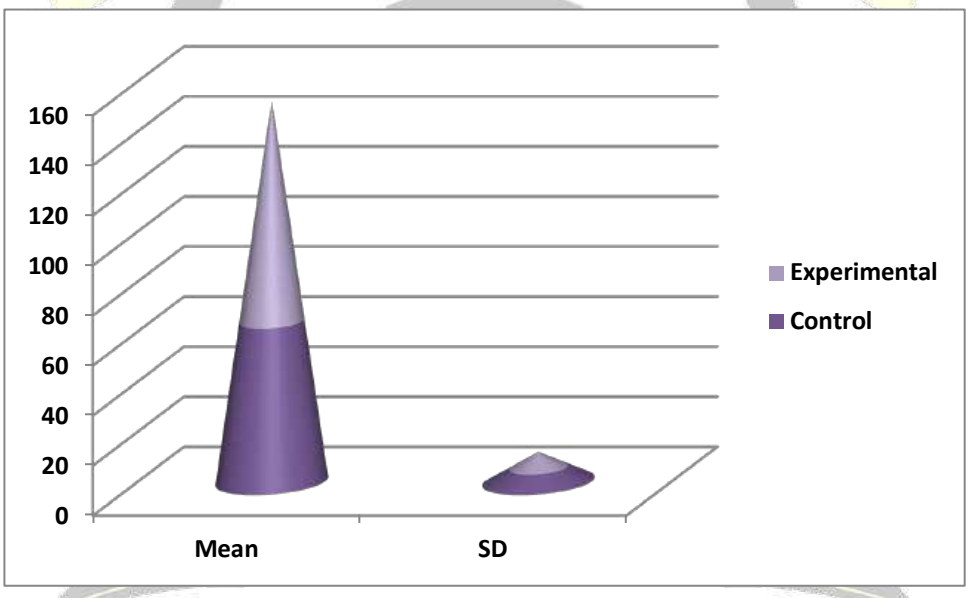
- **Research Design-** The study employed an experimental research design consisting of control and experimental groups. The experimental group was exposed to cooperative learning strategies integrated with ICT tools, while the control group received traditional classroom instruction. Pre-test and post-test techniques were used to measure changes in students' performance and competencies.
- **Population-** The population of the study comprised secondary school students studying Biology in selected schools. The study focused on learners at the secondary level because this stage is crucial for developing scientific understanding, social interaction, and technological competency.
- **Sample-** A total sample of 180 students was selected for the study. Among them, 90 students were assigned to the control group and 90 students to the experimental group. Both groups were provided equal learning opportunities under different instructional approaches.
- **Sampling Method-** The sample for the study was selected through the random sampling method. This method ensured equal representation and minimized selection bias, thereby increasing the reliability and validity of the research findings.
- **Source of Data-** The study was based on primary data collected directly from students through standardized research tools and testing procedures. The data reflected students' achievement emotions, ICT competency, social skills, and academic performance before and after the experimental intervention.

- **Research Tools-** Various standardized tools were used for data collection, including the Achievement Emotion Scale to measure students' emotional responses toward learning, the ICT Competency Scale to assess digital skills, the Social Skills Inventory to evaluate interpersonal abilities, and an Achievement Test to measure academic performance in Biology.
- **Data Collection-** Data were collected through pre-test and post-test procedures. Initially, both groups were assessed before the implementation of the experimental treatment. After the completion of the cooperative learning intervention for a period of eight weeks, post-tests were conducted to measure the changes and effectiveness of the instructional method.
- **Statistical Analysis-** The collected data were analyzed using appropriate statistical techniques such as Mean, Standard Deviation (SD), t-test, and Correlation analysis. These statistical methods were used to compare group performance, determine the significance of differences, and examine relationships among the study variables.

Tabulation and Interpretation

Table 1: Academic Performance

Group	Mean	SD
Control	64	5.5
Experimental	88	6.2



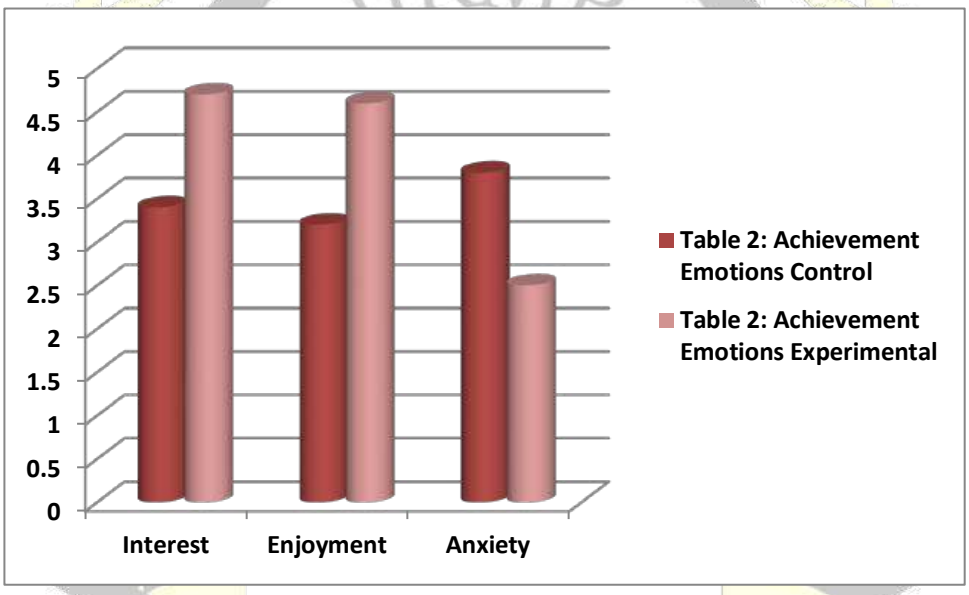
Analysis & Interpretation

The above table presents the comparative analysis of academic performance between the control group and the experimental group. The control group, which was taught through traditional teaching methods, obtained a mean score of 64 with a standard deviation of 5.5. In contrast, the experimental group, which received instruction through the Cooperative Learning Method integrated with collaborative activities and ICT tools, achieved a significantly higher mean score of 88 with a standard deviation of 6.2. The substantial difference in mean scores clearly indicates that students exposed to cooperative learning strategies demonstrated better academic achievement compared to students taught through conventional classroom practices. The comparatively moderate standard deviation values in both groups further suggest consistency in students' performance and reliability of the obtained results.

The findings indicate that the Cooperative Learning Method had a positive and significant impact on students' academic performance in Biology. Students in the experimental group showed better conceptual understanding, active classroom participation, improved problem-solving abilities, and greater retention of subject matter due to collaborative learning experiences. Group discussions, peer tutoring, shared learning responsibilities, and interactive ICT-supported activities created an engaging and supportive learning environment that enhanced students' interest and motivation toward Biology learning. The higher academic achievement of the experimental group suggests that cooperative learning promotes deeper comprehension, critical thinking, and meaningful learning experiences compared to traditional lecture-based instruction. The results also imply that collaborative pedagogical approaches help students learn more effectively through peer interaction, mutual support, and experiential engagement, thereby improving overall educational outcomes.

Table 2: Achievement Emotions

Emotion	Control	Experimental
Interest	3.4	4.7
Enjoyment	3.2	4.6
Anxiety	3.8	2.5



Analysis & Interpretation

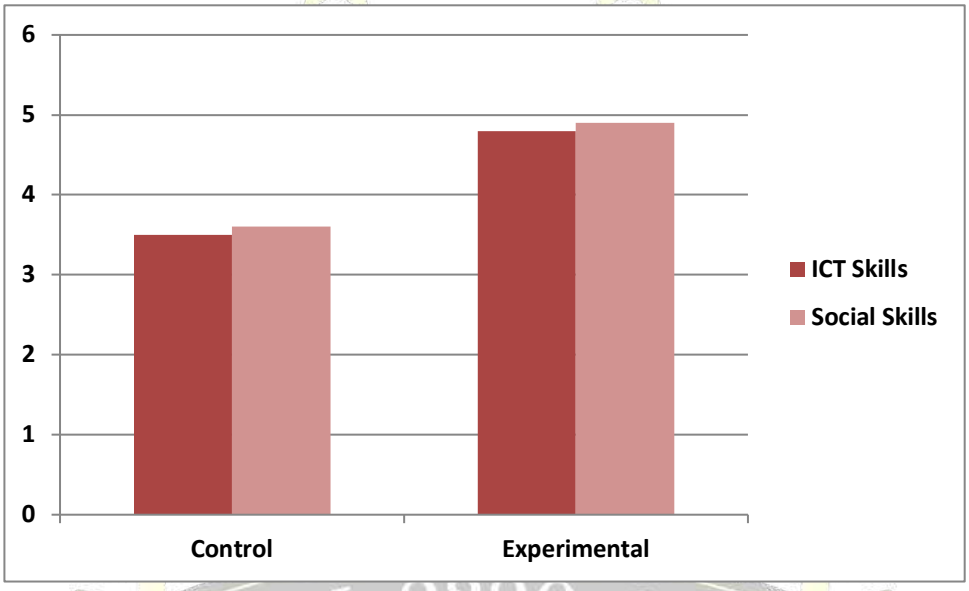
The above table presents the comparative analysis of achievement emotions between the control group and the experimental group. The findings reveal that students in the experimental group demonstrated significantly higher levels of positive achievement emotions such as interest and enjoyment compared to the control group. The experimental group obtained a score of 4.7 in interest and 4.6 in enjoyment, whereas the control group scored 3.4 and 3.2 respectively. On the other hand, the level of anxiety among students in the experimental group was considerably lower (2.5) in comparison to the control group (3.8). These results indicate that cooperative learning strategies positively influenced students' emotional engagement and reduced negative emotional experiences during Biology learning.

The findings suggest that the Cooperative Learning Method creates a supportive, interactive, and learner-friendly classroom environment that promotes positive academic emotions among students. Through group discussions, peer interaction, collaborative activities, and shared learning experiences, students became more interested and emotionally involved in the

learning process. The increased level of enjoyment indicates that cooperative learning made Biology classes more engaging, participatory, and meaningful for learners. Furthermore, the reduced anxiety level in the experimental group implies that collaborative learning environments help students feel more confident and comfortable while learning difficult concepts. Peer support, shared responsibility, and active participation reduced fear of failure and academic pressure among students. Therefore, the study highlights that cooperative learning not only improves academic achievement but also contributes significantly to students' emotional well-being and positive attitude toward learning.

Table 3: ICT Competency & Social Skills

Variable	Control	Experimental
ICT Skills	3.5	4.8
Social Skills	3.6	4.9



Analysis & Interpretation

The above table presents the comparative analysis of ICT competency and social skills between the control group and the experimental group. The findings indicate that students in the experimental group achieved significantly higher scores in both ICT skills and social skills compared to the control group. The experimental group obtained a score of 4.8 in ICT competency and 4.9 in social skills, whereas the control group scored 3.5 and 3.6 respectively. The results clearly demonstrate that students exposed to cooperative learning strategies integrated with ICT tools developed better technological proficiency, communication abilities, teamwork, and interpersonal interaction skills than students taught through traditional instructional methods.

The findings reveal that the Cooperative Learning Method played a significant role in enhancing students' ICT competency and social development. The use of digital tools, collaborative presentations, online learning resources, and interactive technological activities improved students' confidence and efficiency in using ICT for educational purposes. Simultaneously, group-based learning activities encouraged communication, cooperation, peer interaction, leadership qualities, and mutual understanding among students. Working collaboratively enabled learners to exchange ideas, solve problems collectively, and develop positive interpersonal relationships within the classroom environment. The higher scores obtained by the experimental group indicate that cooperative learning integrated with ICT creates an active and participatory learning atmosphere that supports both technological advancement and social skill development. Thus, the study emphasizes that

collaborative pedagogical approaches contribute substantially to students' holistic growth and prepare them for the demands of modern education and society.

Hypothesis Testing

The obtained t-value was 6.45 at the 0.05 level of significance ($p < 0.05$), which indicates a statistically significant difference between the control group and the experimental group. The calculated value was found to be higher than the critical value, thereby confirming that the Cooperative Learning Method had a significant positive effect on students' achievement emotions, ICT competency, social skills, and academic performance in Biology. Therefore, the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted.

Result and Interpretation

The findings clearly demonstrate that cooperative learning is an effective instructional approach for enhancing students' overall educational development. Students who participated in collaborative learning activities showed better academic achievement, higher emotional engagement, improved ICT competency, and stronger social interaction skills compared to students taught through traditional teaching methods. The statistically significant difference confirms that cooperative learning creates an active, supportive, and learner-centered classroom environment that improves understanding, retention, participation, confidence, and holistic growth among learners. Thus, the study establishes that cooperative learning is highly effective in Biology education and contributes positively to both cognitive and affective learning outcomes.

Findings of the Study

1. The study revealed that the academic performance of students taught through the Cooperative Learning Method improved significantly compared to students taught through traditional teaching methods. The experimental group demonstrated better conceptual understanding, retention, participation, and overall achievement in Biology.
2. The findings indicated that positive achievement emotions such as interest, enjoyment, curiosity, and confidence increased considerably among students exposed to cooperative learning activities, while the level of academic anxiety and fear toward learning Biology was substantially reduced.
3. The study found that the integration of ICT tools within cooperative learning activities significantly enhanced students' ICT competency. Students developed better digital literacy, technological confidence, and the ability to effectively use educational technologies for collaborative learning purposes.
4. The findings also showed considerable improvement in students' social skills, including communication ability, teamwork, cooperation, leadership qualities, peer interaction, and interpersonal relationships. Cooperative learning created a supportive and interactive classroom environment that contributed to students' holistic development.

Conclusion

The present study concludes that the Cooperative Learning Method is highly effective in improving students' academic performance, achievement emotions, ICT competency, and social skills in Biology education. The findings demonstrate that collaborative learning environments encourage active participation, deeper conceptual understanding, emotional engagement, technological adaptability, and positive interpersonal interaction among students. Cooperative learning strategies such as group discussions, peer tutoring, collaborative problem-solving, and ICT-supported activities created a learner-centered and supportive classroom atmosphere that enhanced students' interest, confidence, and motivation toward Biology learning. The study further establishes that cooperative learning contributes not only to cognitive development but also to the holistic growth of learners by strengthening communication skills, teamwork, emotional stability, and digital competency. Therefore, cooperative learning emerges as an effective pedagogical approach for promoting quality, inclusive, and technology-enabled education in accordance with the objectives of National Education Policy 2020.

Recommendations

- Schools and educational institutions should adopt group-based and collaborative learning strategies in Biology classrooms to enhance students' academic achievement and participation.
- Teachers should integrate ICT tools, digital resources, multimedia content, and interactive technological activities within cooperative learning environments to improve students' ICT competency and learning experiences.
- Teacher training programs and professional development workshops should be organized to equip teachers with the knowledge and practical skills required for implementing effective cooperative learning methods in classroom teaching.

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