EFFECT OF STUDENTS TEAM ACHIEVEMENT DIVISION MODEL ON ACADEMIC ACHIEVEMENT IN THE SUBJECT OF GENERAL SCIENCE AT ELEMENTARY LEVEL

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(October, 2025)

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A thesis submitted in partial fulfillment of the requirement for the degree of

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SUPERVISOR'S CERTIFICATE

The thesis titled "EFFECT OF STUDENTS TEAM ACHIEVEMENT DIVISION MODEL ON ACADEMIC ACHIEVEMENT IN THE SUBJECT OF GENERAL SCIENCE AT ELEMENTARY LEVEL" submitted by Mr. Zafar Iqbal Reg. No. 182-FSS/PHDEDU/F20 in partial fulfillment of Ph.D. degree in Education has been completed under my guidance and supervision. I am satisfied with the quality of the student's research work and allow him to submit this for further processing as per IIUI rules and regulations.

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APPROVAL SHEET

EFFECT OF STUDENTS TEAM ACHIEVEMENT DIVISION MODEL ON ACADEMIC ACHIEVEMENT IN THE SUBJECT OF GENERAL SCIENCE AT ELEMENTARY LEVEL

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AUTHOR'S DECLARATION

I, Mr. Zafar Iqbal Reg. No. 182-FSS/PHDEDU/F20 as a student of Ph.D. in Education at International Islamic University, Islamabad do hereby declare that the thesis entitled "EFFECT OF STUDENTS TEAM ACHIEVEMENT DIVISION MODEL ON ACADEMIC ACHIEVEMENT IN THE SUBJECT OF GENERAL SCIENCE AT ELEMENTARY LEVEL" submitted for the partial fulfillment of Ph.D. Education is my original work, except where otherwise acknowledged in the text, and has not been submitted or published earlier and shall not in the future, be submitted by the researcher for obtaining any degree from this or any other university or institution.

_____

Zafar Iqbal

DEDICATION

To all my teachers,

Whose wisdom and kindness have guided me ,

To explore, refine, and expand my knowledge.

ACKNOWLEDGEMENTS

In the name of Allah, the most Beneficent, the most Merciful, the Creator of the World. It is the grace of Allah, Love of Prophet Muhammad (Peace be upon him) and prayers of my mother whose gracious favors enabled me to complete such a hard research work successfully.

The researcher feels a great sense of gratitude and sense of obligation to his supervisor, Dr. Azhar Mahmood for his inspiring guidance and encouragement during the entire study program. The researcher feels pleasure to place on record his deep sense of thankfulness to his teachers, Prof. Dr. Nabi Bux Jumani (Late), Prof. Dr. Samina Malik, Dr. Muhammad Munir Kayani, Dr. Asad Abbas Rizvi, Dr. Sheikh Tariq Mahmood, Dr. Muhammad Zafar Iqbal Chaudhry, and Dr. Muhammad Nasir Khan, who helped me a lot in each step. The experimenter would like to thank the administration of the Islamabad Model School for Boys Islamabad for their help and support. In the end, I am thankful to my dear friends Dr. Zeeshan Raees Khattak, Dr. Sufi Amin, Mr.Nauman Sadeeq, Mr.Nauman Saeed, and Malik Shokat Ali, throughout the Endeavor of this Ph.D. study.

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ABSTRACT

This study examined the effect of the Students Team Achievement Division (STAD) model on the academic achievement of elementary-level students in General Science. The objectives were: (a) to examine the effect of the Students' Team Achievement Division Method on the academic achievement of elementary-level students in general science, (b) to determine the effect of Lecture Method on the academic achievement of elementary-level students in general science, (c) to compare the effect of the Students' Team Achievement Division Method and Lecture Method on the academic achievement of elementary-level students in general science, (d) to investigate the effect of the Students' Team Achievement Division Method and the academic achievement of lower medium and higher achievers. (e) to investigate the effect of Lecture Method on the academic achievement of lower, medium and higher achievers in general science (f) To compare the effect of Students' Team Achievement Division Method and Lecture Method on the academic achievements of lower, medium and higher achievers in general science. The true experimental pretest-posttest equivalent group design was employed. The study was conducted at Islamabad Model School for Boys, with a sample of 60 students of grade 8 selected through simple random sampling technique. A subject achievement test was developed and conducted as pre-test before the start of the experiment, based on pretest scores, students were divided into two equivalent groups: an experimental group (n = 30) taught with the Student Team Achievement Division method and a control group (n = 30) taught with the lecture method. After 7 weeks of treatment Post-test was administered. Data were analyzed by using SPSS version 25. Descriptive statistics (Mean, Standard Deviation) were used to determine academic achievement whereas inferential statistics (independent sample t-test, paired sample test and partial eta squared test) were used to compare the group difference and effect size. The findings revealed that the Student Team Achievement Division method has a statistically significant and large positive effect *ηp2* (.147 to.427) on students' achievement in General Science compared to the lecture method. Theoretically, the study contributes to team based learning literature by validating the role of team-based strategies in enhancing student outcomes. From a policy perspective, it is recommended that educational stakeholders, curriculum developers, and school administrators incorporate team based learning models particularly the Student Team Achievement Division approach into General Science instruction to foster active engagement, individual accountability, and improved academic performance among students.

Keywords: *Students Team Achievements, Control Group, Experimental Group, Lecture Method, General Science, Lower, Medium, Higher Achievers, Significantly, Performance.*

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LIST OF ABBREVIATIONS

STAD	Students Team Achievement Division Model
APS	Army Public Schools
AVA	Audio Visual Aids
LT	Learning Together
TGT	Teams- Games-Tournaments
GI	Group Investigation
TAI	Team Accelerated Instruction
VTE	Vocational Technical Education
CL	Cooperative Learning
HOTS	Higher Order Thinking Skills
ZPD	Zone of Proximal Development
PBL	Problem-Based Learning
NEAS	National Education Assessment System
NEP	National Education Policy
TPS	Think-Pair-Share

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Pakistan's school system particularly in science remains dominated by lecture-based instruction despite repeated policy calls for student-centered pedagogy (NEP 2009, 2017; NQF 2015). Large classes, rote-learning traditions, and limited resources constrain active participation and higher order thinking. Recent national assessments continue to flag weak learning outcomes, underscoring the need for instructional models that promote engagement and conceptual understanding (NEAS, 2022). Team-based learning (TBL) addresses these challenges by structuring peer interaction and accountability (Johnson, 2017). A widely studied approach within this family is Student Teams Achievement Divisions (STAD), which organizes heterogeneous teams of four to five students and couples whole-class input with team study, individual quizzes, improvement-based scoring, and team recognition (Millis, 2023). This mechanism incentivizes both individual responsibility and mutual support.

Evidence from multiple contexts shows STAD can improve achievement, motivation, and social skills across subjects and levels (Rosfiani, 2023). Emerging work in South Asia including Pakistan also reports gains in conceptual understanding and reduction of achievement gaps (Javed & Mehmood, 2021)However, despite this promise and limited uptake in select private systems (City and APS), classroom practice in most public and private schools remains lecture-centric. There is insufficient post-2015, Pakistan-based evidence on the comparative effectiveness of STAD versus lecture in elementary general science classrooms. Establishing whether STAD yields superior academic performance under local conditions is therefore warranted to inform evidence-based pedagogy in science learning.

In the 21st century, the requirements of education are evolving quickly, and learners are no longer expected to merely memorize facts or replicate knowledge. Instead, they are required to cultivate critical thinking abilities, problem-solving skills, communication competencies, and teamwork (Ahmad & Mahmood, 2023). Conventional teaching methods, particularly the lecture approach, although

commonly utilized in many developing nations such as Pakistan, frequently fail to address these contemporary educational needs. The lecture model tends to encourage rote memorization rather than comprehension, and it restricts chances for active involvement, collaborative problem resolution (ASER Pakistan, 2024). In reaction to these obstacles, team based learning has gained traction as a substitute for teacher-centered education. Team based learning is an instructional approach in which students collaborate in small groups to achieve shared academic objectives while being personally accountable for their learning (Johnson & Johnson, 2017).

Among the various cooperative learning models, Student Teams Achievement Divisions (STAD) has been acknowledged as one of the most effective and organized methodology. Developed by Robert Slavin and his colleagues in the late 1970s at Johns Hopkins University, STAD has been broadly implemented in classrooms worldwide and extensively studied for its influence on students' academic success, motivation, and social growth. STAD is based on the principle of team-oriented learning where students are grouped into heterogeneous teams typically four to five members per team based on varying achievement levels, gender, and backgrounds. After the instructor presents the lesson, students collaborate to ensure that all group members have grasped the material. Each student then takes an individual quiz or assessment, and the team's overall score is determined based on individual improvements rather than absolute scores. This framework encourages high achievers to assist low achievers and ensures every student contributes significantly to the team's success (Kousar, Sadeeq, & Akhter, 2024).

Numerous studies globally have validated the effectiveness of STAD in enhancing students' academic performance. Slavin (1995) established that STAD was one of the most effective team based learning strategy for boosting achievement in disciplines like mathematics, science, and language studies. Sharan (2014) asserted that STAD not only fosters academic knowledge but also cultivates essential social skills such as teamwork, leadership, collaboration, and communication. Huda et al. (2019) noted that STAD substantially increased motivation and classroom engagement among students in Indonesia, particularly in large classrooms. Javed and Mehmood (2021) conducted a research study in Pakistan and concluded that STAD enhances conceptual understanding and assists in closing achievement gaps between

high and low performers. More recent investigations in South Asia have similarly underscored its advantages in science and social studies classrooms (Kousar et al., 2024). Research further indicates that STAD contributes to the establishment of a positive classroom atmosphere. Since every team member is held accountable for each other's learning, it nurtures a sense of belonging, mutual respect, and collaboration. This setting is particularly advantageous in culturally diverse classrooms where social interaction and inclusivity play a vital role (Yeni et al., 2023).

In Pakistan, the education system encounters numerous challenges, including overcrowded classrooms, insufficient teaching resources, reliance on rote memorization, and limited student engagement (Pakistan Institute of Education, 2024). According to the Pakistan Education Statistics (2021–22), the student teacher ratio at the elementary level is frequently very high, complicating individualized instruction. Furthermore, the traditional lecture format continues to prevail in schools, especially in public institutions, which limits active learning opportunities. Pakistani students often underperform in areas that require analytical skills, creativity, and independent problem-solving, as highlighted in various national assessment reports.

The Annual Status of Education Report (ASER, 2024) emphasized that while enrollment rates have improved, the quality of learning outcomes remains inadequate. For example, many Grade 5 students struggle to read Grade 2 level texts or execute basic arithmetic operations. These educational gaps necessitate instructional strategies that transcend memorization and actively engage students in the learning process. In this regard, the STAD model offers a promising alternative. By involving students in collaborative tasks, ensuring accountability through individual assessments, and rewarding team achievements, STAD addresses the deficiencies of the lecture method (Latif, Nisa & Hidayatullah, 2024).

Subjects such as elementary level general science require students to not only remember concepts but also to comprehend processes, engage in critical thinking, and apply knowledge to practical situations. Conventional methods frequently do not foster these skills. Conversely, STAD encourages students to actively engage in discussions about concepts, collaboratively solve problems, and reinforce each other's understanding. This interactive approach boosts comprehension, retention, and

practical application of scientific knowledge (Shofiatin, Miristianti, Faqih, & Kusnandar, 2024).

Furthermore, science classrooms in Pakistan often face challenges due to inadequate laboratory resources. STAD can address these shortcomings by offering peer supported learning experiences, where students can exchange ideas and clarify concepts amongst themselves. In this manner, STAD not only enhances performance but also nurtures scientific attitudes such as inquiry, curiosity, and logical reasoning. Therefore, there is a pressing necessity to transition from traditional lecture based teaching to more student focused strategies. The STAD model, bolstered by extensive international and national studies, has demonstrated improvements in academic performance, motivation, and interpersonal skills. Given Pakistan's educational hurdles such as overcrowded classes, unsatisfactory learning outcomes, and excessive reliance on memorization the implementation of STAD can provide significant advantages. This study thus aims to investigate the effectiveness of the STAD model in boosting the academic performance of students, particularly in the area of general science at the elementary level.

1.2 Rationale

Science education at the elementary level in Pakistan continues to face serious challenges, primarily due to the persistence of lecture-based pedagogies that emphasize rote memorization over inquiry, conceptual understanding, and problem-solving. Such approaches have been associated with low student engagement, limited critical thinking, and weak application of scientific knowledge. National assessment findings further reinforce these concerns, showing that only a small proportion of students demonstrate proficiency in general science, which underscores the urgent need for more effective instructional strategies (NEAS, 2022). International evidence demonstrates that team based learning models, particularly the Students' Team Achievement Division (STAD), significantly improve student achievement, foster motivation, and enhance collaborative skills (Slavin, 2005; Mukmin, 2019). However, despite strong global evidence, the empirical base for STAD in Pakistan remains limited.

Recent local studies highlight the growing interest in team based learning strategies. For instance, Iqbal (2020) found that team based learning produced better science achievement among Grade 8 students compared to lecture methods, while Parveen, Akhter, and Sahar (2019) demonstrated that the Jigsaw technique significantly improved elementary students' performance in science. Similarly, Fatima, Akbar, and colleagues (2022) reported positive effects of team based learning across different school settings in Punjab, and Fatima, Akbar, and Thakur (2023) showed its effectiveness in accelerating science learning at the early childhood level. Yet, findings are not universally consistent. Noor, Parveen, and Ehsan (2024) found no significant difference in science achievement when comparing team based learning with traditional teaching among Grade 7 students. These mixed results suggest that the success of team based learning strategies may vary depending on context, grade level, subject, and the specific model applied.

Despite recognition of student-centered learning in policy documents such as the National Education Policy (2009, 2017) and the National Qualifications Framework (2015), classroom practices in Pakistan continue to be dominated by traditional, teacher-centered approaches (Shah & Khan, 2017; Rehman & Malik, 2021). It disconnects between policy and practice highlights a significant gap in science education reform. Against this backdrop, the present study seeks to empirically examine the effectiveness of the STAD team based learning model in improving science achievement at the elementary level in Pakistan. By employing a rigorous experimental design, the study intends to determine whether STAD produces significantly higher academic achievement compared to lecture-based instruction. The findings are expected to contribute to the body of knowledge on cooperative learning, provide evidence-based recommendations for teaching practice, and support educational policymakers in aligning classroom pedagogy with contemporary learning goals.

1.3 Problem Statement

Team-based learning has been introduced in some private institutions in Pakistan, such as the City and APS school systems; however, most public and private schools still rely on traditional lecture-based instructions. Although educational reforms emphasize student-centered pedagogies, evidence shows that teacher-centered methods continue to dominate science classrooms, limiting student engagement and conceptual understanding (Ahmad & Mahmood, 2019; NEAS, 2022). For instance, the National Education Assessment System (2022) reported that only 38% of elementary students demonstrated proficiency in science, underscoring the need for more effective teaching strategies. This reliance on rote memorization, over inquiry and problem-solving, results in weak conceptual grasp, poor problem-solving ability, low engagement, and limited critical thinking, restricting meaningful learning and application of scientific knowledge. Elementary students in Pakistan consistently underperform in general science due to the dominance of lecture-based teaching methods that emphasize rote memorization over conceptual understanding, inquiry, and problem-solving. This teacher-centered approach yields a weak conceptual grasp, poor problem-solving ability, low engagement, and limited critical thinking among students, thereby restricting meaningful learning and the application of scientific knowledge. Although team-based learning strategies such as the Students' Team Achievement Division (STAD) have been shown internationally to improve science achievement, their effectiveness in Pakistani elementary classrooms remains underexplored, leaving a clear research gap.

Globally, the Student Teams Achievement Divisions (STAD) model has been shown to enhance academic achievement, motivation, and social skills (Slavin, 2005; Mukmin, 2019). However, in Pakistan, limited empirical research particularly after 2015 has systematically examined its effectiveness in elementary or secondary science education. While team based learning approaches are recognized in policy documents such as the National Education Policy (2009, 2017) and the National Qualification Framework (2015), classroom practices remain dominated by lecture-based teaching (Shah & Khan, 2017; Rehman & Malik, 2021). This persistence of traditional methods, despite the acknowledged benefits of active learning, represents a significant gap. This study addresses that gap by investigating the impact of the

STAD team based learning model on elementary students' academic achievement in general science in Pakistan. Specifically, it examines whether STAD produces significantly higher achievement compared to conventional lecture-based teaching. Addressing this issue is crucial for promoting evidence-based instructional practices and improving student performance in line with Pakistan's educational goals.

1.4 Significance of the Study

This study addresses a critical gap in empirical research on the application of the Students' Team Achievement Division (STAD) model in elementary science classrooms in Pakistan. It contributes theoretically by providing evidence on the effectiveness of team-based learning in enhancing student achievement across different performance levels, thereby extending the literature on pedagogical mechanisms. Practically, the findings offer actionable insights for curriculum designers and policymakers to integrate structured team based learning strategies into science education, fostering inclusive and collaborative classroom environments. Theoretically, it contributes new knowledge by empirically testing the Students' Team Achievement Division (STAD) model within the under-explored context of Pakistani elementary science classrooms. Prior team based learning research has predominantly focused on secondary or international settings, leaving a gap in early-grade science education. By examining how STAD enhances achievement across diverse performance levels, the study extends team based learning theory into a fresh cultural and curricular domain, thereby establishing clear theoretical novelty.

1.5 Objectives of the Study

The Objectives of the Study were:

1. To examine the effect of the Students' Team Achievement Division Method on the academic achievement of elementary-level students in general science.
2. To determine the effect of Lecture Method on the academic achievement of elementary-level students in general science
3. To compare the effect of the Students' Team Achievement Division Method and Lecture Method on the academic achievement of elementary-level students in general science
4. To investigate the effect of the Students' Team Achievement Division Method on the academic achievement of lower medium and higher achievers.
5. To investigate the effect of Lecture Method on the academic achievement of lower, medium and higher achievers in general science
6. To compare the effect of Students' Team Achievement Division Method and Lecture Method on the academic achievements of lower, medium and higher achievers in general science.

1.6 Hypotheses

Following were the research hypotheses of the study:

$H_{0}1$. There is no significant effect of Students' Team Achievement Division (STAD) method on the academic achievement of elementary-level students in General Science.

$H_{0}2$. There is no significant effect of Lecture Method (LM) method on the academic achievement of elementary-level students in General Science.

$H_{0}3$. There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of elementary-level students in General Science.

H_{04}. There is no significant effect of the Students Team Achievement Division Method on the academic achievement of lower achievers in General Science.

H_{05}. There is no significant effect of the Students Team Achievement Division Method on the academic achievement of medium achievers in General Science.

H_{06}. There is no significant effect of the Students Team Achievement Division Method on the academic achievement of higher achievers in General Science.

H_{07}. There is no significant effect of Lecture Method on the academic achievement of lower achievers in General Science.

H_{08}. There is no significant effect of Lecture Method on the academic achievement of medium achievers in General Science.

H_{09}. There is no significant effect of Lecture Method on the academic achievement of higher achievers in General Science.

H_{010}. There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of lower-achievers in General Science.

H_{011}. There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of medium-achiever in General Science

H_{012}. There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of higher-achievers in General Science.

1.7 Delimitations of the Study

The study was delimited to:

District Islamabad, Islamabad Model School for Boys, (only boys were selected) Grade-8 General Science textbook published by federal board 2022.

The study was further delimited into the following four chapters, Unit 4 (pollutants and their effects on the environment) Unit 5(chemical reactions), Unit 6(acids, bases/alkalis and salts), and Unit 7 (force and pressure)

The study was delimited to Islamabad Model School for Boys, District Islamabad, to ensure a manageable and controlled research setting. Focusing on Grade 8 General Science allowed for a homogeneous sample, reducing variability in curriculum exposure and cognitive abilities. The use of the Federal Board 2022 textbook ensured a standardized curriculum, enhancing the study's relevance and consistency (Creswell, 2014; Fraenkel et al., 2018; Gall et al., 2015).

1.8 Operational Definitions

A. Presentations: A structured way of sharing information where individuals or groups verbally explain a topic using visual aids like slides, charts, or props to communicate their ideas effectively (Smith & Brown, 2020).

B. Teams Practice: A collaborative training session where team members work together to enhance their skills, coordination, and understanding of tasks to improve overall performance (Johnson & Lee, 2019).

C. Quizzes: Short assessments used to evaluate knowledge, understanding, or progress on a specific subject, typically consisting of multiple-choice, true/false, or short-answer questions (Anderson & Krathwohl, 2001).

D. Individual Improvement Scores: A numerical measure of a person's progress over time, based on performance in tasks, assessments, or skill development activities (Dweck, 2006).

E. Team Recognition: Acknowledging and appreciating a group's efforts, achievements, or contributions through awards, certificates, or verbal praise (Katzenbach & Smith, 1993).

F. Academic Achievement: refers to the measurable performance outcomes of a student in educational settings, typically assessed through grades, standardized tests, and teacher evaluations. It reflects how well a student has mastered specific academic skills or content areas such as mathematics, science, language arts, or social studies (Steinmayr et al. 2014)

G. Elementary Level: refers to the foundational stage of formal education, typically encompassing grades 1 through 5 or 6, depending on the education system. At this level, children usually range from 5 to 11 years old and are introduced to basic literacy, numeracy, science, and social studies. (International Standard Classification of Education, ISCED 2011)

1.9 Conceptual framework

In educational research, a conceptual framework serves as a foundational structure that guides the investigation by linking theoretical concepts to empirical observations. It assists researchers in identifying relevant variables, formulating research questions, and interpreting findings within a coherent theoretical context. For example, applying constructivist theories in education can help researchers understand how learners actively construct knowledge based on their experiences and interactions. The importance of a conceptual framework lies in its ability to provide clarity and focus, ensuring that the research process is systematic and aligned with established theories, thereby enhancing the validity and reliability of the study's outcomes. Another significant application is seen in the constructivist approach to learning, which posits that learners actively construct knowledge through their experiences and interactions. This perspective has led to the development of various subtypes, such as social constructivism and communal constructivism, each offering unique insights into the learning process (Bjorklund, D. 2018).

A conceptual framework in educational research serves as a guiding structure that defines and organizes key concepts, theories, and relationships within a study. It provides clarity, coherence, and direction by linking theoretical perspectives with empirical research. A conceptual framework establishes a theoretical basis for a study by drawing from existing theories, models, and literature. It helps researchers position their study within a broader academic context. One of the primary roles of a conceptual framework is to identify and define key variables in a study. It helps differentiate between independent, dependent, and mediating/moderating variables. A conceptual framework prevents research from being too broad or unfocused. By outlining the scope and boundaries of a study, it helps researchers stay on track. Without a clear framework, studies may lack coherence and struggle to produce meaningful conclusions.

In summary a conceptual framework plays a pivotal role in educational research by providing theoretical grounding, which helps establish a strong foundation based on existing theories and literature. It also defines key variables, clarifying relationships between different factors in a study. By shaping research design, the framework guides methodology, ensuring that the study follows a

structured approach. Additionally, it aids data interpretation, helping researchers analyze findings within a meaningful theoretical context. A well-structured conceptual framework ensures coherence and focus, preventing research from becoming too broad or fragmented. Furthermore, it informs educational policies, contributing to evidence-based decision-making and improvements in teaching and learning practices. Lastly, it encourages critical thinking and innovation, allowing researchers to identify gaps, refine existing theories, and propose new models to enhance educational outcomes.

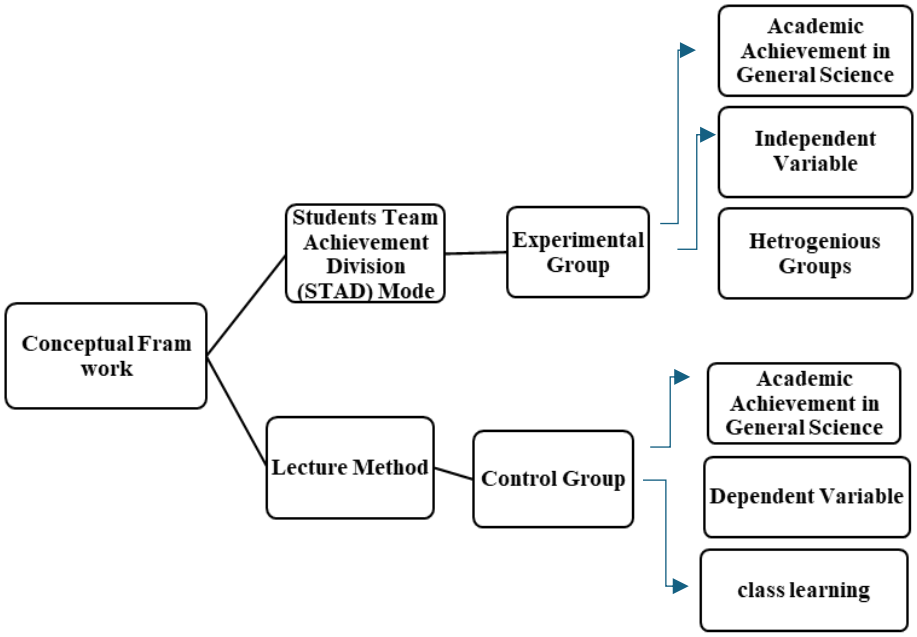

Figure: 1.1

Constructivist Learning Theory: Knowledge is constructed actively by learners through experiences and interactions. Students collaboratively engage with peers to explore, discuss, and understand new concepts. This interaction promotes deeper

learning as students build on their prior knowledge while integrating new information. Constructivist Learning Theory is a framework that emphasizes the active role of learners in constructing their understanding of the world through experience and reflection. The theory suggests that knowledge is not passively received but actively built by the individual.

It emphasized the importance of discovery learning, where learners actively engage in problem-solving and exploration to construct new ideas based on their current knowledge. It highlighted the role of scaffolding: temporary support provided by teachers or peers to help learners achieve tasks they cannot complete independently. Both theories underpin constructivist approaches in classrooms, encouraging active participation, inquiry-based learning, and hands-on experiences. Constructivism supports frameworks like the Students Team Achievement Division model, where learners actively construct knowledge in collaboration with peers. Social Interdependence Theory: Positive interdependence enhances group dynamics, motivation, and outcomes, where members perceive that their success is linked to the success of the group. In Students Team Achievement Division model teams are rewarded based on collective improvement, encouraging students to work together, share knowledge, and support each other's learning.

Motivational Theory: Motivation drives engagement, and learning is most effective when tasks are meaningful, and rewards are aligned with efforts. In Students Team Achievement Division model individual accountability (quizzes) and group rewards combine intrinsic and extrinsic motivators to sustain effort and participation.

Vygotsky’s Sociocultural Theory: Social interaction plays a fundamental role in cognitive development, especially within the Zone of Proximal Development (ZPD). In Students Team Achievement Division model peer tutoring and collaboration enable students to perform tasks beyond their capabilities, facilitating scaffolding and shared learning experiences.

Behaviorist Theory: Positive reinforcement strengthens desired behaviors, in the Students Team Achievement Division model group rewards for improved performance act as reinforcements, encouraging collaboration and consistent effort.

The theoretical framework is a configuration that offers direction to the researchers by relying on recognized theory. The researchers can use it as a good

connection for the constructs of the study. According to the founder of this model, Slavin's (1994) Student team achievement division model is applicable in all academic areas to enhance learning outcomes. In this continuity, he suggested teaching strategies to improve learning through teamwork, which structured the basis for the conceptual framework of this study. Introducing the founders of this model by the foundation for cooperative learning, the movement of cooperative learning and worked as research director at the Center for Learning Together and by doing teamwork (Munawaroh, 2013). This method is highly applicable and flexible to various levels of students since classes are organized based on diverse groupings. It is also ensured that students experience accelerated learning as it emphasizes the principle that students collaborate to learn while also being accountable for their own education (Widhyastika, 2017).

1.9.1 Theoretical and practical articulation of STAD:

Extension of Cooperative Learning Theory: While cooperative learning has been extensively studied in Western contexts, there is still a need to test whether its underlying principles hold true in diverse cultural and educational systems. This study provides empirical evidence for STAD's applicability in classrooms, which are often characterized by large class sizes, limited resources, and teacher-centered instruction. Contribution to Achievement and Equity Research: Research suggests that cooperative learning models help reduce achievement gaps (Javed & Mehmood, 2021). By testing STAD's effects on different ability groups, this study strengthens the theoretical framework on equity and inclusiveness in education.

Integration with Constructivist Learning Theory: The results support constructivist views of learning, where knowledge is actively built through interaction and collaboration. If STAD proves effective, it adds weight to constructivist and socio-cultural learning theories (Vygotsky's Zone of Proximal Development), highlighting peer interaction as a crucial mechanism for academic growth.

1.9.2 Practical Significance of STAD:

For Teachers: STAD provides a structured yet flexible teaching strategy that can move classrooms beyond rote memorization to active, student-centered learning. Teachers facing large classes can use STAD to engage (Kousar et al., 2024).

For Students: STAD fosters teamwork, communication, and critical thinking while enhancing academic achievement. It builds confidence among low achievers, reduces fear of failure, and cultivates a sense of belonging. Students learn not only subject matter but also essential 21st-century skills such as collaboration (Yeni et al., 2023).

For Schools: At the institutional level, adopting STAD can improve overall school performance indicators, reduce dropout rates, and enhance student motivation. Schools struggling with limited resources may find STAD a cost-effective way to improve learning outcomes without relying heavily on technology.

For Policymakers: In a country like Pakistan, where disparities in educational outcomes persist (ASER Pakistan, 2024a), STAD offers a model for equitable classroom practices.

1.9.3 Educational Gaps and Challenges

While STAD has been shown to enhance students' mastery of scientific concepts, its effectiveness at the elementary level is constrained by systemic and contextual barriers that call into question its sustainability. The Indonesian classroom action research study with fourth graders illustrates this tension: although proficiency levels rose substantially, the improvements were contingent upon intensive teacher guidance, highlighting that without structured professional support, the model's gains are fragile (Fahmi et al., 2025). This finding point to a deeper issue: the assumption that cooperative learning is self-sustaining ignores the high pedagogical demands it places on teachers, particularly in under-resourced systems.

Moreover, the misalignment between team-based pedagogies and assessment regimes rooted in individual performance creates a structural disincentive for schools to fully integrate STAD. The challenges are further magnified in multilingual and culturally diverse contexts

Crucially, the short-term nature of most interventions raises doubts about the model's long-term viability. Without systemic investment in professional development, coaching, assessment reform, and resource provision, the benefits of STAD are

unlikely to be institutionalized. Thus, the critical issue is not whether STAD works in principle, but whether the surrounding educational infrastructure is capable of sustaining its promise (Ullah et al., 2023).

1.9.4 Why Students Team Achievement Division (STAD) Model

In the rapidly evolving educational landscape, traditional methods of instruction are being increasingly challenged by more interactive and student-cantered pedagogies. One such innovative approach is the Student Teams Achievement Divisions (STAD) model, a team based learning technique designed to enhance student engagement, motivation, and academic achievement. Despite the global shift towards team based and collaborative learning, many schools, particularly in developing countries like Pakistan continue to rely heavily on the lecture method, a teacher-centred approach that often limits student participation (Rehman et al., 2023). The lecture method remains the most commonly used instructional practice in public and private schools, especially in science subjects, making it a logical and relevant point of comparison (Akhtar & Mahmood, 2024). Unlike other active learning strategies that are not yet widely adopted in Pakistan, STAD provides a structured, research-backed alternative. Therefore, comparing STAD with the lecture method is both necessary and timely to understand the pedagogical shift needed to improve student learning outcomes. This study aims to contribute to evidence-based reforms in classroom instruction by empirically evaluating these two contrasting approaches.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Team Based Learning and STAD Foundations

Team based learning grounded in social interdependence and constructivist theory, is widely recognized for fostering academic achievement through structured peer interaction (Tadesse, 2024). Within TBL models, the Student Teams Achievement Division (STAD) framework stands out for combining group goals with individual accountability, as theorized by Slavin (1995). Studies show that when students collaborate toward team rewards, they develop responsibility, motivation, and communication skills while reinforcing content mastery (Yulini, 2023; Luzyawati, 2024).

2.1.1 Strengths and Criticisms

Research consistently highlights STAD's benefits, including enhanced achievement, motivation, teamwork, and problem-solving (Alijanian, 2022; Mahadi et al., 2023; Rejeki, 2023). At the same time, scholars caution that its implementation can be time-intensive, demanding in terms of teacher preparation, and difficult to sustain in overcrowded or resource-limited classrooms (Nazari, 2023; Sholikhah et al., 2024). Moreover, without adequate training, teachers often struggle to manage group dynamics and align STAD with exam-driven curricula (Juliansih, 2023).

2.1.2 Local and Recent Evidence

In Pakistan, lecture-based instruction continues to dominate despite repeated policy endorsements of active learning (NEP, 2017; Rehman & Malik, 2021). National assessments reveal the consequences of this reliance on traditional methods: only 38% of elementary students achieved science proficiency (NEAS, 2022), while persistent rural learning gaps were also documented (ASER, 2023). Emerging local evidence indicates that the Students' Team Achievement Division (STAD) model can improve science achievement and reduce classroom anxiety (Fatima & Ahmad, 2020; Ghaffar et al., 2021; Maqbool et al., 2022). Nevertheless, empirical research since 2018 remains sparse, highlighting a critical gap in evaluating STAD's effectiveness within Pakistani classrooms.

2.1.3 Comparative Perspectives

Comparisons of team based learning models reveal distinct strengths: STAD provides structured accountability and achievement focus, Jigsaw fosters content specialization, Teams-Games-Tournaments boost motivation through competition, while Group Investigation emphasizes inquiry (Tran, 2021). Studies conclude that STAD is particularly effective in quantitative subjects (math, science), whereas inquiry-based models suit project learning (Altun, 2023).

2.1.4 Strengths and Weaknesses of STAD

Strengths and weaknesses of STAD Method discuss about the existence of different setting in particular situations for learning.

Collaboration and Peer Support: Students learn through teamwork, where stronger learners help weaker ones, ensuring collective progress.

Increased Motivation: Since success depends on both individual effort and group achievement, students stay more engaged and motivated.

Active Learning: STAD emphasizes understanding and applying concepts rather than rote memorization.

Improved Academic Achievement: Research shows that STAD can raise performance, especially in subjects like mathematics and science.

Development of Social Skills: Students practice communication, problem-solving, and teamwork skills that are useful beyond the classroom.

Weaknesses of STAD

Time Consuming: Implementing STAD requires more class time, which can be difficult in large or fast-paced courses.

Dependence on Group Dynamics: If group members are uncooperative or some remain passive, the entire group’s performance may decline.

Heavy Teacher Involvement: Teachers must carefully prepare, monitor, and manage group activities for STAD to be effective.

Assessment Challenges: Balancing individual and group evaluation can be complicated and sometimes unfair.

Limited Applicability: STAD may not be suitable for all subjects, grade levels, or contexts, especially when the syllabus is too broad or time is limited.

2.1.5 Motivation, Engagement, and Social Interaction

Beyond academic achievement, STAD has a strong impact on affective and social outcomes. Research highlights that it increases student motivation, enthusiasm, and classroom participation by fostering collaboration and accountability within groups (Rini, 2022; Rorimpandey, 2022). Activities such as games, discussions, and peer support create a sense of belonging and positive classroom dynamics (Rasanti et al., 2022). Studies further emphasize improvements in teamwork, social skills, and peer-assisted learning, underscoring STAD's role in building collaborative competencies (Zebua et al., 2022; Pardiyana, 2023).

2.1.6 Skills Development in Language and STEM Education

STAD has also proven effective in language learning, particularly in improving reading comprehension, grammatical competence, and communication skills in both EFL and native language contexts (Sirod, 2022; Tabatabaei, 2022). In STEM subjects, it promotes conceptual understanding, critical thinking, and problem-solving skills, even in resource-constrained environments such as schools with limited laboratory facilities (Shofiatin et al., 2024; Mustapa, 2023). These findings demonstrate STAD's adaptability across disciplines and its capacity to foster both cognitive and practical skills.

2.1.7 Integration with Other Strategies

Several studies have explored STAD's integration with instructional innovations such as flipped learning, crossword puzzles, scientific approaches, and digital cooperative learning. These combinations often yield higher learning outcomes, particularly in expository writing, biology, and online science learning, by blending active participation with structured assessment (Shafiee, 2022; Mensah, 2022; Rosnawati, 2022; Sopiyah & Mogelvang, 2023). Such findings suggest that STAD is flexible and effective when adapted to modern pedagogical contexts, including digital and blended learning environments.

2.1.8 Challenges and Considerations

Despite its strengths, STAD is not without challenges. Studies caution that its success depends heavily on teacher preparation, classroom management, and equitable participation among students (Miguel & Garcia, 2023). Large class sizes, time constraints, and variations in student ability can effect while STAD enhances

collaboration, some research indicates that alternative cooperative strategies like Jigsaw may be more effective for certain skills such as reading descriptive texts (Ramdhani, 2023). These limitations highlight the need for contextual adaptation, especially in settings like Pakistan where overcrowded classrooms and rote memorization dominate (ASER, 2024).

2.1.9 Theoretical Perspectives

Social and Cognitive Learning Foundations: Social Learning Theory emphasizes that students learn by observing and interacting with peers, highlighting how collaborative learning enhances both intellectual and emotional development. Studies confirm that STAD promotes cooperation, problem-solving, and social awareness, transforming passive classrooms into engaging environments (Pudjiarti & Simpson, 2023; Fauziah & Rusi, 2023). Similarly, research on collaborative online learning and inclusive strategies (e.g., for visually impaired learners) demonstrates that peer-supported interaction strengthens metacognition, autonomy, and civic competencies (Fosua & Nnamani, 2023; Van & Malazonia, 2023).

2.1.10 Conventional Teaching Methods

In contrast, conventional teacher-centered methods, particularly lectures, dominate classrooms in many developing contexts. These approaches prioritize rote memorization, passive listening, and rigid discipline, often leading to surface-level learning. While such methods may deliver content efficiently, they rarely cultivate critical thinking, problem-solving, or collaboration skills essential for 21st-century education (ASER, 2024).

2.1.11 Motivation and Student Engagement

STAD has been shown to significantly enhance motivation compared to traditional approaches. Strategies such as sharing team achievements, fostering peer accountability, and rewarding progress boost student enthusiasm and engagement across disciplines (Insani, 2023). Active learning models like Think–Pair–Share and Picture-and-Picture further confirm that structured collaboration increases self-esteem, participation, and learning outcomes (Nasrulloh & Suleman, 2024).

2.1.12 Cognitive and Literacy Skills

Research indicates that STAD improves not only subject-specific achievement but also broader intellectual and soft skills. Applications in reading comprehension

(Ibrahim, 2023), vocational training (Kamal, 2023), and media-supported team based learning (Asriyani, 2024) have enhanced literacy, creativity, and communication. These approaches integrate cooperative structures with supplementary tools, strengthening both academic outcomes and transferable skills.

2.1.13 Social Competence and Behavior

Team based learning also develops social competencies such as teamwork, communication, and conflict resolution. Large-scale studies, including the French PROFANE project, found that collaborative models like Jigsaw reduce gender gaps in perceived social skills over time (Rudman, 2024). Similarly, research across physical education and mathematics classrooms shows that team based learning fosters responsibility, inclusivity, and cultural integration, benefiting both academic and behavioral outcomes (Zhou, 2024; Nur'aini, 2024).

2.1.14 Components of Students Team Achievement Division Model

The Student Team Achievement Division (STAD) framework exemplifies a structured approach to team-based learning, with five interconnected components that collectively balance direct instruction, accountability, and group interdependence. Teacher-led presentations remain foundational but are deliberately narrowed to essential concepts, serving as a scaffold for subsequent team activity. This design highlights STAD's hybrid character bridging traditional instruction with active engagement yet it also creates vulnerability, overly compressed presentations may reduce conceptual depth and limit the value of peer collaboration.

The deliberate heterogeneity of group formation reflects the framework's equity-oriented design, as mixed-ability teams encourage peer tutoring and distributed responsibility. However, while this structure aligns with the principles of team-based learning, it also imposes practical challenges, particularly in teacher-managed settings where interpersonal tensions or dominance patterns may undermine inclusivity. The use of individual testing reinforces personal accountability within the team, converting collective preparation into individual responsibility. Closely linked to this, the improvement score system shifts assessment from absolute achievement to relative progress, motivating underperforming students while still rewarding high achievers. Critics, however, caution that such emphasis on incremental gains may undervalue deeper conceptual mastery. The consolidation of results into group scores

further embeds interdependence, with recognition and rewards acting as extrinsic motivators. While this strategy can strengthen group cohesion, it risks displacing intrinsic motivation if rewards are perceived as the primary driver of participation. Moreover, the assumption of balanced contribution is not always sustainable, especially in contexts characterized by large class sizes, rigid authority structures, or scarce resources.

In synthesis, STAD operationalizes team-based learning by embedding equity, accountability, and motivation into its structure, thereby addressing common criticisms of group work such as free-riding and uneven participation. Yet its effectiveness is not universal; it is contingent on skilled facilitation, sensitivity to classroom dynamics, and institutional support.

2.1.15 Cooperative Learning

Cooperative learning (CL), grounded in social interdependence and constructivist theories, is widely recognized for fostering academic gains through structured group interaction. Central to its effectiveness are the five fundamental components—positive interdependence, individual accountability, promotive interaction, social skills, and group processing whose presence strongly predicts successful outcomes (Adl-Amini, 2024). However, the extent to which these benefits are realized depends heavily on the quality of implementation, which in turn reflects educators' beliefs and perceptions about social learning. Teachers who value collaboration and assume responsibility for collective success demonstrate higher implementation quality, highlighting the interplay between pedagogical design and teacher agency. Complementing this perspective, Tadesse (2024) demonstrates that embedding CL frameworks in higher education reform enhances student engagement and learning compared with traditional lecture-based instruction.

Together, these findings indicate that while the theoretical strengths of CL are well established, its practical impact hinges on educators' commitment to fostering meaningful collaboration and on institutions' willingness to redesign curricula accordingly. Cooperative learning possesses the potential to boost students' political efficacy, primarily by offering them chances to practice democratic skills and by having peers serve as political role models. Nonetheless, students' feedback highlights tensions within the student group and between viewing the classroom as a collective

learning unit versus the expectations of the classroom as a space for individuality and assessment. These significant contradictions may obstruct the establishment of cooperative learning classrooms and restrict the practice space that could be beneficial for political efficacy (Kosberg, 2024).

Enhancing Motivation, Engagement, and Social Studies Learning Outcomes Through the Jigsaw Type Cooperative Learning Model for Fifth Grade Students. This study seeks to bolster motivation, engagement, and social studies learning outcomes using the Type Jigsaw Cooperative learning model for fifth-grade students. This research is categorized as Classroom Action Research. The findings indicated that the Jigsaw Type Cooperative Learning model can increase motivation for learning. Utilizing the Cooperative Type Jigsaw learning model can enhance student engagement. Furthermore, learning through the Jigsaw Type Cooperative learning model can improve academic outcomes (Soares, 2024).

Extensive research has demonstrated that the Student Teams Achievement Division (STAD) model consistently enhances students' academic outcomes across diverse subjects such as mathematics, science, biology, and social studies. Studies in Indonesia, Africa, and South Asia report that students taught through STAD outperform peers taught with traditional lecture methods, particularly in comprehension, problem-solving, and higher-order thinking (Ibrahim, 2022; Marajo & Syahbuddin, 2022; Ridwan, 2022). STAD has also been shown to improve analytical thinking and process skills when compared to models like Jigsaw, though effectiveness varies depending on grade level and classroom (Winarni, 2022).

2.1.16 Cooperative Learning Technology

This study underscores the growing significance of integrating cooperative learning with technology in primary education, where the development of teamwork, critical thinking, and social skills is foundational. While traditional collaborative methods already enhance peer interaction, incorporating digital tools expands their scope by providing access to diverse resources, fostering engagement, and enabling connectivity beyond the classroom. Abdullaevna (2024) emphasizes that the transformative potential of cooperative learning technology lies not merely in tool adoption but in how it is embedded into pedagogy. Effective implementation requires deliberate strategies, including careful selection of platforms, sustained teacher

training, structured interactive tasks, and mechanisms for peer feedback and digital citizenship. At the same time, evaluation of outcomes and extension of collaboration into virtual spaces ensure that learning is both authentic and future-oriented. Collectively, these considerations suggest that technology can amplify the benefits of cooperative learning, but its success depends on pedagogical alignment rather than technological novelty alone.

2.1.17 Students Team Achievement Division Model for Skill Development

Serota (2023) highlights the importance of pedagogical approaches that move beyond rote learning and theoretical knowledge to emphasize the development of transferable skills. In response to these evolving educational demands, a range of innovative models have been introduced, with cooperative learning standing out as one of the most effective. Cooperative learning frameworks center on structured group interaction, enabling students to work collectively toward common academic goals while building interpersonal competencies. Within this domain, the Student Teams Achievement Division (STAD) model has gained particular recognition for its effectiveness. Although cooperative learning principles have long been part of educational theory, their adaptation through STAD in modern classrooms has produced significant benefits. Recent studies, such as Kamid (2022), demonstrate that STAD not only enhances collaborative engagement but also strengthens students' academic achievement, illustrating its relevance as a transformative instructional strategy in the 21st century.

2.1.18 Students Team Achievement Division (STAD) Model in 21 Century

The Student Team Achievement Division (STAD) model organizes students into heterogeneous groups where peer assistance, collective problem-solving, and preparation for individual assessments intersect. By design, this approach embeds structured teamwork within academic tasks, linking small-group collaboration to individual accountability. Empirical evidence consistently highlights its potential to strengthen student interaction and improve achievement, yet the effectiveness of these outcomes is context-dependent. Mahadi et al. (2023) emphasize that carefully managed implementation enables students to engage actively in discussions, analyses, and problem-solving, thereby supporting both cognitive and social development.

Similarly, Rejeki (2023) identifies participation, social skill cultivation, and peer-supported comprehension as notable strengths.

Juliansih (2023) argues that the shifting demands of the Industrial Revolution complicate STAD's application, suggesting that rigid adherence to its traditional structure may not adequately meet evolving educational needs. Yerizon (2020) extends this critique by situating STAD within the broader imperative of 21st-century education, noting that while the model promotes collaboration, it must also integrate creativity, critical thinking, and adaptability if it is to remain relevant in uncertain and dynamic contexts. Taken together, these perspectives highlight a dual reality: STAD has proven pedagogical value in fostering participation, inclusivity, and academic gains, but its success is neither automatic nor universal. For the model to achieve sustained impact, teachers and curriculum designers must adapt it to contemporary educational priorities, aligning its collaborative structures with the competencies essential for long-term success. Thus, STAD is best understood not as a static method but as a framework requiring contextual modification to bridge immediate learning outcomes with the broader challenges of 21st-century education.

2.1.19 Students Team Achievement Division Model with Dynamic Settings

Research highlights both the pedagogical promise of the Student Team Achievement Division (STAD) model and the structural barriers that complicate its implementation. Nazari (2023) underscores the inadequacies of technological infrastructure particularly limited access to digital devices as a major impediment to adoption, while inconsistent teacher training further restricts effective facilitation. Without adequate professional development, educators may lack the skills to manage group processes or to translate the model's principles into meaningful learning experiences. This challenge becomes more pronounced in large, heterogeneous classrooms, where diverse student competencies intensify difficulties in sustaining equitable participation (Sholikhah et al., 2024).

Despite these constraints, STAD aligns strongly with the demands of 21st-century education. As structured dialogue and shared understanding within groups foster accountability, process skills, and deeper engagement. When supported by thoughtful task design, careful group formation, and constructive feedback, the model cultivates critical thinking, communication, collaboration, and problem-solving. In

doing so, it not only strengthens academic performance but also encourages the development of autonomous learners prepared for lifelong challenges. Kamid (2023)

Nonetheless, successful implementation remains contingent on contextual adaptation. Evidence suggests that STAD can be effective in both face-to-face and online environments, enhancing motivation when digital tools are available. However, persistent obstacles such as large class sizes, unequal student performance, resource scarcity, and the complexity of group management continue to limit its universal applicability. Recent scholarship (Hamidi et al., 2023) Taken together, these perspectives suggest that while STAD holds considerable potential for advancing academic, social, and process-oriented outcomes, its effectiveness is not guaranteed. Teacher training, institutional support, and curricular innovation remain essential in transforming the model from a theoretical framework into a sustainable pedagogical practice capable of meeting the evolving demands of contemporary education.

2.1.20 Students Team Achievement Division (STAD) Model with Educators

Qureshi (2023) emphasizes that effective teacher training is central to the successful implementation of the STAD model, as educators with adequate preparation are more capable of managing group dynamics and ensuring equitable participation. Without such training, the model's collaborative potential risks are undermined by uneven contributions or ineffective facilitation. Expanding on this, Yunita (2023) situates the notion of "expected learning" within a broader educational shift from traditional, one-way instruction dominated by the teacher to interactive, multi-directional engagement among teachers, students, communities, and learning resources. This reconceptualization positions the instructor not merely as a transmitter of knowledge but as a facilitator of innovation, guiding students toward enhanced cognitive development through interactive processes.

2.1.21 Students Team Achievement Division (STAD) Implication for Education

Drawing on Vygotsky's sociocultural theory, Amalia (2024) identifies two key implications for contemporary pedagogy: the cultivation of cooperative learning within diverse groups, enabling students to develop problem-solving abilities within their respective zones of proximal development, and the use of scaffolding, whereby learners gradually assume greater responsibility for their own learning. These insights underscore the need for instructional models that actively structure interaction and

cognitive support, thereby transforming learning from a passive to a participatory process. Said (2023) reinforces this point by conceptualizing a learning model as a systematic framework that organizes experiences, guiding both planning and implementation. When such frameworks fail to meet criteria of effectiveness, inefficiencies and disengagement are likely to arise.

Within this context, Sutiyono (2024) highlights the relevance of cooperative approaches, particularly the Student Team Achievement Division (STAD) model, which engages learners through dialogue, idea exchange, and evidence-based inquiry. This resonates with Sari's (2023) argument that learning models are most effective when they prioritize active student involvement within groups. Extending this view, Febriani and Frasandy (2024) emphasize that STAD requires learners to become more proactive, self-reliant, and innovative, while fostering collaboration through peer-to-peer communication and mutual support. Beyond academic outcomes, such collaboration develops essential social skills that prepare students for wider interpersonal and professional contexts. Taken together, these perspectives situate STAD as a pedagogical model that not only operationalizes Vygotskian principles of interaction and scaffolding but also addresses the dual goals of cognitive development and social competence. However, its effectiveness is contingent upon the degree to which educators can balance structured support with opportunities for independent and collaborative learning.

2.1.22 Students Team Achievement Division Model with Positive Effects

Zahro (2024) emphasizes the importance of developing innovative learning models tailored to subject matter, noting that effective models strengthen communication both among students and between students and teachers. Such interaction fosters collaboration skills and enhances academic outcomes, positioning cooperative frameworks like STAD as valuable tools for active engagement. Learning outcomes, in this regard, extend beyond content mastery to encompass the competencies and skills students acquire through participation in structured educational activities. Septian (2024) links positive learning outcomes to students' ability to demonstrate new competencies by completing tasks and responding to assessments accurately and within prescribed parameters. This reinforces the principle that outcomes should not only serve as benchmarks for student progress but also guide

teachers in designing and sequencing instruction. Similarly, Rahayu (2024) underscores the centrality of group formation in cooperative learning, arguing that student achievement levels must be considered to maximize the effectiveness of small-group work. Through such structuring, students are encouraged to support one another in understanding material, thereby creating learning experiences that are purposeful, engaging, and enjoyable. Collectively, these perspectives illustrate that while cooperative models such as STAD offer clear potential to enhance learning outcomes by integrating communication, collaboration, and peer support, their success depends on careful alignment with instructional goals and thoughtful group organization. Without these conditions, the promise of improved outcomes risks being reduced to procedural compliance rather than meaningful learning.

2.1.23 Transformation through Education

Xu (2023) positions education as a central pillar for cultivating high-quality human resources, a role that has become increasingly urgent in the context of the Fourth Industrial Revolution. Emerging technologies such as artificial intelligence, robotics, and digitalization are reshaping employment, communication, and social life, compelling education systems to adapt accordingly. In this new landscape, education is no longer confined to the transmission of academic knowledge; rather, it must prioritize the development of competencies aligned with contemporary global demands. Widyastuti (2023) reinforces this argument by highlighting that critical thinking; communication, collaboration, and digital literacy represent indispensable skills for navigating 21st-century challenges. These competencies enable learners not only to address complex problems but also to function effectively in diverse, team-based environments. From this perspective, educational infrastructure must serve a dual function: equipping students with subject-specific expertise while simultaneously preparing them to adapt to rapidly evolving technological and social conditions. The ability to integrate disciplinary knowledge with transferable skills thus becomes a defining criterion of quality education in the present era.

2.1.24 Students Team Achievement Division (STAD) Theoretical Foundations

The Student Team Achievement Division (STAD) model, grounded in Slavin's cooperative learning theory, operationalizes Vygotsky's social constructivist principles by structuring peer interactions to facilitate learning within the Zone of

Proximal Development (ZPD). According to Vygotsky, collaboration with more knowledgeable peers enhances cognitive growth, a concept that STAD enacts through heterogeneous teams, peer tutoring, and guided discussion. Slavin (1995) further emphasizes that cooperative learning is most effective when it combines shared group objectives with individual accountability both central features of STAD. In practice, students initially engage with direct instruction, collaborate in teams to consolidate understanding, and are subsequently assessed individually, ensuring personal responsibility while benefiting from collaborative reinforcement.

Synthesis of Research Themes

Impact on Science Achievement: Empirical studies (Ghaffar et al., 2021; Maqbool et al., 2022) indicate that STAD significantly enhances elementary-level science performance. The model's structured team interactions, frequent feedback, and reinforcement mechanisms are credited with promoting active engagement and deeper comprehension of scientific concepts.

Influence on Group Dynamics and Motivation: Research by Fatima and Ahmad (2020) suggests that STAD strengthens interpersonal communication, reduces classroom anxiety, and increases motivation. Its emphasis on peer support fosters social cohesion, its beneficial in culturally and academically diverse classrooms.

Comparative Effectiveness: Comparative analyses of cooperative learning strategies (e.g., STAD versus Jigsaw or traditional lecture methods) reveal that all models improve learning relative to conventional teaching; however, STAD's integration of structured assessments and group rewards yields more consistent outcomes, particularly in quantitative disciplines such as science and mathematics.

Contextual Challenges in Pakistan: Despite its demonstrated benefits, implementing STAD in Pakistani public schools faces several systemic barriers. Inadequate teacher training in cooperative methods limits educators' capacity to manage mixed-ability teams or provide timely, constructive feedback. Rigid curricula, high-stakes examination pressures, and low student interest often linked to outdated textbooks and minimal laboratory-based learning further constrain adoption. Large class sizes exacerbate challenges in team management and oversight. To overcome these limitations, localized teacher training, curriculum flexibility, and cost-effective resources are essential. Integrating STAD-compatible strategies into government and

provincial teacher development programs could promote interactive science learning while aligning with contextual constraints.

Table 2.1 *Comparisons with Other Cooperative Learning Models*

Feature	STAD	Jigsaw	TGT	Group Investigation
Focus	Achievement & accountability	Content specialization	Motivation via games	Inquiry & student control
Teacher Role	High structure	Moderate	Moderate	Low (more student-led)
Assessment	Individual quizzes + team average	Mixed individual & group	Tournament scores	Group presentation/reports
Best Use	Science, Math	Social studies, Literature	Basic skills, review	Project-based learning

2.2 Different team based Learning Strategies

Effective teaching requires selecting instructional strategies that align with learners' needs and maximize both cognitive and affective outcomes. Educators must be proficient in diverse teaching methods and implement them strategically to foster meaningful learning experiences. In recent years, team-based learning (TBL) a subset of student-centered approaches has gained global attention for its ability to engage learners collaboratively and improve learning outcomes. Techniques within this paradigm include Learning Together (LT), Jigsaw, Teams-Games-Tournaments (TGT), Group Investigation (GI), Student Teams Achievement Division (STAD), and Team Accelerated Instruction (TAI), all of which have demonstrated positive impacts on cognitive and social development (Tran, 2021).

Successful TBL depends on active participation by all team members, who must collaboratively engage with the material to achieve shared and individual goals (Faramarz, 2023). Within STAD, students work in small heterogeneous teams following teacher-led instruction, complete individual assessments, and contribute to team performance. Structured team interactions, combined with incentives for collaborative achievement, reinforce accountability and social cohesion while enhancing understanding of the subject matter (Cooper, 2010; Pambudi, 2016).

Project-based learning (PBL) complements TBL by immersing students in hands-on, authentic tasks that connect theory to real-world applications. Evidence suggests that PBL fosters deep learning, critical thinking, and problem-solving while enhancing motivation when students actively participate in meaningful projects (Baran et al., 2023). Integrating gamified elements into PBL further enhances engagement, providing clear objectives, feedback, and motivational rewards (Innovating Pedagogy, 2019; Markham, 2020). Together, these approaches align with student-centered and experiential learning paradigms, which emphasize active participation, metacognition, and the application of knowledge in diverse contexts.

Team-based learning, particularly STAD, consistently demonstrates benefits across academic, social, and affective domains. It encourages student interaction, accountability, and peer support, thereby fostering critical thinking, self-reliance, and collaborative skills (Lipowski, 2021; Lie, 2023). Empirical studies from Tanzania, China, Kenya, and Turkey confirm that TBL improves student achievement, enhances social-emotional competencies, and cultivates autonomy, engagement, and team cohesion (Vitalice, 2018; Altun, 2023; Amin, 2020). By facilitating active learning in small teams, TBL also addresses motivational deficits and promotes meaningful participation compared to traditional teacher-centered methods (Shih, 2020). From a theoretical perspective, STAD operationalizes Vygotsky's social constructivism by supporting peer-assisted learning within the Zone of Proximal Development (ZPD). Students receive scaffolding from more knowledgeable peers while gradually assuming responsibility for their balancing team collaboration with individual accountability (Amalia, 2024; Slavin, 1995). Learning activities structured under STAD promote dialogue, problem-solving, and knowledge application, enabling students to integrate academic content with critical social and cognitive skills.

In practical terms, STAD offers a framework for addressing specific instructional challenges, such as low motivation, uneven participation, and limited engagement in subjects like Islamic cultural history. By fostering positive team dynamics, mutual respect, and collaborative problem-solving, the model cultivates both academic performance and essential social competencies. Teacher facilitation remains crucial, guiding team interactions, structuring assessments, and providing feedback to ensure meaningful participation. As a result, STAD serves as both a

pedagogical strategy and a classroom organization tool, creating an interactive, team-centered learning environment capable of enhancing outcomes across cognitive, social, and affective domains.

2.2.1 Learning Process

The learning process typically begins with the teacher introducing new material to the class. Subsequently, team members collaborate to practice and internalize the content, often engaging in paired work, discussions, problem-solving exercises, and shared worksheets. Each team member is expected to master the assigned tasks, yet in many classrooms, student independence remains limited, with learners focusing on rote memorization rather than deep understanding and active participation. The Student Team Achievement Division, developed at Johns Hopkins University following extensive research on collaborative instructional strategies, addresses these challenges by providing a structured team-based learning (TBL) approach. STAD encourages active participation from all students, ensuring that every contribution enhances both individual and collective learning (Wonk, 2022).

2.2.2 Collaborative and Cooperative Learning

Collaborative and cooperative learning represent distinct yet interconnected pedagogical approaches that emerged during 1960s and 1970s, aiming to enhance learner engagement and interaction. Collaborative learning emphasizes open-ended group work, shared responsibility, and active communication, allowing students to collectively construct knowledge and deepen conceptual understanding. Cooperative learning, by contrast, is more structured, assigning specific roles to team members to ensure positive interdependence and individual accountability.

In practice, team-based learning (TBL) draws on the strengths of approaches, combining structured collaboration with shared problem-solving and accountability mechanisms. For instance, in social studies, collaborative activities encourage dialogue, debate, and knowledge construction, while TBL fosters a sense of community, mutual support, and respect for diverse perspectives (Johnson, 2022). By integrating structured teamwork with collaborative inquiry, TBL enhances both cognitive development and social competence, preparing students to engage effectively in complex, real-world tasks.

2.2.3 Problem-Based Learning

Research indicates that team-based learning (TBL) models, particularly Student Teams Achievement Division (STAD) and Problem-Based Learning (PBL), are highly effective in promoting sustainable development within e-learning environments in higher education. These approaches enhance student engagement, critical thinking, collaborative problem-solving, and knowledge acquisition, particularly on topics related to sustainability. By emphasizing student-centered learning, TBL empowers learners to take ownership of their education, strengthens problem-solving skills, and deepens their understanding of complex concepts such as sustainable development. In the context of mathematics education, TBL has been shown to improve conceptual understanding through its structured process, which guides students through successive stages of learning while maintaining individual accountability (Nasution, 2020). Similarly, research on Home Science STAD implementations demonstrates its capacity to support the development of higher-order thinking skills (HOTS), equipping teachers to design lessons that foster analysis, evaluation, and synthesis among students (Takko et al., 2020). These findings highlight the broader pedagogical value of TBL in cultivating both cognitive and metacognitive skills, suggesting that future research should investigate its application across diverse educational contexts to maximize learning outcomes and promote holistic student development.

2.2.4 STAD Positively Influences

The Student Teams Achievement Division (STAD) team-based learning (TBL) model exerts a significant positive impact on classroom dynamics and overall learning experiences. By fostering structured interaction and collaboration, STAD enhances student comprehension, engagement, and academic performance while simultaneously supporting teacher facilitation and classroom management (Pardiyana, 2023). The development and implementation of STAD learning tools further reinforce these outcomes by providing practical, high-quality resources that meet essential educational standards. Their effectiveness is evidenced by factors such as efficient teacher management, active student participation, positive student feedback, and the attainment of learning. When integrated with learning, STAD and TBL has been shown to substantially improve students' expository writing skills and

overall perceptions of learning. This blended methodology allows learners to engage with instructional content both independently and collaboratively, promoting deeper understanding, teamwork, and personal responsibility. (Shafiee, 2022).

2.2.5 Crossword Puzzles

Another study explored the integration of the cooperative model with crossword puzzles to improve students' biology learning outcomes, focusing on the topic of Development and Growth from a cognitive perspective. Students in the experimental group were taught using Student Team Achievement Division method combined with crossword puzzle worksheets, while the control group followed conventional teaching methods. The findings indicate that incorporating it with crossword puzzles positively influences cognitive learning outcomes, particularly in the area of biology (Mensah, 2022).

2.2.6 Social Interaction

Cooperative Learning is a group-based educational activity that highlights social interaction among students, individual accountability, and mutual encouragement to enhance each other's learning. Methods like Student Teams Achievement Divisions foster active student involvement, collaboration, and shared responsibility for learning within group settings. Research has shown a positive impact of this method on mathematics learning outcomes, although the effectiveness of any instructional approach may vary based on factors like context, student characteristics, and how the teacher implements the method (Arnas, 2022).

Despite differences in students' backgrounds and abilities, the Student Team Achievement Division method has proven effective in achieving shared goals, such as improving graduation rates, enhancing understanding, and raising the overall quality of teaching and learning. It underscores the concept that the learning process is fundamentally an interaction between teachers and students, aimed at achieving intended learning outcomes.

2.2.7 Efficient Strategies

To enhance student learning outcomes, teachers must implement strategies that are both efficient and pedagogically effective. Research comparing traditional instructional methods with the Student Teams Achievement Division (STAD) approach, alongside structured discussions and strategies to foster student interest,

indicates that TBL is more effective in improving elementary students' performance in social studies. The study demonstrates that when TBL is combined with guided discussion and attention to learners' motivation, it significantly enhances academic achievement and engagement in social studies (Marajo & Syahbuddin, 2022).

2.2.8 Peer-Assisted Learning

Research has highlighted the potential of the STAD cooperative learning model as an effective tool for facilitating peer-assisted learning in subjects such as Anatomy. The study also explored diverse assessment techniques for evaluating students' learning in Akidah Akhlaq, including written tests, assignments, projects, portfolios, observations, self-assessments, peer evaluations, and teacher journals. These integrated assessments provided a comprehensive understanding of students' knowledge and application of the subject matter. The Madrasah education system incorporates authentic assessments that evaluate cognitive, affective, and psychomotor aspects throughout the learning process of Akhlaq (Zebua et al., 2022).

2.2.9 Stimulates Students' Enthusiasm

The Student Teams Achievement Division (STAD) method is a team-based learning (TBL) approach designed to enhance student interaction and engagement. A distinctive feature of this model is the integration of games and interactive classroom activities, which make the learning process enjoyable and stimulating. By incorporating these elements, STAD fosters student motivation, enthusiasm, and active participation. Empirical research indicates that this approach significantly improves science learning outcomes, as the combination of collaboration and engaging activities promotes deeper understanding of content while reinforcing teamwork and shared responsibility (Rorimpandey, 2022).

2.2.10 Students Team Achievement Division Model Increased Student Activity

Research indicates that combining action research with the Student Teams Achievement Division (STAD) model significantly enhances student engagement and learning outcomes in the classroom. Students demonstrate higher levels of participation, deeper comprehension, and improved mastery of the instructional material. Furthermore, studies show that team-based learning (TBL) approaches yield significantly better academic outcomes compared to traditional instructional methods. (Lestari & Armita, 2022).

2.2.11 Analytical Thinking Abilities

A study examining the relationship between analytical thinking and process skills compared the Jigsaw method with the Student Teams Achievement Division (STAD) approach. The findings revealed a strong correlation between analytical thinking and process skills across both models. Differences were observed in students' performance, with higher levels of analytical thinking corresponding to enhanced process skills, particularly when the Jigsaw method was implemented in junior classes. Similar patterns emerged for the STAD model, confirming that team-based learning (TBL) strategies are effective in fostering students' cognitive development and strengthening their analytical and procedural competencies (Winarni, 2022).

2.2.12 Students Team Achievement Division Model Improve Motivation

The implementation of the Student Teams Achievement Division (STAD) team-based learning (TBL) model has been shown to enhance learning outcomes in social studies among fifth-grade students. During the 2018–2019 academic year, its application increased engagement and participation in social studies lessons. Similarly, the use of TBL improved the learning motivation of fourth-grade students studying economic activities. To sustain and further enhance motivation, educators are encouraged to integrate elements of creativity, innovation, enjoyment, and meaningful content into the learning process. Such strategies contribute to making TBL approaches more effective, engaging, and conducive to learning (Rini, 2022).

2.2.13 Think Pair Share

Comparative research on the Think-Pair-Share and Student Teams Achievement Division (STAD) team-based learning (TBL) methods revealed significant differences in students' problem-solving abilities. Students instructed through the STAD/TBL approach achieved notably higher average scores in problem-solving tasks compared to those taught via Think-Pair-Share. These findings suggest that the collaborative strategies inherent in TBL are more effective in developing students' problem-solving skills within the studied context (Siahaan, 2022).

2.2.14 Science Education

Although widely acknowledged, the application of team-based learning (TBL) theory requires further exploration to fully understand its potential for fostering higher-order cognitive skills and problem-solving abilities, particularly in science

education (Vijayalakshmi, 2022). Research evaluating the impact of TBL on the academic performance of senior secondary students in Biology revealed significant differences in achievement between students taught using the Student Teams Achievement Division (STAD) model and those receiving traditional lecture-based instruction. Students instructed through STAD/TBL consistently outperformed their peers in the lecture group, demonstrating enhanced mastery of the material.

2.2.15 Different Factors

A meta-analysis was conducted to evaluate the impact of cooperative learning on mathematics learning outcomes among vocational high school students compared to conventional teaching methods. The findings indicated that the effectiveness of cooperative learning varied based on certain factors. Teachers can leverage these insights to implement cooperative learning strategies tailored to the specific grade level and student demographics in their classrooms (Ridwan, 2022).

2.2.16 Sense of Belonging

Research on the implementation of the Student Teams Achievement Division (STAD) team-based learning (TBL) model indicates a significant increase in students' motivation to learn. TBL strategies enhance both motivation and academic achievement by promoting active engagement, collaborative problem-solving, and the development of essential social and cognitive skills. By organizing students into diverse teams with clearly defined roles, the model fosters a sense of belonging and encourages meaningful participation. This structure not only supports individual accountability but also cultivates a collaborative and supportive learning environment, contributing to the overall success of the team (Rasanti et al., 2022).

2.2.17 Students Team Achievement Division Model Improves Competencies

Research indicates that team-based learning strategies, particularly the Student Team Achievement Division (STAD) model, can significantly enhance students' grammatical competence while also shaping a more positive classroom climate. Sirod (2022) found that STAD not only strengthened language skills but also increased learner engagement, confidence, and willingness to communicate. These outcomes suggest that the value of STAD lies in its ability to integrate skill development with active participation, creating a supportive environment where students feel encouraged to contribute. Nonetheless, while the evidence highlights its effectiveness,

attention must also be given to potential challenges such as uneven group dynamics and increased teacher preparation that may affect broader applicability. Overall, STAD can be regarded as a promising form of team-based learning when applied with careful consideration of context.

2.2.18 Students Team Achievement Division (STAD) Model for EFL

Tabatabaei (2022) provides evidence that the Student Team Achievement Division (STAD) model enhances both academic achievement and creativity among Iranian secondary school EFL learners, suggesting its dual impact on cognitive and affective domains. Broader research supports this claim, showing that team-based learning approaches can strengthen not only subject knowledge but also higher-order skills such as creativity. Comparative studies further reveal that while both STAD and Team-Assisted Individualization (TAI) yield significant gains in mathematics performance, TAI appears to produce slightly stronger effects (Tarim, 2008). Notably, however, students' attitudes toward mathematics did not differ across methods, indicating that improvements in achievement may not always translate into shifts in learners' perceptions or motivation.

2.2.19 Students Team Achievement Division Model Promotes Engagement

The effectiveness of the Student Team Achievement Division (STAD) model stems from its integration of group collaboration with individual accountability, ensuring that diverse learners collectively share responsibility for progress. Evidence shows that this structure promotes active engagement and participation in classroom discussions, with studies demonstrating superior outcomes over traditional instruction in contexts such as teaching systems of linear equations (Ramadhan et al., 2022). In online settings, however, the success of team-based learning is shaped by mediating factors such as the technological tools available to support collaboration and communication. Beyond mathematics, the model has also been shown to increase activity and achievement in physics (Aslamiyah, 2022), though limitations remain in areas such as oral, drawing, and mental tasks, where performance gains are less consistent. Furthermore, STAD has been reported to strengthen students' communicative competence in English, with evidence suggesting greater improvements in reading and speaking skills compared to conventional approaches (Farizawati et al., 2022).

2.2.20 Students Team Achievement Division Model Scientific Approach

Integrating the Scientific Approach with the Student Team Achievement Division (STAD) model has been shown to strengthen both student achievement and motivation. Rosnawati (2022) found that this blended strategy outperformed the Scientific Approach used in isolation, as its structured group processes made instructional delivery more practical and teacher-friendly. The integration was operationalized through stages such as introducing real-world problems, organizing students into groups to generate questions and receive guidance, monitoring discussions, conducting individual assessments, and sharing results to acknowledge group performance. These steps collectively demonstrate that embedding the Scientific Approach within a team-based framework not only improves learning outcomes but also fosters motivation and collaborative knowledge construction. However, the study also points to the need for continued exploration of how such integrations function across different subjects and learning environments to assess their broader applicability.

2.2.21 Pedagogical Competencies

Evidence suggests that team-based learning not only benefits students but also strengthens teachers' professional and pedagogical competencies, which in turn enhance classroom engagement and learning outcomes in science. Geletu and Arum (2022) report that such approaches generate more authentic student participation and improved achievement compared with lecture-driven instruction, as reflected in consistent gains across baseline, midline, and end-line assessments. By accommodating learners from diverse backgrounds, team-based methods ensure inclusive participation and equitable opportunities for achievement. Within this framework, the Student Team Achievement Division (STAD) model has proven particularly effective in reducing language errors and supporting English language development, with both teachers and students recognizing its value for improving communicative competence. Collectively, these findings underscore STAD's dual potential to advance teacher practice and foster student learning, highlighting its promise as a sustainable pedagogical approach.

2.2.22 Effectiveness

Research continues to demonstrate that team-based learning strategies are effective in enhancing both academic performance and student engagement across diverse contexts. Usmaedi (2022) reported that the "listening team" strategy improved mastery in social science subjects by fostering active participation from both teachers and students. Similarly, comparative studies of models such as Team Game Tournament, Jigsaw, Think-Pair-Share (TPS), and STAD show gains in oral communication skills, with evidence of increased classroom interaction, collaboration, confidence, and reduced disruptive behavior (Mahecha, 2022). Beyond communicative competence, STAD has also been examined for its impact on higher-order skills: Ghufron (2023) found that combining STAD with targeted learning tools significantly strengthened critical thinking, psychomotor, and affective outcomes, regardless of prior academic ability. In vocational and technical education settings, TPS has proven particularly relevant. Ismail (2023), studying Brunei Darussalam, highlighted that TPS not only improved participation and subject-specific performance but also fostered essential transferable skills such as teamwork, problem-solving, and critical thinking, while also identifying practical barriers to implementation. Collectively, these findings underline the versatility of team-based learning approaches in promoting academic achievement, communication, and critical skills, though their effectiveness remains contingent on subject context, instructional design, and institutional support.

2.2.23 Metacognition

Recent research underscores the adaptability of team-based learning approaches, particularly the Student Team Achievement Division (STAD) model, when integrated with complementary instructional strategies. Ardianty (2023) demonstrated that combining STAD with the IDEAL-type metacognitive learning strategy enhanced problem-solving skills in thermochemistry more effectively than either approach alone, though improvements in self-efficacy were contingent on students' motivation levels. Parallel findings in physics education confirm that online media–based STAD significantly improved conceptual understanding compared with conventional online methods, with additional benefits observed when paired with virtual laboratory tools (Rasyid, 2023; Mustapa, 2023). Beyond the sciences, team-

based models have proven effective in language and mathematics education. The Think-Pair-Share strategy was shown to significantly strengthen speaking skills in language and arts programs, while STAD yielded substantial gains in geometry performance and overall mathematical engagement, particularly for students with learning difficulties (Sukra, 2023). Collectively, these findings highlight the versatility of STAD and related team-based learning models in fostering problem-solving, critical thinking, and communication across disciplines, while also pointing to the moderating influence of learner motivation and the importance of integrating supportive instructional tools.

2.2.24 Students Team Achievement Division (STAD) Model and Jigsaw

Comparative studies of team-based learning strategies confirm their effectiveness in language and beyond. Both the STAD and Jigsaw models have been shown to significantly improve English reading comprehension, reinforcing their value in language instruction and suggesting practical benefits for teachers seeking to enhance proficiency (Triansyah & Adawiyah, 2023). Extensions of STAD, such as the Remap-STAD model, have positive effects on creative thinking, and academic performance, thereby contributing to broader aspects of student development. Beyond language learning, trend analyses reveal a growing body of research on the Jigsaw model in economics education, with increasing publications focusing on student activity, achievement, and cooperative engagement. These patterns not only highlight the sustained relevance of team-based models in diverse subject areas but also signal their potential to shape future pedagogical research agendas.

2.3 Students Team Achievement Division (STAD) Model and Skills

To enhance students' collaborative and academic skills, research has examined the implementation of the STAD model in conjunction with scientific worksheets among elementary learners. Gillis (2023) reported that this approach led to significant gains in both learning outcomes and teamwork abilities, highlighting the model's dual role in fostering academic achievement and social development. The underlying principle of positive interdependence where students share responsibility for group goals encourages active engagement, mutual support, and collaborative problem-solving. As a widely recognized instructional strategy, team-based learning has been

applied across diverse disciplines and educational contexts to cultivate essential skills, including communication, critical thinking, and cooperative competence.

2.3.1 Inclusive Education

Integrating team-based learning within inclusive education settings has been shown to create supportive environments that value diversity and promote collaboration among students with varying abilities. According to Gillies (2023), this approach allows learners to capitalize on individual strengths while developing essential skills such as leadership, self-regulation, and teamwork. Participation in team-based learning not only enhances academic engagement but also equips students with competencies necessary for lifelong learning and active societal contribution.

2.3.2 Students Team Achievement Division (STAD) Model Organize Students

Team-based learning is an instructional approach in which students work in small groups to collaboratively support each other's learning. Its effectiveness is rooted in the principle that social interdependence and active engagement within the classroom significantly shape learning outcomes. Equally emphasizing the development of interpersonal skills alongside content knowledge, team-based learning provides a structured environment where learners can express ideas, ask questions, and clarify understanding. In language education, this collaborative framework not only promotes active participation but also deepens comprehension, fostering both linguistic proficiency and essential social competencies.

2.3.3 Language Teaching

Although team-based learning has been shown to enhance student engagement and learning outcomes in language education, it also presents challenges related to equitable participation. Yusuf (2023) notes, some students may dominate group discussions, while others remain passive, potentially disrupting collaborative balance. Addressing these issues requires teachers to establish clear participation guidelines and actively monitor group dynamics to ensure inclusive engagement. When effectively managed, team-based learning fosters an interactive environment that not only supports language development but also cultivates essential interpersonal skills.

2.3.4 Students Team Achievement Division (STAD) Model for Mathematics

Khusna and Acho (2023) report that the Student Team Achievement Division (STAD) model can significantly enhance student engagement and learning outcomes

in mathematics, particularly among fourth-grade learners, by promoting interactive and participatory instruction. Beyond mathematics, team-based strategies have also been shown to strengthen critical thinking skills in history education at secondary and high school levels. The Jigsaw technique, for instance, facilitates peer-to-peer idea exchange and collaborative problem-solving, contributing to improved performance. However, these approaches are not without challenges; issues such as student resistance, unequal participation, and difficulties managing group dynamics may limit their effectiveness, highlighting the need for careful implementation.

2.3.5 Reading Comprehension

Evaluations of the Student Team Achievement Division (STAD) model indicate its effectiveness in improving reading comprehension among secondary students. Comparative studies show that classes taught using STAD outperform those receiving traditional lecture-based instruction, demonstrating notable gains in comprehension skills among tenth-grade learners. Extending this evidence to digital environments, Sopiyah and Mogelvang (2023) found that online team-based learning produced significant improvements in students' psychosocial outcomes, including sense of belonging, confidence in science, and development of generic skills, with effects comparable to face-to-face settings. These findings suggest that team-based learning can be successfully adapted to online instruction, addressing challenges inherent to digital education while promoting both cognitive and socio-emotional growth in students.

2.3.6 Impact on Science Education

According to Kuswandi (2023) impact of cooperative learning in science education was also explored. Cooperative learning approaches positively influenced students' attitudes, beliefs, and behaviors, promoting greater engagement and active participation. This approach supported the goals of historical education by cultivating a deeper understanding of scientific principles. Data were collected through tests and direct observations, revealing the strategies enhance both the cognitive and affective dimensions of students' educational experiences.

2.3.7 Jigsaw vs STAD

Comparative research on team-based learning approaches indicates that their effectiveness is not uniform but contingent upon the instructional context and learning

objectives. Ramdhani (2023), for example, reported that the Jigsaw method outperformed the STAD model in enhancing students' reading comprehension of descriptive texts. This suggests that Jigsaw, with its emphasis on interdependence and distributed expertise, may be particularly well-suited to tasks requiring the integration of detailed information and collaborative meaning-making. By contrast, STAD's reliance on structured group rewards and accountability mechanisms may be more effective for reinforcing factual knowledge and basic concept mastery.

2.3.8 Academic Achievement

Agwu (2023) highlighted the effectiveness of interactive engagement pedagogies, particularly team-based learning, in enhancing both academic achievement and self-concept in chemistry. The study demonstrated a positive relationship between students' academic performance and their self-perception, emphasizing that collaborative learning approach can simultaneously foster cognitive and affective development. However, the research also identified challenges in implementing such innovative pedagogies, especially in developing contexts, and proposed strategies to overcome these barriers to ensure successful adoption and sustainability.(Kreng, 2014). Students Team Achievement Division model stands out as one of the most extensively studied, simplest, and most direct forms of cooperative learning. It was 4 developed based on the principles of effective teaching methods (Fatima, 2020). This strategy is employed to fulfill clearly defined instructional targets, as it involves small teams of students with diverse competencies, who unite to reach a shared learning aim (Hasmyati, 2018).

Team based learning emphasizes student-centered group work, enabling learners to collaborate toward shared objectives. Cooperative learning, a structured form of this approach, involves students working together on organized tasks, necessitating coordinated efforts to achieve common goals. One prominent cooperative learning strategy is the Student Teams-Achievement Divisions model, which has been empirically shown to enhance student motivation and learning outcomes. In this model, students are organized into diverse teams to master academic content collectively. Furthermore, this model has been utilized as a tool for peer-assisted cooperative learning in disciplines such as anatomy, demonstrating its versatility and effectiveness in enhancing educational outcomes across different

fields. Conventional lecture-centric education, followed by traditional self-study, remains the predominant teaching approach in higher education globally, enjoying wide acceptance and praise from a multitude of faculty members and students. Historically, it has been regarded as the most efficient means of delivering knowledge directly to learners. However, the efficacy of this method is progressively being questioned, as didactic instruction is a passive and superficial strategy that elicits minimal student engagement in their educational journey. This approach often fails to encourage student initiative and does not foster innovation within the classroom. In contrast, active learning engages students' enthusiasm for learning, promotes participation, and solidifies understanding. Cooperative learning, facilitated through peer-assisted learning, is a prominent active learning strategy (Atradinal, 2024).

Team-based learning involves dividing a classroom of students into smaller groups, allowing them to collaboratively explore a new concept and assist each other in enhancing their understanding. Although the concept of cooperative learning has existed for many years, it has not achieved the same level of recognition as blended learning or differentiated instruction. The Students Team Achievement Division 5 model includes elements such as class presentations, teams, quizzes, individual improvement scores, and team recognition. Educational models that fail to emphasize student participation tend to lead to decreased student activity, lack of independence, and diminished confidence in articulating their viewpoints, ultimately failing to foster creative thinking, which results in low academic performance. Students often remain passive, merely listening, writing, sitting quietly, and following the teacher's instructions instead of being actively engaged in their learning (Elpisah, 2020).

Furthermore, the American Association for the Advancement of Science has proposed teaching strategies aimed at enhancing and optimizing student learning by utilizing general principles of education. According to research planning, the researcher instructed the students in the experimental groups. Several factors were taken into account: it poses a risk for the researcher if the school teacher instructs the experimental group, as school teachers may be unfamiliar with the Student Team Achievement Division Model. The fundamental principle of the Students Team Achievement Division model is to encourage students to support and assist each other in mastering the material. If the students desire rewards for their teams, they must

collaborate and thoroughly understand the content. They encourage their peers to perform their best. They work together to ensure they comprehend the lessons or instructional materials. Active interaction and positive relationships among students during the learning process can enhance motivation and inspire critical thinking (Yulini, 2019). The Students Team Achievement Division model is reinforced by recent empirical evidence highlighting its effectiveness in improving academic performance and student engagement. A study by Khan et al (2022) found that STAD significantly enhanced science achievement and collaborative learning skills among elementary students in Pakistan. Similarly, Putra and Wahyuni (2021) demonstrated improved student outcomes in Indonesian classrooms using STAD in mathematics and social studies. These findings underscore the model's versatility and effectiveness across different cultural and educational settings, making it a promising approach for boosting academic achievement at the elementary level.

2.3.9 Reactive Positive Behavior

Research underscores that students' prior experience and exposure to structured learning environments play a crucial role in shaping their engagement and behavior in collaborative settings. Miguel and Garcia (2023) observed that university students with greater familiarity with the academic environment exhibited more positive interactions, higher motivation, and stronger commitment in group activities, indicating that academic experience enhances both collaboration and participation. Furthermore, early exposure to highly structured team-based learning frameworks was linked to sustained improvements in empathy, social relationships, and leadership skills, whereas students in low-structured settings showed limited development over time. Beyond cognitive gains, team-based learning cultivates essential social and personal competencies, including teamwork, communication, conflict resolution, leadership, and respect for others, by fostering active peer interaction, idea exchange, and mutual recognition of strengths (Anijah, 2023). Collectively, these findings highlight the critical importance of implementing carefully designed collaborative learning structures that simultaneously promote academic achievement and holistic skill development, preparing students for future professional and social contexts.

2.3.10 Constructivism Theory

The study is rooted in constructivism, a theory that asserts that knowledge is built through understanding. In this view, learning is an active process, where students develop meaning based on their experiences, interactions, and reflections. The study supports the idea that cooperative learning plays a key role in knowledge construction, highlighting the importance of social relationships in shaping learning outcomes.

2.3.11 Interdependence Theory

This theory emphasizes the interconnectedness and mutual reliance of individuals within a social context. In cooperative learning, students depend on each other to accomplish shared objectives, fostering interdependence and collaboration. The study likely demonstrates the positive impact of this interdependence on student engagement and academic performance.

2.3.12 Social Learning Theory

Social learning theory suggests that individuals learn by observing and imitating others. Within cooperative learning, students have the opportunity to observe their peers' strategies, approaches, and perspectives. Engaging in discussions and collaborative tasks allows students to broaden their knowledge and skills. The study likely supports the role of social learning in enhancing student involvement and achievement.

2.3.13 Cognitive Social Learning Theory

Cognitive social learning theory integrates principles from both cognitive and social learning, emphasizing that students' cognitive development and academic outcomes are shaped by the interaction of individual thought processes and social engagement. Research has extended this framework by exploring the role of emotional intelligence, social-emotional learning, and collaborative learning, highlighting that mental health and emotional well-being are critical determinants of academic performance (Pudjiarti & Simpson, 2023).

Within this context, the Student Team Achievement Division (STAD) model has been shown to foster cooperation, problem-solving, and social awareness among students. Its implementation in geography classes increased engagement, skill development, and positive social dynamics, transforming previously unengaging subjects into interactive learning experiences. Similarly, in fifth-grade mathematics,

STAD enhanced understanding through a cyclical classroom action research approach encompassing planning, implementation (Fauziah & Rusi, 2023). Further studies emphasize the importance of structured collaborative learning environments. Cross-cultural online collaborative learning research found that high-performance groups exhibited superior cognitive, social, and regulatory processes, underlining the role of metacognition in socially shared regulation during teamwork. In special education contexts, strategies such as Jigsaw and Team-Pair-Solo significantly increased interest and engagement among visually impaired students, outperforming traditional lecture methods (Fosua & Nnamani, 2023). Teacher support has also been identified as crucial; promoting student autonomy and competence within collaborative frameworks enhances performance, self-organization, and positive learning attitudes, while fostering social, civic, and democratic competencies (Van & Malazonia, 2023).

Cooperative learning strategies further mediate the relationship between teacher-student interactions, student self-efficacy, and mathematics achievement, reinforcing the importance of collaborative approaches in academic performance (Aporbo, 2023). Active learning methods, including Collaborative Strategic Reading (CSR) and the Jigsaw technique, have demonstrated effectiveness in improving literacy, promoting student-centered engagement, and influencing teaching practices in subjects such as physical education (Riswanto, 2023). This body of research underscores the versatility and impact of team-based and collaborative learning approaches across disciplines, student populations, and learning environments, highlighting their capacity to enhance cognitive, social, and affective outcomes.

2.3.14 Conventional Teaching Method

In many schools, conventional teaching methods, particularly the lecture-based approach, remain the dominant form of instruction. This teacher-centered model positions the instructor as the primary source of knowledge, directing the learning process while students assume a largely passive role. Emphasis is placed on listening and rote memorization, which often results in surface-level understanding, with learners reproducing content without deep comprehension or critical engagement. Classrooms operating under this framework frequently rely on a reward-punishment system, using grades or disciplinary measures to regulate behavior, while limiting opportunities for questioning, discussion, or application of knowledge.

Consequently, student engagement and active learning are constrained, as the one-way transmission of information reinforces passivity and inhibits the development of higher-order cognitive and analytical skills.

2.3.15 improving student learning motivation

Insani (2023) investigated the impact of sharing student team achievements on learning motivation in history classes. The study found that publicly acknowledging team accomplishments effectively enhanced students' motivation, suggesting that recognition and feedback within a collaborative framework can positively influence engagement and drive. These findings underscore the role of structured team-based strategies in not only supporting academic performance but also fostering intrinsic motivation among learners.

2.3.16 Explanation Texts

Ibrahim (2023) explored the application of the Student Team Achievement Division (STAD) learning model to improve students' ability to read explanation texts, motivated by the prevalent reliance on conventional teaching methods. Unlike general group work, STAD emphasizes structured collaboration, integrating five key elements: positive interdependence, cooperative competencies, and group processes. Analysis of the study's data revealed that students' reading proficiency improved progressively from cycle I to cycle II, indicating that the structured, team-based approach effectively enhanced comprehension.

2.3.17 Intellectual and Soft Skills

The passage describes a research study aimed at assisting teachers in vocational institutions who are struggling with the new curriculum structure implemented in 2012. The focus is on creating lesson plans using cooperative learning as a strategy. The researchers anticipate that the development of such guidelines will enhance the practice of teaching and learning, elevating it to a higher level. By incorporating cooperative learning strategies and focusing on the identified components, teachers will be better equipped to improve student performance both intellectually and in acquiring soft skills (Kamal, 2023).

2.3.18 Matching Card Media

The importance of English proficiency in contemporary life underscores the need for effective strategies to develop reading skills. Asriyani (2024) emphasized

that reading awareness is crucial for comprehending concepts and achieving learning objectives. To address challenges in reading, the study implemented a team-based learning approach combined with Matching Card media, a method particularly suitable for junior high school students, as it fosters interaction, engagement, and creativity. The findings suggest that integrating structured collaborative strategies with interactive media can effectively enhance students' comprehension and active participation in language learning.

2.3.19 Social Behavior

Khan (2024) examined the impact of collaborative learning on students' academic performance and social behavior, drawing on empirical studies, theoretical models, and meta-analyses. The research highlights that structured team-based learning positively influences intellectual outcomes and social interactions, fostering engagement, communication, and cooperative skills. By synthesizing evidence across multiple contexts, the study underscores the dual benefits of collaborative learning, offering practical insights for educators and policymakers seeking to implement instructional strategies that enhance both academic achievement and social development.

2.3.20 Application of Think, Pair, Share

Nasrulloh and Suleman (2024) investigated the impact of the Picture and Picture cooperative learning model, alongside the Think-Pair-Share approach, on students' self-esteem and academic performance. The study found that structured team-based strategies effectively enhanced student engagement, while also increasing teacher involvement in the learning process. These findings indicate that implementing collaborative learning models such as Picture and Picture can foster both affective and cognitive development, supporting improved academic outcomes and active participation in the classroom.

2.3.21 Social Competences

Research highlights the critical role of cooperative learning in developing essential social and cognitive skills among students, including communication, teamwork, problem-solving, and personal accountability. Longitudinal studies, such as the Profane Project in France involving over 10,000 vocational high school students, reveal persistent gender disparities in social competencies, with boys

generally exhibiting lower perceived social skills than girls (Rudman, 2024). The study compared the Jigsaw classroom, which promotes positive interdependence, against two control conditions and found that the gender gap widened in the control scenarios but remained relatively stable under the Jigsaw model, indicating its effectiveness in fostering equitable social skill development over time.

In physical education, cooperative learning has been shown to support holistic student development, encompassing physical, social, emotional, and cognitive outcomes (Zhou, 2024). At the micro level, collaborative strategies enhance motor skills, teamwork, and cognitive functioning in younger learners, while reducing negative emotions. At the macro level, cooperative learning promotes self-reflection, cultural integration, and personal responsibility. These findings underscore the versatility of team-based learning across disciplines, cultural contexts, and educational philosophies, demonstrating its adaptability and relevance for fostering lifelong learning and social competence.

Additionally, research in mathematics education demonstrates that cooperative learning models effectively enhance students' representational skills. Nur'aini (2024) highlighted that integrating cooperative learning with appropriate media, strategies, and instructional approaches can significantly improve junior high school students' ability to visualize, interpret, and apply mathematical concepts.

2.4 Theoretical Review

Cooperative learning has gained significant attention due to the wealth of positive research findings it has garnered. Numerous experimental studies have compared the effects of cooperative learning with traditional teaching methods across various academic fields, including social studies, geography, psychology, management, mathematics, science, biological sciences, chemical bonding, educational theory, economics, and accounting. These studies consistently point to the effectiveness of cooperative learning. The impact of the Student Teams Achievement Divisions method on students' academic performance in Pakistan is that students in the STAD group outperformed those in the traditional teaching group.

Constructivist Theory: The STAD model is rooted in constructivist principles, which suggest that learners construct knowledge actively through interaction with peers and

their environment. By working in teams, students share diverse perspectives, enhancing their understanding and cognitive development.

Social Interdependence Theory: This theory emphasizes positive interdependence among group members; individual success is tied to the group's success. STAD promotes this by structuring activities where each member's contribution is crucial.

Motivational Theory: STAD leverages group rewards and individual accountability, motivating students to perform better. This aligns with expectancy-value theory, where students are motivated when they value the outcome and believe their efforts will lead to success.

2.5 Empirical Review

Global evidence demonstrates STAD's effectiveness across subjects and levels. In Bhutan, Grade 9 biology students showed significant gains in achievement and confidence (Chophel, 2023). Elementary studies confirm improvements in mathematics outcomes and motivation (Hermawan, 2020; Tania et al., 2024), while applications in computer programming and online learning environments further validate its adaptability (Tiantong, 2023). Research in Nigeria and South Asia also highlights significant academic benefits compared to lecture-based methods. A study comparing the Student Team Achievement Division method with classical learning methods found that students taught using STAD demonstrated better mathematics understanding. This highlights the model's potential to enhance comprehension in mathematical subjects. Effect on Academic Performance in Nigeria: Research conducted in Nigeria assessed the impact of the Student Team Achievement Division method on students' academic performance. The study concluded that it was effective in improving students' learning outcomes, suggesting its applicability in diverse educational settings. These empirical studies demonstrate the versatility and effectiveness of cooperative learning model in enhancing student achievement across various subjects and educational levels (Tiwow et al., 2020).

2.6 Critical Summary of Literature Review

The literature consistently supports STAD's role in improving academic performance, motivation, and social development. Its structure promotes inclusivity, mastery learning, and peer tutoring, particularly benefiting low-achieving students. However, challenges include time-intensive implementation, unequal participation,

and dependence on effective teacher facilitation. Cultural resistance and large class sizes further constrain outcomes. Research gaps include limited longitudinal studies, insufficient evidence for special-needs learners, and underexplored digital adaptations. Research by Slavin (1995) shows that cooperative learning frameworks particularly STAD, improve knowledge retention and comprehension. Evidence indicates that lower-performing students gain significantly from peer tutoring and collaborative problem-solving. Some studies imply that the benefits may be less significant for high-achieving students, who might not perceive group work as demanding or fulfilling. It cultivates interpersonal skills, such as teamwork, communication, and conflict resolution, which are essential for comprehensive development. By participating in structured group activities, students learn to appreciate diverse viewpoints. Research has emphasized the model's capacity to diminish social barriers, fostering inclusivity.

It focuses on group rewards, and individual responsibility enhances student motivation. The blend of intrinsic and extrinsic motivation creates a positive educational atmosphere. Studies have indicated that acknowledgment of team achievements promotes consistent effort from all participants. Excessive dependence on rewards may result in superficial engagement, where students concentrate on completing tasks rather than gaining a profound understanding. Successful application of STAD requires strategic group formation, diligent monitoring, and effective feedback mechanisms. Teachers play a crucial role in facilitating group interactions and ensuring equitable involvement.

Literature underscores the necessity for professional development to prepare educators with the competencies needed for cooperative learning. Some teachers find the model challenging, as it demands considerable time for planning, supervising, and evaluating group activities. In collaborative cultures, it aligns effectively with existing educational practices, boosting its success. Conversely, in individualistic cultures, students may resist group-centric tasks, viewing them as unfair or unproductive. Institutional limitations, such as large class sizes or inflexible curricula, may restrict the model's usefulness.

2.7 Theoretical Critiques

While the Student Team Achievement Division (STAD) model exemplifies structured team-based learning, scholars have noted several limitations. Critics argue that STAD may oversimplify complex group dynamics, assume equal participation among students, and prioritize quizzes over deeper forms of assessment, potentially constraining higher-order thinking unless supplemented with metacognitive strategies. Its universal applicability is also questioned, particularly in resource-limited or culturally individualistic contexts.

Nevertheless, the model's strength lies in its structured mechanisms that link individual accountability to team success, embedding peer support and collaborative responsibility into the instructional process. Research consistently highlights motivation, collaboration, and equitable participation as the key drivers of its effectiveness. Yulini (2023) emphasizes that STAD enhances cognitive engagement and motivation through interpersonal interactions, while Luzyawati (2024) underscores its sustainability in fostering self-confidence and inquiry skills. Alijanian (2022) further notes that structured interactions prevent dominance by high-achieving students, ensuring genuine teamwork rewards, with intrinsic drivers, including motivation, inquiry, and confidence. However, the literature also indicates that its transformative potential depends on careful implementation, for STAD to function as more than a cooperative alternative to traditional teaching methods.

2.8 Conclusion

Overall, STAD strengthens academic achievement, social skills, and motivation while addressing some limitations of traditional teaching. Yet its effectiveness depends on teacher readiness, classroom context, and sustained application. Future research should explore long-term effects, integration with technology, and adaptability for diverse learners to ensure relevance in evolving educational landscapes. The literature on the STAD model highlights its strengths in promoting academic achievement, social skill development, and motivation. A study by Irawan (2020) demonstrated that students in the experimental group taught using STAD, exhibited significantly better problem-solving skills than those in the control group who were taught using traditional methods. Research also suggests that it positively affects students' attitudes toward science (Justina, 2019).

The Students' Team Achievement Division (STAD) model demonstrates notable strengths and limitations within instructional practice. It advances active learning by engaging students in heterogeneous groups that promote peer tutoring, discussion, and shared responsibility, thereby reducing passive learning behaviors. Empirical evidence, including large-scale meta-analyses, indicates significant gains in academic achievement particularly in science, mathematics, and language when STAD is implemented with mechanisms of team rewards and individual accountability. The model further contributes to the development of social competencies, communication skills, and inclusivity, while offering motivational benefits to low-achieving students through progress-based evaluation rather than absolute performance measures. Despite these advantages, STAD is not without constraints. Effective implementation is resource- and time-intensive, demanding strong teacher preparation, classroom management, and continuous assessment. Risks of unequal participation persist, with dominant voices potentially overshadowing less active members, and assessment practices may pose challenges in balancing group and individual accountability.

CHAPTER 3

RESEARCH METHODOLOGY

This research study was conducted to find out the effect of students' team achievement division model on academic achievement in the subject of general science at the elementary level. The following procedure was adopted for the study.

3.1 Research Design

The study employed a true experimental pre-test post-test control group design. Two groups were formed: the experimental group and the control group. Students were selected randomly from the accessible population and then randomly assigned into experimental and control groups, ensuring equivalence at the outset. The equivalence of groups was further checked through pre-test scores from Grade 8 *General Science* (National Book Foundation, 2023). The experimental group received instructions through the Student Teams Achievement Division (STAD) method, while the control group was taught through the Lecture Method. At the end of the treatment, a post-test was administered to both groups. The symbolic representation of the research design was:

Table 3.1

Research Design

Groups	Pre-test	Treatment	Post-test
RE	O1	T1	O2
RC	O3	T2	O4

Here:

RE and RC= randomly selected experimental and control group

O1 and O3 = pre-test

T1= Treatment group with STAD Method

T2= Treatment group with Lecture Method

O2 and O4= post-test

3.2 Population

In this study, the targeted population consisted of all (15,934) the grade 8 students in Islamabad (FDE, 2023-2024) and accessible population was 130 grade 8 students of Islamabad Model Schools for Boys Nai Abadi khanna kaak Islamabad.

3.3 Sample and Sampling of the Study

A sample is a smaller group of individuals representing the characteristics of a larger population. For this study, the researcher selected 60 students (male) from the accessible population of 130 Grade 8 students at Islamabad Model School for Boys, Nai Abadi (urban area), using the simple random sampling technique through lottery method. From the selected sample, students were randomly assigned into experimental and control groups, each containing 30 participants. Pre-test scores were used to confirm group equivalence before the intervention.

Table 3.2

Sample of the study

Group Type	General Science students(Grade 8, Boys)
Experimental	30
Control	30
Total	60

Power Analysis

According to Cohen's (1988) guidelines for sample size estimation

Large effect (d = 0.8):

Big differences are easier to detect, requiring fewer participants.

Approximate sample size = 25 participants per group.

Total sample size = 49 participants.

3.4 Selection of Chapters

Before the selection of text to experiment, the researcher considered the specific text on the following basis: Meeting to discuss the syllabus covered by the working teachers of concerned 8th class, Course outline of Grade 8, general science proposed by Federal Board of Intermediate and Secondary Education Islamabad. Four units of class 8th General Science were planned for intervention, General Science textbook, published by National Book Foundation (2023) was used for the purpose. The details of these four chapters are as follow:

- Biotechnology
- Chemical Reactions
- Acids, Bases/alkalis, and Salts
- Force and pressure

Chapter 4 Biotechnology includes the sub topics, How DNA is replicated, the relationship between DNA, Genes and chromosomes bacterium, How genes are introduced into a bacterium, the biotechnological products used in daily life, How genetic modification in different foods. Chapter 5 "Chemical Reactions" includes the sub topics, Define chemical reactions and examples to explain the rearrangement of atoms in chemical reactions, explain the balancing of a chemical equation, Identify the nature of chemical changes in various reactions. Chapter 6 "Acids, Bases/alkalis, and Salts" includes, Define the terms acid, alkali, and salt, Describe the properties of acids, alkalis, and salts, Explain the uses of acids, alkalis, and salts in daily life, Use indicators to identify acids, alkalis, and neutral substances. Chapter 7 "Force and pressure" includes the sub-topics Define the term pressure, Identify the units of pressure, Explain how gases behave under pressure, Describe the causes of gas pressure in a container.

3.5 Development of Lesson Plans

The researcher developed a total of 32 lesson plans, of which 16 lesson plans were related to the experimental group and 16 lesson plans for the control group. All the lesson plans were developed from the sub-topics of the already selected four Chapters of Grade 8 General Science. Same sub-topics were selected for teaching both groups. Lesson plans of experimental groups were planned implying five components of the student's team achievement division method. Whereas, the lesson plans of the

control group were based on the Lecture Method which consisted on the steps introduction, presentation (description), evaluation and homework. The researcher had taught classes for both the experimental and control groups according to the developed lesson plans for each group.

3.5.1 Lesson plans of experimental group

The researcher developed 16 lesson plans for the experimental group, based on STAD model, which consisted 5 steps, the format of these steps was applied to develop the lesson plans, here are five steps used in this model:

Presentation: It involves instructions delivered by the teacher to the class in a traditional manner. Teaching in STAD does not significantly differ from conventional instruction, except that the lessons must concentrate on the concepts of the material being examined. After the teacher presents the material one or two times, students then work in groups to tackle the assigned questions.

Groups: In the Students Team Achievement Division model process, groups consist of 4-6 students of varying abilities. The purpose of forming groups is to ensure that all members collaborate in learning, more specifically, to prepare each member for strong individual testing. The group plays a crucial role, as it fosters cooperative work among peers to achieve the desired academic level. To determine group membership, students' report card rankings are organized, and students can also be grouped based on their final test scores. From this ranking list, grouping is conducted. Each group includes one student from the upper tier, one from the lower tier, and two students with average skills. The teacher arranges students according to this composition. Teachers need to avoid significant conflict among group members, although students are not allowed to choose their friends.

Test or Quiz: After one or two instructional sessions and collaborative work in groups, students receive individual tests. This is where each student attempts to perform their best as a result of their learning. Students also recognize that their efforts and achievements will significantly contribute to the success of the group.

Individual Improvement Scores: The aim of this is to provide students with attainable goals if they exert effort and achieve better results than those obtained previously. The management of student achievement scores follows this order: initial score, test score, improvement score, and group score.

Group Scores: To evaluate group performance, individual scores from each member are collected, recorded, and totaled to arrive at each group's scores. From these group scores, one can see which groups achieved the highest scores, thus deserving the promised rewards. The variables assessed in this study include learning motivation. Learning motivation is the comprehensive psychological drive within students that propels them into learning activities, ensures the persistence of those activities, and directs them toward achieving a goal.

3.5.2 Lesson Plans for the Control Group

The researcher developed 16 lesson plans based on the Lecture Method for the control group. These lesson plans followed a structured approach consisting of introduction, presentation (description), evaluation, and homework. This method relies on rote memorization, which helps students retain factual information. The Lecture Method follows these steps:

Introduction: The researcher created conducive learning environment for the students. To engage them, the researcher asked questions related to their prior knowledge on the topic.

Presentation (Description): This step involved providing explanations of the related topics. To enhance understanding, a question-and-answer technique was used, and models or examples were provided when necessary.

Evaluation: The researcher assessed students' learning by asking questions based on the delivered lecture. This also allowed the researcher to evaluate the effectiveness of their teaching.

Homework: After completing all steps, the researcher assigned homework tasks related to the delivered lecture to reinforce learning.

Fidelity Verification: To ensure that the experimental group (STAD Method) and control group (Lecture Method) were delivered as intended, structured checklists were developed and applied. Researcher was weekly updating to the respected supervisor and process was monitored by the headmaster of the school. (Appendix 4)

3.6 Research Instrument

The researcher developed the research instrument named the Subject Achievement Test with the help of the supervisor.

3.6.1 Construction of test items

For the purpose of pre-test multiple-choice questions (MCQs) construction, the researcher selected four chapters from the 8th-grade General Science textbook**,** published by the National Book Foundation, Federal Textbook Board; Islamabad (2023)**.** The test carried 80 marks and consisted of 40 multiple-choice questions**.** The total duration of the test was 50 minutes. The 10 MCQs from Chapter No.3, 10 MCQs from Chapter No.5, and 10 MCQs from Chapter No.6, 10 MCQs were developed.

3.6.2 Validity of the Instrument

All the test items were refined with the help of expert opinions, since a sound research instrument must be both reliable and valid (Creswell, 2014). The Subject Achievement Test was carefully designed and then reviewed by subject specialists and research experts. Based on their feedback and recommendations, necessary modifications were incorporated to improve clarity, content alignment, and appropriateness of the items. After revisions, the instrument was again discussed with the experts to ensure that it met the required standards of content validity and was suitable for administration in the study.

3.6.3 Reliability of the Instrument

Reliability refers to the consistency, stability, and dependability of a measurement tool, indicating the degree to which it produces stable and repeatable results under similar conditions (Fraenkel & Wallen, 2009). In educational research, a reliable instrument ensures that variations in scores reflect true differences among students rather than measurement errors. In the present study, the split-half method was applied to test the reliability of the Subject Achievement Test. For pilot testing, twenty students from each class were randomly selected. The split-half procedure involves dividing the test items into two subsets (often even-numbered and odd-numbered items) and then calculating the correlation between the two sets of scores. A higher correlation indicates greater internal consistency of the instrument. The obtained correlation was further estimated using the coefficient alpha (Cronbach's Alpha), which provides a more refined measure of internal consistency. The reliability

coefficients for the Subject Achievement Test were .80 and .77 for the two classes, respectively. According to Nunnally and Bernstein (1994), a reliability coefficient of .70 or above is generally considered acceptable for research purposes. Therefore, the instrument used in this study demonstrated satisfactory reliability, confirming that it consistently measured the intended learning outcomes.

3.6.4 Pre-test

A pre-test was designed using selected units from the 8th-grade General Science textbook. It was administered to categorize the sample of the study into experimental and control groups before giving the treatment. The scores obtained in the pre-test were used as the basis for the experimental and control group formulation. Based on the pre-test scores, the students were divided into two groups, Experimental and Control group. The pre-test was developed under the supervision of a supervisor. It was validated by subject specialists, academicians, and assessment experts. The test consisted of 40 multiple-choice questions (MCQs), containing 80 marks.

3.6.5 Post-test

After completing the seven week experiment, a post-test was conducted. This test was an equivalent version of the pre-test, but the order and sequence of the questions, correct answers, and distractors were modified. In terms of content and question types, the post-test was identical to the pre-test. However, the arrangement of test items was changed

3.6.6 Marking of test items

The researcher chose the international standard for marking multiple-choice test items. Accordingly two marks are allocated to each correct multiple-choice test item. To maintain standard errors like cutting, overwriting, and picking of more than one option were not allocated any marks. All multiple test items were marked by the researcher according to the developed marking key.

3.7 Variables

The variables which were used in the current study are described below:

3.7.1 Independent variable

The treatment variables were considered as independent variables.

Treatment variable: The teaching methods were used as treatment variables in the current study. The treatment variables were comprised of STAD method and Lecture method.

3.7.2 Dependent variable

The academic achievement of students was considered as dependent variable.

3.7.3 Extraneous variables

In the current study, different types of situational variables were used, e.g., time, duration of treatment, age of students, teacher, subject to being taught, use of teaching aids, condition of teaching, sample size, the language of teaching, selection of the sample, equating of time, equating the groups through pretesting and through equal environment etc.

Details of Extraneous Variables in the Current Study

Time: Both control and experimental groups were taught at the same time of the day. Time differences (morning vs. afternoon) may affect students' learning capacity.

Duration of Treatment: The duration of teaching sessions was kept equal for both groups. Longer exposure to teaching may lead to better results and create bias if not controlled.

Age of Students: Only students of the same age group (elementary level) were selected to avoid differences in maturity, comprehension, and learning ability.

Teacher: The same teacher taught both groups to control for teacher-related differences such as teaching style, experience, and communication skills.

Subject to be taught: The subject of General Science was chosen for both groups, since variation in subjects could influence learning outcomes.

Sample Size: Equal numbers of students were included in the control and experimental groups to maintain balance and ensure reliable statistical analysis.

Language of Teaching: The same medium of instruction (Urdu) was used in both groups to prevent differences in understanding due to language.

Selection of the Sample: A proper sampling procedure was applied to avoid selection bias and ensure comparability between groups.

Time Equation: Teaching schedules were synchronized for both groups, preventing any group from having an advantage due to extra time.

All these extraneous variables were carefully controlled so that the differences in achievement could be attributed only to the teaching method (STAD vs. Lecture), not to other external factors.

3.8 Explanation of the experiment

The experiment was conducted by the researcher in Islamabad Model School for Boys Nai Abadi Islamabad. The school is administered under the management of the Federal Directorate of Education, Department of Education, Federal Government of Pakistan, and Islamabad Model School for Boys was selected for completing the experiment. The researcher received written permission from the Federal Directorate of Education. Researcher performed the experiment from January 5, to February 28, 2024. According to the time table of the selected school, 40 minutes per day were specified for intervention in experimental and control groups. In this way experiments prolonged for seven weeks.

3.8.1 Duration of the Experiment

The research was conducted from January to February 2024, as final exams were scheduled to begin at the end of February in Islamabad. Therefore, postponing the experiments at the school was not feasible. The school's administration allocated the 4th period at the Islamabad Model School for Boys, from 11:10 am to 11:50 am, and the 5th period from 11:50 am to 12:30 pm, without altering the school schedule. However, they arranged a separate classroom for the experimental group. The researcher provided the same number of lesson plans (16) for the control group.

3.8.2 Equal Educational Opportunities

The experimental and control groups were provided the equivalent educational opportunities in the current experiment by the researcher. Therefore, to fulfill the requirements of the experiment, the researcher took the following steps:

i. Equal time duration (40 minutes) of teaching to each group
ii. Same units and sub-topics selected for both groups to teach
iii. Same number of lesson plans for both groups
iv. Same time was allocated for both groups during pre-test and post-test

Fidelity report: The experiment was conducted from January to February 2024, before the final exams in Islamabad. The school administration allocated the 4th period (11:10 am – 11:50 am) and 5th period (11:50 am – 12:30 pm) for the study, without

altering the regular timetable. A separate classroom was arranged for the experimental group to prevent distractions. Both groups were provided with 16 lesson plans, ensuring equal exposure to instructional content. During all this experimental procedure, researcher made the pictures of each step of both groups and shared with the department concerned person, which proves the transparency of experimental process.

3.9 Execution of Experiment

The following steps were taken by the researcher to execute the experiment.

3.9.1 Ethical Consideration

Ethical integrity was carefully maintained throughout the study. Prior to conducting the experiment, the researcher obtained formal approval from the Federal Directorate of Education (FDE), Islamabad through an official permission letter (Ref. No. FDE/Acad/2023/F1.107, dated December 1, 2023) see appendix 4. Additional signed consent was secured from the principal of the selected school as well as from the concerned Grade 8 science teacher, ensuring institutional cooperation and compliance with ethical requirements. Furthermore, the students and their guardians were briefed about the objectives and procedures of the study in clear and simple terms. Participation was voluntary, and students were assured that the data collected would be used strictly for research purposes and would remain confidential. The primary aim of the research was explained as improving students' conceptual understanding of General Science, fostering logical reasoning, and developing collaborative learning skills through the Student Teams Achievement Division (STAD) Model.

3.9.2 Administration of pre-test

Before starting the treatment, a pre-test was held on January 05, 2024. The scores collected from the pre-test were used to assess the academic ability of students in specific Chapters of General Science.

3.9.3 Teaching-learning sessions

Teaching-learning sessions were conducted from January 06 to February 28, 2024. The intervention of a total of 32 lesson plans was implemented with the help of Students Team Achievement Division model and Lecture Method for the

experimental and control groups respectively. The experimental period was comprised of seven weeks.

3.10 Variables' control in the study

This experiment was held in Islamabad Model School for Boys, Nai Abadi, Islamabad. The following steps were taken by the researcher to minimize the effect of internal and external threats.

3.10.1 Internal validity of the experiment

The researcher took the following steps to control the internal threats of the experiment.

History: History is a threat that occurs when participants' responses change due to unexpected events during the experimentation process. To control this threat, the study was conducted under well-planned and controlled conditions. Moreover, no such case was observed during the study that may affect the students' achievement. Hence, this threat was controlled.

Testing: Another threat is testing that occurs if the students' results in their post-test are improved due to pre-test taken from the same group of members. To overcome this threat, time of one and half month was given between the pre-test and the post-test, which was enough to forget the test items in the pre-test. Therefore, this threat was also controlled logically.

Instrumentation: The pre-test was validated with the help of experts' opinion and its reliability was checked through pilot testing before administering it on the experimental and control groups to avoid this threat. Therefore, this threat was also controlled.

Maturation: This threat occurs if the results of the post-test are better not due to the treatment but due to the time period between the pre-test and post-test. Therefore, to control this issue, time duration for the experiment consisted of only seven weeks; which was sufficient to develop the students to improve their post-test. Hence, this threat was also controlled.

Implementation: The experimental group and control group were treated with Student Team Achievement Division model and Lecture method respectively. To control this threat, the researcher taught both groups himself. Therefore, this threat was also controlled in a logical manner.

Location: The meaning of this threat is having dissimilar results due to the subject being treated at different locations. One school was selected and the selected students belong to the same locality. Furthermore, experimental and control groups were treated in their regular classrooms. Therefore, this threat was also controlled.

Mortality: The experimental study was limited to only seven weeks, which is not a long duration. Due to the support and management of the school and also the attentiveness of the selected students made it possible for student not to miss the sessions and make sure their presence fully.

3.10.2 External validity of the experiment

The researcher took the following steps to control the external threats:

Interference of multiple treatments: There is a possibility of taking extra tuition classes as an extra treatment by the subjects instead of the researcher or subjects already involved in any related research study which may distort the actual results of the experiment. The public school teachers in Islamabad were not aware of the Student Team Achievement model, so there was no risk of treatment being affected. In addition, the researcher applied a similar treatment in both groups.

Specificity of variables: All technical steps have been taken to prevent external threats. Lesson plans have been verified; the pre-test was pilot-tested and randomly administered. Because of these specifics, he tried to avoid this threat. There was no gap between the end of the experiment and the post-test. All criteria of the experiment were well defined, such as pre-test, post-test, application of the STAD model through Students Team Achievement Division methods, and duration of the intervention.

Experimenter Effects: The awareness of the STAD model of team based learning, is not present in our education system, and our school teachers were not aware of this model. It could remain a gap in training and implementation if school teachers were trained in the STAD model to facilitate the teaching of the experimental group. The researcher studied this model for about two years and gained a deep understanding of this model through a respected supervisor, literature, and interactions with cooperative learning experts. To avoid any gap in the experiment, the researcher planned to teach both groups himself by using the STAD model and Lecture method. Various variables were controlled by comparing their effects in experimental and control groups, such

as time and place of intervention, lesson length, number of lesson plans, teaching material, students with mixed abilities, and timing of pre-test and post-test.

3.11 Conduction of post-test

After the completion of treatment, the post-test was managed to the next day on February 29, 2024. Furthermore, the achievement scores of all the students were calculated by subtracting the pre-test scores from post-test scores.

3.12 High, Lower and Medium Achievers

The students of experimental and control groups were also analyzed into higher, lower and medium achievers. First 25% of the students were considered as high achievers and last 25% were lower and middle 50% were taken as medium achievers on the basis of their academic achievement.

3.13 Data Analysis

After scoring the responses of students on pre-test, post-test, SPSS, version-25 (Statistical Package for the Social Sciences) was used. After collecting data from the students, the data were analyzed. The descriptive analysis was used to calculate the measures of central tendency (Mean) and measures of dispersion (Standard Deviation). The researcher applied a dependent *t*-test to compare the achievement of students of the same group in the pre-test and post-test. Another inferential statistic test was used called the independent sample *t*-test, which is a statistical test to compare the achievements of experimental and control groups and to determine the significant difference in both groups.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATIONS

This chapter comprises the use of descriptive statistics (means and standard deviations) and inferential statistics (independent samples t-test, paired samples t-test) to analyze, interpret, and represent the data.

4.1 Academic Achievements of the Students before Treatment

Table 4.1

Academic achievements of the Control and Experimental Group (pre-test)

Group	*N*	*M*	*SD*	*SEM*
Control	30	27.25	9.589	2.369
Experimental	30	28.13	8.325	1.764

Note. Descriptive statistics (Mean and Standard Deviation) were used to determine the academic achievement of students in General Science before the treatment, (SEM=standard error of the mean).

Table 4.1 shows that, the pretest marks of the control group were: *N=30, M=27.25, SD=9.589, SEM= 2.369* and pretest marks of experimental group were; *N=30, M=28.13, SD=8.325, SEM= 1.764*. The pretest results indicate that both the control and experimental groups have similar initial performance levels, as reflected in their mean scores (*M = 27.25* for the control group and *M = 28.13* for the experimental group). The slight difference in means suggests minimal variation between the groups before any intervention. Additionally, the standard deviation (*SD = 9.589* for the control group and *SD = 8.325* for the experimental group) shows that the scores in the control group were slightly more spread out, indicating greater variability compared to the experimental group. Furthermore, the standard error of the mean (*SEM*), which measures how precisely the sample mean represents the population mean, is lower for the experimental group (*SEM = 1.764*) compared to the control group (*SEM = 2.369*), suggesting that the experimental group's mean score is a more stable. Overall, the statistical values suggest that both groups started at comparable levels before any experimental intervention

4.2 Academic Achievements of the Students after Treatment

Table 4.2

Academic achievements of Control and Experimental Group (post-test)

Group	*N*	*M*	*SD*	*SEM*
Control	30	57.46	29.358	1.864
Experimental	30	74.53	10.478	2.589

Descriptive statistics (Mean and Standard Deviation) were used to calculate the academic achievements of students in General Science after the treatment. The posttest marks of control group were: *N=30, M=57.46, SD=29.358, SEM= 1.864* and the posttest marks of experimental group were; *N=30, M=74.53, SD=10.478, SEM= 2.589.* Table 4.2 shows that the posttest marks of the experimental group were significantly more than the posttest marks of the control group. Additionally, the standard error of the mean *(SEM),* is smaller for the control group (*SEM = 1.864*) compared to the experimental group *(SEM = 2.589).* However, the larger SEM in the experimental group, suggests a strong effect of the intervention. Overall, these results indicate that the experimental group outperformed over the control group after the intervention. These results also imply that team based learning strategies are particularly effective in engaging students actively in the learning process. The structured teamwork, peer discussion, and shared accountability in STAD likely contributed to greater motivation, participation, and confidence among students, especially for those who might struggle under traditional lecture-based instruction. Moreover, the findings suggest that interventions like STAD can reduce achievement gaps by providing all students, regardless of prior ability, with opportunities to learn collaboratively and benefit from peer support. The substantial improvement in the experimental group further indicates that the method promotes not only cognitive learning but also social and collaborative skills, which are essential for holistic educational development. In summary, these descriptive statistics reinforce the conclusion that the STAD method is a more effective instructional strategy than the Lecture Method, fostering higher academic achievement, engagement, and active participation in General Science at the elementary level.

4.3 Comparison between the marks of the pretest

Table 4.3

Comparison between marks of pretest of control and experimental group

Pre-test	*N*	*M*	*SD*	*Df*	*t*	*p*
Control Group	30	27.25	9.585	58	.235	.856
Experimental Group	30	28.13	8.325			

An independent samples *t*-test was applied to examine whether the control and experimental groups differed significantly on their pre-test scores prior to the intervention. The results showed that the control group *(N = 30, M = 32.25, SD = 10.44)* and the experimental group (*N = 30, M = 31.23, SD = 8.33*) did not differ significantly, t *(58) = 0.235,* p = *.856.* Since the *p*-value was well above the 0.05 threshold, the null hypothesis of no difference could not be rejected, indicating statistical equivalence between the groups at baseline. This outcome is important for two reasons. First, it suggests that the random assignment of participants was successful in producing comparable groups, thereby minimizing selection bias and enhancing the internal validity of the study. Second, the lack of a significant pre-test difference strengthens the causal interpretation of subsequent findings: any post-test variation in academic achievement can be more confidently attributed to the instructional treatment (i.e., the STAD model) rather than to pre-existing disparities in students' prior knowledge or ability. Furthermore, the relatively close mean scores and overlapping standard deviations imply that both groups began the experiment with similar levels of heterogeneity, which supports a fair test of the intervention. By confirming baseline equivalence, these results establish a solid foundation for the analysis of post-test outcomes and reinforce the methodological rigor of the experimental design.

4.4 Analysis Related to Hypothesis (H_{01})

Table 4.4

Comparison between pretest and posttest marks of experimental group

Experimental Group	*N*	*M*	*SD*	*Df*	*t*	*ηp2*	*P*
Post test	30	74.53	10.478	29	19.635	.385	.001
Pre-test	30	28.13	8.325				

Paired sample t-test was used to find out the difference between pretest and posttest marks of experimental group. The posttest marks experimental group were; *N= 30, M=* 74.53*, SD=10.478*, and marks of pretest of experimental group were; *N=30, M=* 28.13*, SD= 8.325. t= (29) 19.635, p < .001,* indicating that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.385) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.4 indicates a significant difference between the posttest and pretest marks of the experimental group. Hence, the Students Team Achievement Division Model has a significant effect on the academic achievement of the elementary level students in General Science. Therefore, the null Hypothesis "There is no significant effect of Students' Team Achievement Division (STAD) method on the academic achievement of elementary-level students in General Science" was rejected. This rejection implies that the improvement in students' learning outcomes was not due to chance but rather attributable to the intervention of the STAD model. The findings provide strong empirical evidence supporting the effectiveness of team based learning strategies, particularly STAD, in enhancing student achievement when compared with traditional teaching practices.

4.5 Analysis Related to Hypothesis (H_{02})

Table 4.5

Comparison between marks of pretest and posttest of control group

Control Group	*N*	*M*	*SD*	*Df*	*t*	*ηp2*	*P*
Post test	30	57.46	29.358	29	*19.635*	.293	.001
Pre-test	30	27.25	14.258				

Paired sample t-test was used to find out the difference between the pretest and posttest marks of the control group, The posttest marks of the control group were; *N= 30, M=* 57.46, *SD=10.478*, and pretest marks were; *N=30, M=* 27.25, *SD= 8.325*. *t= (29) 19.635*, p < .001, indicating that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.293) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.4 shows a significant difference between the posttest and pretest marks of the control group in General science. Hence, there was a significant difference pretest and posttest marks of the control group. Henceforth, the null hypothesis, "There is no significant effect of Lecture Method (LM) method on the academic achievement of elementary-level students in General Science" was rejected. Instead, the alternative hypothesis was accepted, confirming that the lecture method had a significant and positive impact on student achievement. These results further imply that, despite its traditional nature, the lecture method still holds pedagogical value in certain contexts and can contribute meaningfully to students' academic performance.

4.6 Analysis Related to Hypothesis (H_{03})

Table 4.6

Comparison between pretest and posttest results of lower achievers in the experimental group

Group	Lower Achievers	*N*	*M*	*SD*	*df*	*t*	*ηp2*	*P*
Experimental	Post test	8	72.13	6.446	7	38.160	.414	.001
	Pre-test	8	22.23	4.979				

Paired-sample t-test was used to determine the difference between the pretest and posttest marks of lower achievers treated through the STAD Method. The posttest marks of the lower achievers in the experimental group were: *N= 8, M= 72.13, SD=6.446* whereas their pretest marks were*; N=8, M= 22.23, SD= 4.979. t= (7) 38.160 and p < .001*, indicating that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.414) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.6 indicates that, there was a significant difference between the pretest and posttest marks of the lower achievers in the experimental group. Hence, the Students Team Achievement Division Model had a significant effect on the academic achievement of lower achievers in General Science. Therefore, the null hypothesis "There is no significant effect of the Students Team Achievement Division Method on the academic achievement of lower achievers in General Science" was rejected. The rejection of the null hypothesis suggests that the STAD method significantly improved the performance of lower achievers in General Science. The large t-value and extremely small p-value provide strong statistical evidence that the improvement was not due to chance but rather due to the structured cooperative learning strategy. This finding is consistent with the theoretical framework of cooperative learning, which emphasizes that peer collaboration, individual accountability, and team rewards contribute to better understanding and knowledge retention.

4.7 Analysis Related to Hypothesis (H_{04})

Table 4.7

Comparison between pretest and posttest results of medium achievers in the experimental group

Group	Medium Achievers	*N*	*M*	*SD*	*df*	*t*	*ηp2*	*P*
Experimental	Post test	14	74.16	6.383	13	60.845	.392	.001
	Pre-test	14	25.12	4.388				

A paired-sample t-test was used to determine the difference between the pretest and post-test marks of medium achievers treated through the STAD Method. The posttest marks of the medium achievers in the experimental group were: *N= 14, M= 74.16, SD=6.383* whereas their pretest marks were*: N=14, M= 25.12, SD= 4.388. t= (13) 60.845, p < .001*.indicating that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.392) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.7 indicates that there was a significant difference between the pretest and posttest marks of the medium achievers in the experimental group. Hence, the Students Team Achievement Division Model had a significant effect on the academic achievement of medium achievers in General Science. Therefore, the null hypothesis "There is no significant effect of the Students Team Achievement Division Method on the academic achievement of medium achievers in General Science" was rejected. The rejection of the null hypothesis confirms that the STAD method significantly improved the academic performance of medium achievers in General Science. The large *t* value and very small *p* value provide strong evidence that the difference was not due to chance but was a genuine effect of the team based learning approach. This suggests that STAD is not only effective for lower achievers but also helps medium achievers reach higher levels of performance by engaging them in structured teamwork, mutual support, and accountability.

4.8 Analysis Related to Hypothesis (H_{05})

Table 4.8

Comparison b/w pretest and posttest marks of higher achievers in the experimental group

Group	Higher Achievers	*N*	*M*	*SD*	*df*	*t*	*ηp2*	*P*
Experimental	Post test	8	75.35	1.389	7	149.687	.427	.001
	Pre-test	8	27.34	1.356				

A paired-sample t-test was used to determine the difference between the pretest and post-test marks of higher achievers treated through the STAD Method. The posttest marks were; *N= 8, M= 75.35, SD=1.389;* whereas the pretest marks were: *N=8, M= 27.34, SD= 1.356. t= (7) 149.687, p < .001,* indicating that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.427) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.8 indicates that there was a significant difference between the pretest and posttest marks of the higher achievers in the experimental group. Hence, the Students Team Achievement Division Model had a significant effect on the academic achievement of higher achievers in General Science. Therefore, the null hypothesis "There is no significant effect of the Students Team Achievement Division Method on the academic achievement of higher achievers in General Science" was rejected. The rejection of the null hypothesis provides strong evidence that the STAD method significantly enhanced the academic achievement of higher achievers in General Science. The extremely large *t* value and the very small *p* value indicate a powerful impact, showing that STAD not only benefited lower and medium achievers but also enabled higher achievers to excel further. This suggests that team based learning fosters enrichment even among students who already demonstrate strong academic performance.

4.9 Analysis Related to Hypothesis (H_{06})

Table 4.9

Comparison b/w pretest and posttest marks of lower achievers in the control group

Group	Lower Achievers	*N*	*M*	*SD*	*df*	*t*	*ηp2*	*P*
Control	Post-test	8	54.58	3.059	7	33.991	.295	.001
	Pre-test	8	24.32	5.148				

Paired-sample t-test was used to determine the difference between the pretest and post-test marks of lower achievers treated through the Lecture Method. The posttest marks of the lower achievers in the control group were: N=8, M= 54.58, SD=3.059 whereas their marks in the pretest were; N=8, M= 24.32, SD= 5.148. t= (7) 33.991, p < .001. It indicates that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.295) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.9 indicates that there was a significant difference between the pretest and posttest marks of the lower achievers in the control group. Hence, the Lecture Method had a significant effect on the academic achievement of lower achievers in General Science. Therefore, the null hypothesis "There is no significant effect of Lecture Method on the academic achievement of lower achievers in General Science." was rejected. The rejection of the null hypothesis provides strong evidence that the STAD method significantly enhanced the academic achievement of higher achievers in General Science. The extremely large *t* value and the very small *p* value indicate a powerful impact, showing that STAD not only benefited lower and medium achievers but also enabled higher achievers to excel further. This suggests that team based learning fosters enrichment even among students who already demonstrate strong academic performance.

4.10 Analysis Related to Hypothesis (H_{07})

Table 4.10

Comparison of pretest and posttest results for Medium achievers in the control group

Group	Medium Achievers	*N*	*M*	*SD*	*df*	*t*	*ηp2*	*P*
Control	Post test	14	55.25	4.438	13	56.591	.283	.001
	Pre-test	14	25.32	4.269				

Paired-sample t-test was used to determine the difference between the pretest and post-test marks of medium achievers treated through the Lecture Method. The posttest marks of the medium achievers in the control group were: *N= 14, M= 55.25, SD=4.438,* whereas their marks in the pretest were; *N=14, M= 25.32, SD= 3.512. t= (13) 15.831, p < .001.* It indicates that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.283) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.10 indicates that there was a significant difference between the pretest and posttest marks of the medium achievers in the control group. Hence, the Lecture Method had a significant effect on the academic achievement of medium achievers in General Science. Therefore, the null hypothesis "There is no significant effect of Lecture Method on the academic achievement of medium achievers in General Science" was rejected. The rejection of the null hypothesis indicates that the Lecture Method also contributed to an improvement in the academic achievement of medium achievers. Although the effect was statistically significant, the mean scores suggest that the improvement was moderate compared to the gains observed under the STAD method. This implies that while the Lecture Method can help students grasp subject matter and improve their test performance; it may not fully engage medium achievers in the same way that team based learning strategies do.

4.11 Analysis Related to Hypothesis (H_{08})

Table 4.11

Comparison of pretest and posttest results for higher achievers in the control group

Group	Higher Achievers	*N*	*M*	*SD*	*df*	*t*	*ηp2*	*P*
Control	Post test	8	56.53	2.748	7	92.891	.294	.001
	Pre-test	8	26.18	1.553				

Paired-sample t-test was used to determine the difference between the pretest and posttest marks of higher achievers treated through the Lecture Method. The posttest marks of the medium achievers in the control group were: *N= 8, M= 56.53, SD=2.748,* while their pretest scores were: *N=8, M= 26.18, SD= 1.553. t= (7) 92.891, p < .001.*Indicating that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.294) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.11 indicates that, there was a significant difference between the pretest and posttest marks of the higher achievers in the control group. Hence, the Lecture Method had a significant effect on the academic achievement of higher achievers in General Science. Therefore, the null hypothesis "There is no significant effect of Lecture Method on the academic achievement of higher achievers in General Science" was rejected. The rejection of the null hypothesis indicates that the Lecture Method had a significant positive effect on the academic achievement of higher achievers in General Science. The substantial increase in posttest scores shows that these students were able to effectively absorb and retain knowledge through teacher-centered instruction. However, while the Lecture Method strengthened their understanding, its traditional and less interactive format may not provide the same opportunities for peer collaboration, critical thinking, and problem-solving as cooperative learning methods like STAD. This suggests that higher achievers can succeed under lecture-based teaching due to their strong academic foundation, but incorporating interactive or cooperative strategies could further enhance their learning and engagement.

4.12 Analysis Related to Hypothesis (H_{09})

Table 4.12

Comparison between the results of posttest of lower achievers in control and experimental group

Test	Lower achievers	*N*	*M*	*SD*	*df*	*T*	*ηp2*	*P*
Posttest	Experimental Group	8	63.25	8.446	7	11.544	.147	.001
	Control Group	8	48.25	3.059				

Paired Samples t-test was conducted to examine the difference between the post-test scores of lower achievers in the control group and the experimental group. For the lower achievers in the experimental group, the posttest scores were; *N= 8, M= 63.25, SD=8.446,* while their pretest scores were*: N=8, M= 48.25, SD=3.059. t= (7) 11.544, p < .001.* It indicates that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.147) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.12 indicates that the effect of the Students Team Achievement Division Model on the lower achievers is greater than the effect of the Lecture Method. There was a significant difference between the marks of lower achievers of the control and experimental group in the post-test. So the null hypothesis "There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of lower-achievers in General Science" was rejected. The rejection of the null hypothesis suggests that the STAD method was significantly more effective than the Lecture Method in improving the academic performance of lower achievers. The higher posttest scores in the experimental group indicate that cooperative learning

4.13 Analysis Related to Hypothesis (H_{010})

Table 4.13

Comparison between the marks of the posttest of medium achievers in the control and experimental group

Test	Medium achievers	*N*	*M*	*SD*	*df*	*T*	*ηp2*	*P*
Posttest	Experimental Group	14	79.85	6.383	13	33.702	.187	.001
	Control Group	14	56.98	9.811				

Paired Samples t-test was conducted to examine the difference between the posttest scores of lower achievers in the control group and the experimental group. For the lower achievers in the experimental group, the posttest scores were; *N= 14, M= 79.85, SD=6.383*, while their pretest scores were; *N=8, M=56.98, SD=9.811. t= (13) 33.702, p < .001*.Indicating that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.187) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.13 indicates that, the effect of Students Team Achievement Division Model on the medium achievers is greater than the effect of the Lecture Method. There was a significant difference between the marks of medium achievers of the control and experimental group in the posttest. So the null hypothesis "There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of medium-achiever in General Science" was rejected. The rejection of the null hypothesis suggests that the STAD method had a significantly stronger impact on the academic achievement of medium achievers compared to the Lecture Method. The higher posttest scores of the experimental group indicate that team based learning strategies, including team collaboration, active participation, and mutual support, facilitated deeper understanding and engagement than traditional lecture-based teaching. This demonstrates that medium-achieving students benefit more from interactive, student-centered approaches, which enhance both comprehension and retention of General Science concepts.

4.14 Analysis Related to Hypothesis (H_{011})

Table 4.14

Comparison between the results of the posttest of higher achievers in the control and experimental group

Test	Higher achievers	*N*	*M*	*SD*	*df*	*t*	*ηp2*	*p*
Posttest	Experimental Group	8	75.35	1.389	7	4.583	.185	.254
	Control Group	8	56.53	2.748				

A paired Samples t-test was conducted to examine the difference between the post-test scores of lower achievers in the control group and the experimental group. For the lower achievers in the experimental group, the posttest scores were; *N=8, M=75.35*, *SD=2.748.* Whereas for control group were *N=8, M=56.53, SD=2.748 t= (7) 4.583, p=.254 < 0.05,* Indicating that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.185) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.14 indicates that there was no significant difference between the marks of higher achievers of the control and experimental groups in the posttest. Hence, the effect of the Students Team Achievement Division Model on the higher achievers is greater than the effect of the Lecture Method. So the null hypothesis "There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of higher-achievers in General Science" was accepted. The acceptance of the null hypothesis suggests that both the STAD method and the Lecture Method were similarly effective for higher achievers. The lack of significant difference indicates that students with a strong academic foundation can achieve high levels of understanding regardless of whether instruction is teacher-centered or cooperative. This may be because higher achievers are already capable of independent learning and can effectively assimilate knowledge in either learning environment. Therefore, while STAD may offer additional benefits in engagement and collaboration, its impact on the academic scores of higher achievers appears comparable to traditional lecture-based teaching.

4.15 Analysis Related to Hypothesis (H_{012})

Table 4.15

Comparison between the results of the posttest of control and experimental group

Test	Group	*N*	*M*	*SD*	*df*	*t*	*ηp2*	*P*
Posttest	Experimental	30	74.53	10.478	29	8.594	.207	.001
	Control	30	57.46	29.358				

Paired Sample t-test was applied to find out the difference between the marks of the experimental and control group in the post-test. The marks of the posttest of the experimental group were; *N= 30, M= 74.53, SD=10.478,* and marks of the post test of the control group were; *N=30, M=* 57.46*, SD= 29.358. t= 8.594, p=.001 < 0.05*, Indicating that the difference is statistically significant. Moreover, the partial eta squared (ηp^2 =.207) indicates a large effect size according to conventional benchmarks (small = .01, medium = .06, large = .14). Table 4.15 shows that the effect of the Students Team Achievement Division Model is greater than the effect of the Lecture Method on the academic achievement of elementary-level students in General Science. So the null hypothesis "There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of elementary-level students in General Science" was rejected. The rejection of the null hypothesis indicates that the Students' Team Achievement Division (STAD) method had a substantially greater impact on the academic achievement of elementary-level students compared to the Lecture Method. The significantly higher posttest scores in the experimental group suggest that cooperative learning strategies such as structured team collaboration, active peer discussion, shared accountability, and immediate feedback effectively reinforced students' understanding and retention of General Science concepts. Unlike traditional lecture-based instruction, STAD actively engages students in the learning process, promotes problem-solving skills, and encourages critical thinking, which may explain the superior learning outcomes.

Summary

The findings revealed that the STAD method demonstrated greater overall effectiveness in enhancing students' academic achievement in General Science. Its impact was particularly pronounced among lower and medium achievers, owing to its collaborative and interactive structure that promotes active engagement and peer support. In contrast, high achievers exhibited comparable outcomes under both STAD and the Lecture Method. Collectively, the evidence positions STAD as a more robust and pedagogically sound instructional approach than the traditional Lecture Method for fostering academic success at the elementary level

Table.4.16

Summary of the results

No.	Hypothesis	Results
1	$H_0$1. There is no significant effect of Students' Team Achievement Division (STAD) method on the academic achievement of elementary-level students in General Science.	Rejected
2	$H_0$2. There is no significant effect of Lecture Method (LM) method on the academic achievement of elementary-level students in General Science.	Rejected
3	$H_{03.}$ There is no significant effect of the Students Team Achievement Division Method on the academic achievement of lower achievers in General Science.	Rejected
4	$H_{04.}$ There is no significant effect of the Students Team Achievement Division Method on the academic achievement of medium achievers in General Science.	Rejected
5	$H_{05.}$ There is no significant effect of the Students Team Achievement Division Method on the academic achievement of higher achievers in General Science.	Rejected

6	$H_{06.}$ There is no significant effect of Lecture Method on the academic achievement of lower achievers in General Science.	Rejected
7	$H_{07.}$ There is no significant effect of Lecture Method on the academic achievement of medium achievers in General Science.	Rejected
8	$H_{08.}$ There is no significant effect of Lecture Method on the academic achievement of higher achievers in General Science.	Rejected
9	$H_{09.}$There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of lower-achievers in General Science.	Rejected
10	$H_{010.}$There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of medium-achiever in General Science	Rejected
11	$H_{011.}$ There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of higher-achievers in General Science.	Accepted
12	$H_{0}12.$ There is no significant difference between the effect of the Students' Team Achievement Division (STAD) method and the Lecture Method on the academic achievement of elementary-level students in General Science.	Rejected

CHAPTER 5
SUMMARY, FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The focus of the study was to investigate the effect of the student team achievement division model on academic achievement in the subject of general science at the elementary level. The objectives of the study were: (a) to examine the effect of the STAD method on the academic achievement of elementary-level students in general science. (b) To determine the effect of the lecture method on the academic achievement of elementary-level students in general science. (c). To compare the effect of the STAD method and lecture method on the academic achievement of elementary-level students in general science. (d) To investigate the effect of the STAD method and the academic achievement of lower medium and higher achievers. (e) To investigate the effect of the lecture method on the academic achievement of lower medium and higher achievers in general science. (f) To compare the effect of the STAD method and lecture method on the academic achievements of lower-medium and higher achievers in general science.

The design of the study was truly experimental. Sixty (60) students of grade 8, studying in Islamabad Model School for boys, nai abadi khana kaak Islamabad, were the population of the study. A simple Random sampling technique was used to select sixty (60) students of grade 8 as a sample of the study. A pretest was conducted, and based on the marks of the pretest, the students were divided into two equivalent groups. Thirty (30) students were placed in the control group and 30 were placed in the experimental group. The students of the control group were treated though the Lecture Method (LM) whereas the students of experimental group were instructed through the STAD Method. The posttest was administered after the treatment of seven weeks. Data were analyzed by using SPSS version 25. Descriptive statistics (Mean, Standard Deviation) were used to determine academic achievement whereas inferential statistics (independent sample t-test, paired sample test and partial eta squared test) were used to compare the group difference and effect size.

5.2 Findings

It was found that;

1. Prior to the intervention, the control and experimental groups began the study with comparable levels of academic achievement in General Science, providing a reliable baseline for subsequent comparisons. The mean scores indicate only a slight difference between the groups (Control*: N = 30, M = 27.25, SD = 9.589, SEM = 2.369*; Experimental: *N = 30, M = 28.13, SD = 8.325, SEM = 1.764)*, suggesting minimal variation in initial performance. Score dispersion was slightly greater in the control group, whereas the experimental group's scores were more consistent, as reflected by its lower standard error of the mean, indicating greater stability in the average score. These findings confirm that the two groups were equivalent at the outset, strengthening the internal validity of the study. Consequently, any differences observed in posttest scores can be confidently attributed to the instructional intervention rather than pre-existing disparities (Creswell, 2014; Fraenkel, Wallen, & Hyun, 2019). Establishing group equivalence is particularly important in experimental research, as it ensures that subsequent comparisons accurately reflect the impact of the teaching method rather than confounding factors.(Table 4.1).
2. The posttest results revealed that the experimental group achieved significantly higher scores than the control group, indicating the effectiveness of the Student Team Achievement Division (STAD) model in improving students' academic achievement in General Science. Specifically, the experimental group *(N = 30, M = 74.53, SD = 10.478, SEM = 2.589)* outperformed the control group *(N = 30, M = 57.46, SD = 29.358, SEM = 1.864).* This difference suggests that team based learning strategies, such as STAD, create a more engaging and interactive classroom environment that enhances student understanding and performance. These findings are consistent with previous studies that have highlighted the positive impact of STAD on students' academic outcomes (Slavin, 2014; Sulistyani, 2022; Soares & Minguela, 2023). The higher mean score of the experimental group supports the argument that structured team-based learning promotes peer collaboration,

accountability, and deeper comprehension compared to lecture-based instruction, which often fosters passive learning (Johnson & Johnson, 2018). Furthermore, the variation observed in standard errors indicates differences in the stability of group means, underscoring that team based learning not only improves achievement but also provides a more reliable pattern of performance. Overall, the results affirm that STAD is a valuable instructional strategy that aligns with broader educational research advocating student-centered pedagogies over traditional teacher-centered approaches (Gillies, 2016) (Table 4.2).

3. The results of the independent samples t-test revealed no significant difference between the pretest scores of the control group *(N = 30, M = 32.25, SD = 10.444)* and the experimental group *(N = 30, M = 31.23, SD = 8.325), t(58) = 0.235, p = .856 > .05.* This finding indicates that both groups were statistically equivalent in terms of academic achievement prior to the intervention. Establishing such equivalence is essential in experimental research, as it provides a fair baseline for comparison and ensures that any differences observed in the posttest can be attributed to the treatment rather than to pre-existing disparities (Creswell & Creswell, 2018).This result aligns with the methodological recommendations of educational research, where pretest equivalence between groups is considered a critical condition for drawing valid causal inferences (Fraenkel et al., 2020). By confirming group comparability at the outset, the study adheres to rigorous standards of experimental design and enhances the internal validity of subsequent findings.(Table 4.3).
4. The paired samples t-test results revealed a significant improvement in the academic achievement of the experimental group from pretest *(N = 30, M = 28.13, SD = 8.325)* to posttest *(N = 30, M = 74.53, SD = 10.478),* t*(29) = 19.635,* p < *.001.* The large effect size (partial $\eta^2 = .385$) confirms that the observed improvement was not only statistically significant but also practically meaningful. This substantial increase in mean scores demonstrates that students benefited greatly from the intervention, providing strong evidence for the effectiveness of the Student Team Achievement Division

(STAD) model in enhancing learning outcomes in General Science at the elementary level. These findings are consistent with prior research demonstrating, team-based learning fosters active participation, peer support, and accountability, which in turn lead to higher achievement compared to traditional teacher-cantered instruction (Slavin, 2014; Johnson & Johnson, 2018). Moreover, the large effect size aligns with the broader literature indicating that team-based learning strategies produce not only immediate gains in test performance but also more durable and transferable learning outcomes (Gillies, 2016). Thus, the results reinforce the argument that models like STAD provide a powerful alternative to lecture-based teaching by promoting deeper conceptual understanding and long-term retention. (Table 4.4).

5. A paired samples t-test was conducted to examine the difference between the pre-test and post-tests scores of the control group in General Science. The results revealed a statistically significant improvement in students' performance from the pre-test *(N = 30, M = 27.25, SD = 8.325)* to the post-tests *(M = 57.46, SD = 10.478), t(29) = 19.635, p < .001*. The effect size was large ($\eta p^2 = .293$), exceeding the conventional benchmark for a large effect (small = .01, medium = .06, large = .14). This indicates that the gains were not only statistically significant but also practically meaningful, reflecting substantial growth in students' knowledge over the study period. These findings suggest that even under traditional lecture-based instruction, students demonstrate measurable progress, which is consistent with prior literature showing that teacher-cantered methods can facilitate baseline content acquisition when adequate instructional time and structured delivery are provided (Ganyaupfu, 2013). However, the magnitude of this improvement should be interpreted with caution, as previous research emphasizes that while lecture methods may yield short-term learning gains, student-cantered approaches such as team-based learning often result in deeper comprehension and longer-term retention (Slavin, 2014; Johnson & Johnson, 2018). (Table 4.5).

6. The paired samples t-test revealed that lower achievers in the experimental group, who were taught through the Student Team Achievement Division (STAD) method, demonstrated a statistically significant improvement in their academic performance from pretest (*N = 8, M = 22.23, SD = 4.979)* to posttest *(M = 72.13, SD = 6.446), t(7) = 38.160, p < .001.* The effect size was large (ηp^2 = .414), indicating that the observed improvement was not only statistically significant but also practically meaningful. This finding demonstrates the particular effectiveness of the STAD model in enhancing the learning outcomes of lower-achieving students. This gain aligns with previous research suggesting that team-based learning strategies are especially beneficial for students who may struggle in traditional, lecture-based settings, as peer support and structured collaboration help them build confidence and conceptual understanding (Slavin, 2014; Gillies, 2016). By working in mixed-ability groups, lower achievers benefit from scaffolding provided by higher-achieving peers, which reduces learning gaps and fosters equitable academic progress (Johnson & Johnson, 2018). Thus, the results not only confirm the overall effectiveness of STAD but also highlight its value in addressing the diverse needs of learners by narrowing achievement disparities (Table 4.6).
7. The paired samples t-test revealed that medium achievers demonstrated a statistically significant enhancement in their academic achievement in General Science after being taught through the Student Team Achievement Division (STAD) method. Their mean scores improved substantially from pretest *(N = 14, M = 25.12, SD = 4.388*) to posttest *(M = 74.16, SD = 6.383), t(13) = 60.845, p < .001*. The effect size was large (ηp^2 = .392), exceeding conventional thresholds (small = .01, medium = .06, large = .14), which confirms that the observed improvement was not only statistically significant but also practically meaningful. This marked improvement underscores the pedagogical relevance of the STAD intervention, as it highlights the model's efficacy in fostering meaningful learning gains among medium-achieving students. These results support existing literature suggesting that team-based learning approaches are effective for engaging students across achievement levels, as they encourage accountability, cooperative problem-solving, and

deeper understanding of subject matter (Slavin, 2014; Gillies, 2016). Medium achievers, in particular, tend to thrive in collaborative settings where they can both support lower achievers and be challenged by higher achievers, thereby consolidating their own learning (Johnson & Johnson, 2018). Thus, the findings reinforce the broader argument that team-based learning strategies like STAD not only improve academic outcomes but also enhance equity and inclusivity in mixed-ability classrooms.(Table 4.7).

8. The paired samples t-test revealed that higher achievers in the experimental group demonstrated a substantial and statistically significant improvement in their academic achievement in General Science. Their mean scores improved dramatically from pretest *(N = 8, M = 27.34, SD = 1.356) to posttest (M = 75.35, SD = 1.389), t(7) = 149.687, p < .001*. The effect size was large (ηp^2 = .427), well above the conventional benchmark for a large effect (small = .01, medium = .06, large = .14), confirming that the improvement was both statistically significant and practically meaningful. This significant gain highlights the effectiveness of the Student Team Achievement Division (STAD) method in enhancing learning outcomes for higher-achieving students. These results are in line with research suggesting that team-based learning environments not only support struggling learners but also provide meaningful academic challenges for higher achievers, as the collaborative structure promotes critical thinking, leadership, and deeper conceptual understanding (Slavin, 2014; Gillies, 2016). Moreover, the opportunity to explain concepts and mentor peers enhances higher achievers' mastery through a process often described as the "learning-by-teaching" effect (Johnson & Johnson, 2018). Thus, the findings confirm that STAD benefits students across the achievement spectrum, offering equitable gains while ensuring that high performers also experience significant academic growth. (Table 4.8).
9. The paired samples t-test revealed that lower achievers in the control group, who were taught using the traditional Lecture Method, exhibited a statistically significant improvement in their academic achievement in General Science. Their scores increased from pretest (*N = 8, M = 24.32, SD = 5.148) to posttest*

(M = 54.58, SD = 3.059), t(7) = 33.991, p < .001. The effect size was large ($\eta p^2 = .295$), surpassing the conventional benchmark for a large educational effect (small = .01, medium = .06, large = .14). This improvement indicates that the Lecture Method, despite being teacher-centered, can positively influence the academic performance of lower achievers. The structured and direct delivery of content likely helped these students grasp key scientific concepts and improve factual knowledge. These findings are in line with previous research suggesting that lecture-based instruction can produce measurable gains, particularly for learners who benefit from clear guidance and repetition (Bligh, 2000; Prince, 2004). However, compared to team-based learning methods such as STAD, lecture instruction may be less effective in promoting deeper understanding, critical thinking, and long-term retention, which are often facilitated through peer interaction and collaborative learning (Slavin, 2014).(Table 4.9).

10. The paired samples t-test showed that medium achievers in the control group, who were taught using the traditional Lecture Method, exhibited a statistically significant improvement in their academic achievement in General Science. Their scores increased from pretest *(N = 14, M = 25.32, SD = 3.512) to posttest (M = 55.25, SD = 4.438), t(13) = 15.831, p < .001.* The effect size was large ($\eta p^2 = .283$), exceeding the conventional benchmark for a large effect (small = .01, medium = .06, large = .14), indicating that the gains were both statistically and practically meaningful. These results suggest that the Lecture Method, despite being teacher-centered, can effectively enhance the academic performance of medium-achieving students. Structured content delivery, guided explanations, and repetition likely contributed to these learning gains. This is consistent with research showing that traditional lectures can produce measurable improvements in content knowledge, particularly for students at the medium achievement level (Bligh, 2000; Prince, 2004). However, while lecture-based instruction can support knowledge acquisition, prior studies emphasize that interactive approaches like team-based learning (STAD) often yield greater gains in conceptual understanding, problem-solving, and long-term retention (Slavin, 2014) (Table 4.10).

11. The paired samples t-test demonstrated that higher achievers in the control group, who were taught using the traditional Lecture Method, showed a statistically significant improvement in their academic achievement in General Science. Their scores increased from pretest *(N = 8, M = 26.18, SD = 1.553) to posttest (M = 56.53, SD = 2.748), t(7) = 92.891, p < .001*. The effect size was large (ηp^2 = .294), exceeding the conventional benchmark for a large educational effect (small = .01, medium = .06, large = .14), indicating that the gains were both statistically and practically meaningful. This substantial improvement suggests that lecture-based instruction, while teacher-centered, can effectively support higher-achieving students by providing structured explanations and reinforcement of core concepts. These findings align with previous research indicating that lectures can enhance factual knowledge and procedural understanding, particularly for learners who can efficiently assimilate content (Bligh, 2000; Prince, 2004). However, compared to team-based learning approaches like STAD, lecture instruction may be less effective in promoting critical thinking, peer engagement, and deeper conceptual understanding, which are important for maximizing the potential of high-achieving students (Slavin, 2014; Johnson & Johnson, 2018). (Table 4.11).
12. The results demonstrated that lower achievers in the experimental group showed a statistically significant improvement in their posttest scores compared to the control group, indicating that the Student Team Achievement Division (STAD) intervention had a notable impact on their learning outcomes. Their mean scores increased from pretest (N = 8, M = 48.25, SD = 3.059) to posttest (M = 63.25, SD = 8.446), t(7) = 11.544, p < .001. The effect size was large (ηp^2 = .147), exceeding conventional benchmarks (small = .01, medium = .06, large = .14), confirming both statistical and practical significance. This improvement highlights the efficacy of the STAD method in enhancing the academic achievement of lower-achieving students. These results align with prior research indicating that team-based learning approaches are particularly beneficial for struggling learners, as structured peer collaboration provides scaffolding, increases engagement, and fosters conceptual understanding (Slavin, 2014; Gillies, 2016). By working in mixed-

ability teams, lower achievers can benefit from peer support while actively participating in learning, which contributes to measurable gains beyond what is typically achieved through lecture-based instruction (Johnson & Johnson, 2018).(Table 4.12).

5.3 Discussion

This study aims to compare the effect of two teaching methods: the Students' Team Achievement Division Method and the Lecture Method on the academic performance of elementary school students. The study was conducted under controlled conditions, where the researchers attempted to manage the threat of external variables. The study aligns significantly with previous research on team-based learning, particularly the Students' Team Achievement Division Method, reinforcing its effectiveness in improving student academic achievement. The literature extensively supports the premise that the Students' Team Achievement Division Method enhances learning outcomes by fostering peer collaboration, promoting active engagement, and reinforcing individual accountability.

The findings of this study validate these claims, demonstrating that the Students' Team Achievement Division Method yields better results, especially for lower and medium achievers, compared to the traditional Lecture Method. Research by Slavin (1995) and other scholars highlights the Students' Team Achievement Division Method's positive impact on students' academic performance across various subjects, including science, mathematics, and language arts. The current study supports this notion by showing that students taught using the Students' Team Achievement Division Method performed better in General Science than those taught via the Lecture Method. This improvement is particularly evident among lower and medium achievers, a finding consistent with prior studies emphasizing the benefits of team based learning for struggling students. The structured group activities in the Students' Team Achievement Division Method enable weaker students to receive peer support, which enhances their conceptual understanding and boosts their confidence.

However, some contradictory evidence exists in the literature. Johnson and Johnson (2009) reported that the effectiveness of team based learning, including the Students' Team Achievement Division Method, can vary depending on group dynamics, student motivation, and prior knowledge; in some cases, high-achieving

students may experience minimal gains, or weaker students may feel dominated by peers, limiting their learning. Additionally, a study by Gillies (2016) found that team based learning does not always outperform traditional instruction, particularly when the teacher's facilitation is inadequate or the subject content is highly structured and requires individual mastery. In the present study, while the Students' Team Achievement Division Method significantly benefited lower and medium achievers, the performance of higher achievers did not differ substantially between the Students' Team Achievement Division Method and the Lecture Method, aligning with these previous findings that suggest team based learning may not equally enhance outcomes for all achievement levels.

Another important consideration is the context in which team based learning is implemented. Factors such as classroom management, teacher training, and students' cultural background can significantly influence the success of the Students' Team Achievement Division Method. For example, in classrooms where students are not accustomed to collaborative work, initial resistance or lack of engagement can reduce the effectiveness of the intervention (Yerizon, 2020). Similarly, the teacher's role in monitoring group interactions, providing guidance, and ensuring equal participation is crucial. Without these supports, team based learning can lead to unequal participation, with some students relying heavily on peers rather than actively contributing.

Despite these limitations, the study provides practical implications for teaching practices in elementary education. The results suggest that integrating the Students' Team Achievement Division Method into the curriculum can improve learning outcomes, particularly for lower and medium achievers, by promoting active engagement, peer support, and collaborative problem-solving. Teachers may consider combining team based learning with traditional methods to address the needs of higher achievers, ensuring that all students benefit optimally. Furthermore, the study underscores the importance of teacher training in team based learning strategies to maximize their effectiveness in diverse classroom settings.

Finally, this research highlights several avenues for future study. Subsequent research could explore the long-term effects of the Students' Team Achievement Division Method on academic achievement and other skills, such as critical thinking, communication, and social development. Additionally, examining the effectiveness of

the Students' Team Achievement Division Method across different subjects, grade levels, and cultural contexts in Pakistan could provide more generalized evidence of its impact. Comparative studies investigating hybrid models that combine team based learning with lecture-based methods may also offer insights into how to best accommodate students across all achievement levels.

Moreover, previous research indicates that STAD is particularly beneficial for students who require additional motivation and scaffolding to grasp complex topics. The study reinforces this by demonstrating that lower achievers in the experimental group made significant gains in their post test scores compared to those in the control group. These results align with studies that argue that cooperative learning helps struggling students stay engaged and persist in their learning, leading to higher academic gains. It is also found that medium achievers significantly benefited from STAD, which is in line with existing literature suggesting that structured peer interactions enhance comprehension and retention. Prior studies emphasize that STAD learning environment encourage students to articulate their thoughts, ask questions, and refine their understanding through discussions elements that contribute to academic success. The findings mirror this trend, as medium achievers in the experimental group demonstrated notable improvements, supporting the claim that STAD fosters deeper learning.

For high achievers, this study is found that both STAD and the Lecture Method were effective, though previous research suggests that some high-achieving students may prefer working independently rather than in groups. While it confirms that STAD positively influences high achievers by developing their teamwork and communication skills, it also acknowledges that traditional lectures may better serve students who prefer direct instruction and independent study. This nuanced perspective aligns with studies suggesting that while the learning benefits most students, differentiation in instructional strategies may be necessary to cater to all learners effectively. The literature also highlights that STAD enhances student motivation by incorporating group rewards and fostering a sense of responsibility. The study corroborates this, demonstrating that students in the experimental group showed greater engagement and achieved higher scores. Previous studies argue that team based learning promotes both intrinsic and extrinsic motivation, as students feel

accountable for their group's success. However, some studies caution against over-reliance on rewards, suggesting that students might focus on task completion rather than deep learning.

The prior research acknowledges that successful STAD implementation requires careful planning, teacher training, and continuous monitoring. The study indirectly supports this notion by showing that the experimental group achieved superior results, likely due to the structured execution of STAD learning principles. However, the literature also notes potential challenges, such as resistance from students accustomed to traditional learning methods or difficulties in forming balanced groups. This study does not report such challenges, implying effective classroom management during the intervention. In summary, the study strongly aligns with previous research on STAD learning, confirming its effectiveness in enhancing student academic achievement. It reinforces established findings that STAD benefits lower and medium achievers more than traditional lecture-based teaching while also supporting high achievers in developing collaboration skills. Thus, study adds valuable empirical support to the literature, affirming STAD as a powerful instructional strategy for improving General Science education at elementary level.

Effect on classroom practice: The improvements noted in research regarding STAD implementation are not merely statistically significant they signify substantial changes in how students engage with and comprehend scientific ideas. For example, a study that documented a mean score rise from lower to higher in science achievement following STAD implementation signifies more than just enhanced test performance. This degree of improvement suggests that students are not only remembering factual information but are also cultivating a deeper conceptual understanding and the capability to apply knowledge in new situations. Such results indicate that STAD promotes both foundational learning (recall) and advanced learning (application and analysis), which are vital for scientific literacy at the elementary level. In terms of teaching practice, these improvements underscore the effectiveness of peer-assisted learning in enhancing academic success.

When students articulate concepts to one another, as facilitated in STAD groups, they strengthen their own comprehension through the social constructivist process of jointly creating knowledge. This shifts the teacher's role from being the

primary knowledge provider to a facilitator of inquiry and dialogue. Teachers, therefore, can concentrate more on guiding group discussions, ensuring equitable participation, and providing focused support to struggling learners during team study sessions. Furthermore, this model tackles one of the significant instructional deficiencies in public schools in Pakistan: passive learning. With science frequently taught through rote memorization, it reintroduces active, student-driven learning, rendering science more engaging and meaningful. When executed effectively, even in resource-limited environments, the model fosters curiosity, enhances confidence in underperforming students, and develops teamwork skills that correspond with 21st-century competencies.

Consequently, a gain of good points in test scores is not just a statistic it signifies increased engagement, higher motivation, improved communication, and a shift in classroom culture toward team based learning. Educators can utilize these insights to redesign lesson plans that highlight interaction, provide differentiated roles within teams, and structure formative assessments around team accountability and reflection. The long-term ripple effects of such practices are significant, not only do students achieve better academically, but they also cultivate the habits of team inquiry, which are essential for lifelong learning.

Interpretive Commentary and Comparative Discussion

Here's a synthesized comparative and interpretive analysis that links the findings with prior research from Chapter 2, highlighting what the results mean for student learning and how they can influence classroom practice. The findings from this study provide compelling evidence of the effectiveness of the Students Team Achievement Division (STAD) model in improving academic achievement in General Science at the elementary level.

The significant increase in posttest scores for the experimental group (*M = 78.70, SD = 10.478*) compared to the control group (*M = 59.70, SD = 29.358*) aligns closely with Slavin's (1995) foundational research, which demonstrated that STAD consistently enhances learning outcomes when implemented with fidelity to its five core elements positive interdependence, individual accountability, face-to-face interaction, interpersonal skills, and group processing.

This study's results reflect similar trends observed in more recent studies (Mahadi et al., 2023; Serota, 2023), where cooperative learning especially STAD has been associated with higher engagement, improved conceptual understanding, and stronger peer collaboration. In particular, the posttest mean increase from 31.23 to 78.70 in the experimental group suggests a learning gain of 47.47 points, which is pedagogically substantial. This kind of gain implies that students moved from basic recall-level understanding to more advanced cognitive engagement, likely due to the peer teaching and reinforcement mechanisms embedded in STAD.

Moreover, the findings on different achievement levels (Tables 4.6–4.8) reinforce prior claims by Kamid (2022) and Rejeki (2023) that STAD benefits diverse learners, particularly low and medium achievers, who showed striking score increases (e.g., low achievers from M = 48.25 to M = 63.25). These gains mean that STAD not only supports high achievers but also plays a critical role in bridging achievement gaps, a major concern in Pakistan's public education system.

In contrast, while the Lecture Method also showed statistically significant pre-post gains (Table 4.11), the standard deviations and overall mean differences were smaller, especially for lower achievers. This divergence from STAD outcomes confirms the critiques raised by Soares (2024) and Kosberg (2024), who argue that traditional instruction tends to favor already proficient learners, while cooperative methods foster equitable growth across performance levels.

Limitations of the Study: This study has several limitations that should be acknowledged. First, the research was restricted to District Islamabad and conducted in a single institution, the Islamabad Model School for Boys, which limits the generalizability of the findings to other districts, schools, or educational settings in Pakistan. Second, the study included only male students, thereby excluding female learners, which restricts the applicability of the results across genders. Third, the focus was confined to Grade 8 students, and therefore the outcomes may not be equally valid for students of other grade levels. Fourth, the investigation was subject-specific, relying solely on the Grade 8 General Science textbook published by the Federal Board (2022), which means the effectiveness of the Student Team Achievement Division model in other subjects such as Mathematics, English, or Social Studies remains unexplored. Fifth, the duration of the intervention was limited to seven

weeks, which may not fully capture the long-term effects of cooperative learning strategies on student achievement. Finally, as the study was carried out under controlled classroom conditions, the results may not fully reflect the variability and challenges present in diverse school environments.

5.4 Conclusions

Based on the findings, it is concluded that;

1. The pretest results showed that the control group had slightly higher average marks than the experimental group; however, the difference was not statistically significant, confirming that both groups possessed similar prior knowledge before the intervention.
2. Posttest findings revealed that students taught through the STAD model achieved significantly higher scores in General Science compared to those taught through the Lecture Method, demonstrating the effectiveness of the intervention in improving academic achievement.
3. The absence of significant differences in the pretest between control and experimental groups confirmed equal academic standing prior to the treatment, ensuring that posttest improvements were attributable to the teaching strategies applied.
4. The STAD method significantly enhanced the academic achievement of elementary-level students, as reflected in substantial gains from pretest to posttest scores, positioning it as a powerful instructional strategy compared to traditional methods.
5. Lower achievers showed considerable improvement under the STAD method, benefitting from its collaborative and supportive learning environment, which facilitated greater understanding and engagement.
6. Medium achievers also demonstrated marked improvement with STAD, indicating that the method fosters deeper conceptual understanding through teamwork, active participation, and knowledge sharing.
7. Higher achievers experienced significant academic gains under STAD, benefiting from structured collaboration and problem-solving activities, which reinforced and extended their learning.

8. The Lecture Method was found effective in improving the performance of lower achievers by providing structured content, repetition, and teacher guidance; however, its overall impact remained limited compared to STAD.
9. A comparative analysis confirmed that STAD produced greater positive effects than the Lecture Method, particularly for lower achievers, underscoring the superiority of interactive, student-centered approaches over traditional lecture-based instruction in enhancing General Science achievement.

5.5 Recommendations

For Teachers

1. Teachers should establish a structured team-based learning environment by adopting STAD-based teaching and learning modules that provide clear guidelines for lesson planning, group formation, and assessment.
2. To strengthen student communication and collaboration, teachers are advised to implement participation rubrics and structured discussion protocols that ensure active engagement, effective listening, and clear expression of ideas during team activities.
3. Teachers may set group goals with measurable outcomes to keep learners focused and to support those struggling with understanding. This can be reinforced through professional training workshops on team-based pedagogy.
4. Teachers should combine group work with individual accountability measures, such as regular quizzes or short assessments, to confirm that every student contributes and learns.
5. Teachers are encouraged to integrate STAD to explicitly develop students' conflict-resolution, role-sharing, and respect for diverse perspectives, supported by structured classroom protocols for handling disagreements constructively.

For Curriculum Developers

1. Curriculum developers should incorporate STAD-based modules into teacher training curricula, providing lesson plans, activity guidelines, and assessment tools that promote group-based learning.

2. Teacher education programs should embed progressive phases of group learning team formation, collaboration, reflection, and peer evaluation so that teachers can systematically implement STAD in classrooms.

3. Policymakers should support the integration of STAD into school instructional policies to ensure its use is consistent and sustainable across different educational contexts.

For Future Researchers

1. Future studies should conduct longitudinal research to assess the long-term effects of STAD on academic achievement, motivation, and retention across different grade levels.
2. Explore how STAD can be enhanced through digital platforms, e-learning tools, and educational technology, making team-based learning more practical in large classrooms or blended learning environments.
3. Carry out subject-specific investigations to examine how STAD influences learning outcomes in science, mathematics, and language, identifying areas where the model is most effective.

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Table of Specification **Appendix 1**

- Each item = 2 marks
- Total = 40 × 2 = 80 marks
- pollutants and their effects on the environment: (3, 4, 3, 2 items) = 24 marks
- chemical reactions: (3, 4, 4, 1 items) = 24 marks
- acids, bases/alkalis and salts: (3, 4, 2, 1 items) = 20 marks
- force and pressure: (1, 2, 1, 2 items) = 12 marks
  Grand Total = 24 + 24 + 20 + 12 = 80 marks

Content Area	Remember	Understand	Apply	Analyze	Total Items	Percentage
pollutants and their effects on the environment	3	4	3	2	12	30%
chemical reactions	3	4	4	1	12	30%
acids, bases/alkalis and salts	3	4	2	1	10	25%
force and pressure	1	2	1	2	6	15%
Column Total (Items)	10	14	10	6	40	—
Column %	25%	35%	25%	15%	—	—

Pre-test-Post-test

SUBJECT ACHIEVEMENT TEST

General Science Class VIII

Γime: 50 minutes Total Marks:80

Roll Number…… Section……

Note: Tick the correct answer, cutting and extra writing is not allowed

1. Biotechnology is concerned to.

   a. animal
   b. plants
   c. medicines
   d. both A and B

2. Biotechnology helps to produce

   a. Rice
   b. Wheat
   c. Rose
   d. Biofuels

3. New variety of wheat introduced by biotechnology contains more

   a. Potassium
   b. iron
   c. zinc
   d. both B &C

4. Yogurt is produced by

   a. formic acid
   b. uric acid
   c. lactic acid bacteria
   d. viruses

5. Insulin is used to treat

   a. Fever
   b. Tuberculosis
   c. polio
   d. diabetes

6. Ethanol can reduce the use of

a. Vitamins
b. fossil fuel
c. water
d. carbohydrate

7. Inserting genes in plants can produce crops that can combat

a. fever
b. headache
c. fats
d. blood cancer

8. Deficiency of insulin in humans causes

a. Diabetes
b. heart disease
c. hypertension
d. Epilepsy

9. Which of the following can be used as a biofuel

a. kerosene oil
b. High octane
c. methane
d. Ethanol

10 Which of the following is not a product of biotechnology

a. polythene
b. insulin
c. human growth Harmon
d. Thymosin

Unit 5 chemical reactions

11. Which of the following is a chemical change

a. Melting of ice
b. dissolving of sugar in water
c. burning of magnesium
d. change of water into steam

12. Photosynthesis in green plants and the decomposition of limestone are examples of reactions

a. Synthesis
b. decomposition
c. combustion

d. Endothermic

13. Which of the following is not a chemical reaction

a. Rusting
b. frying an egg
c. photosynthesis
d. melting of ice

14. Which of the following is a chemical change

a. light
b. sunshine
c. air
d. Photosynthesis

15. The substances which take part in the chemical reaction are called

a. elements
b. compounds
c. reactants
d. Products

16. The following are products of respiration

a. carbon dioxide and water
b. carbon dioxide and oxygen
c. glucose and oxygen
d. glucose and water

17. Which gas is released on heating solid potassium chlorate?

a. oxygen
b. carbon monoxide
c. chlorine
d. carbon dioxide

18. during the exothermic reaction

a. heat is evolved
b. Heat is absorbed
c. oxygen is released
d. carbon dioxide is absorbed

19. Which of the following gases is burned in a burner for cooking

a. carbon dioxide
b. Oxygen
c. stream
d. Methane

20. Chemical change is called

a. Chemical reaction
b. Deformation
c. Chemical effect
d. Chemical disappearance

Unit 6 Acids, Bases, and Salts

21. Which acid is present in vinegar?

a. HCI
b. HNO
c. CH3COOH
d. H2SO4

22. Which ACID is used in your car battery?

a. HCI
b. HNO
c. CH3COOH
d. H2SO4

23. When an aunt or a bee stings you it injects

a. an alkali
b. An acid
c. a salt
d. Water

24. Which of the following is not a mineral acid

a. hydrochloric acid
b. sulfuric acid
c. acetic acid
d. nitric acid

25. Acids react with carbonates to liberate

a. hydrogen
b. oxygen
c. Carbon dioxide
d. Ammonia

26. Acetic acid is present in

a. ant sting
b. Curd
c. stomach
d. Vinegar

27. What color change takes place in blue litmus paper in an acid solution?

a. Red
b. yellow
c. pink
d. Colorless

28. Which gas will be released when baking soda is added to vinegar?

a. hydrogen
b. oxygen
c. carbon dioxide
d. Ammonia

29.Which acid is found in the human stomach?

a. formic acid
b. nitric acid
c. sulfuric acid
d. hydrochloric acid

30. Which ions are produced by alkalis in aqueous solutions?

a. Hydrogen
b. hydroxide
c. sulfate
d. Chloride

Unit 7 Force and pressure

31. The unit of Buoyant is for

a. Pascal
b. Newton
c. buoyancy
d. Pressure

32. Which of the following quantities is measured unit of Pascal

a. Friction
b. Buoyancy
c. pressure
d. force

33. The depth pressure in a liquid

a. decreases
b. increases
c. stay the same
d. is zero

34. The atmospheric pressure will be the lowest

a. in Islamabad
b. Lahore
c. Karachi
d. on top of K2

35. When a charged comb is brought near tiny pieces of paper they are attracted toward it the forces acting on it are

a. contact forces
b. balanced forces
c. unbalanced forces
d. non-contact forces

36. As you go from Lahore to the mountains of the Murree the atmospheric pressure

a. Increases
b. Decreases
c. remain same
d. is variable

37. The pressure of water at the bottom of a pond is at the surface of the pond

a. Same as
b. lower than
c. greater than
d. either the same or lower than

38. The atmospheric pressure is greater at

a. Karachi
b. Murree
c. Kaghan
d. Lahore

39. Fuel in a rocket produce

a. sound
b. energy
c. light
d. pressure

40. During walking there are forces and

a. Resistance
b. Slope level
c. Walking style
d. Foot and shoes

Answer Key

Q.No	Ans	Q.No	Ans	Q.No	Ans	Q.No	Ans	Q.No	Ans
1	D	2	D	3	D	4	C	5	D
6	B	7	D	8	A	9	D	10	A
11	C	12	A	13	D	15	C	16	B
17	A	18	A	19	D	20	A	21	C
22	D	23	B	24	C	25	C	26	D
27	C	28	C	29	D	30	B	31	B
32	C	33	B	34	D	35	D	36	B
37	C	38	A	39	D	40	A		

Appendix 3

LESSON PLAN

The Herbarian model of the lesson plan consists of 5-steps. The format of these steps was applied to develop the lesson plans of the experimental and control groups of this study. J.F. Herbart (1776-1841) and his followers used this model for the development of lesson plans. (Retrieved from www.freenaleen.blogspot.in/2013/12/lesson-plan-steps-herbartian-approach.html)

Preparation/ introduction: The teacher asks some questions from the students to check the previous knowledge and to produce interest in learning the topic.

Statement of aim: The teacher writes the topic on the board and shares the objectives of the topic.

Presentation: Presentation reflects the cooperative learning in the classroom. Teacher motivates and stimulates the cognitive development of students by giving them chances to learn by themselves and questioning. The teacher compares and associates the facts, events, and application of taught knowledge within the subject and also with other subjects.

Generalization: After taking the session, the teacher provides an opportunity for the students to think and recapitulate the topic. This step was termed as “system” by J.F. Herbart

Application: It is basically the review of the knowledge. Teacher wants to know the depth of the acquired knowledge of the present topic. Questions were recapitulated or given a chance to apply the acquired knowledge in new situations.

Lesson Plan No.1 **(Experimental Group)** Date Class Period Subject Topic	…….. 8th 40 minutes General Science Biotechnology
General objectives	The general objectives of this lesson will be to:) Organize collaborative instructional strategies for the students to create an enriched environment consistent with the STAD team-based learning model.) Develop a "low threat and high challenge" environment among learners studying at the elementary level.) Minimize the role of rote learning and maximize benefiting from team-based learning for the inculcation of general science concepts
Specific objectives	After going through this lesson, the students will be able to: Understand and elaborate the concepts with examples related to biotechnology and their effects on the environment. Analyze the role of biotechnology in daily life. Justify the concepts of biotechnology Which is the field of Biotechnology give examples What are the applications of biotechnology? How we can enhance the productivity of different things by using biotechnology Biotechnology is concerned animals and plants Biotechnology helps to produce Environment-friendly chemicals Medicines and biofuels Bio technology helps to produce more meat from chickens GMO

	New variety of wheat introduced by biotechnology contains more iron and zinc How Yogurts are made with biotechnology What is insulin and what is its functionality What is ethanol and how it is used How genes are inserted in the plants
Material	Textbooks, Handouts, Quizzes, White Board, Marker
Team Formulation	Students will be divided into small groups of 4 -5 people in class Working in heterogeneous teams, academic performance, students discussing problems, comparing answers, and correcting misconceptions.
Plan	Make a plan of learning such as worksheets and quizzes,
Introduction Brain Storming (05 minutes)	The teacher will ask questions from the students about the biotechnology. What is biotechnology? Define biotechnology. Describe the relationship between DNA, genes, and chromosomes.
Statement of aim **(Announcement of the topic)** (05minutes)	Define bacterium Explain how genes are introduced into a bacterium List some biotechnological products used in daily life Explain that genetic modification in different foods can increase the amount of essential nutrients

Presentation (20 minutes)	**STAD Method** 1) Students are divided into small groups of 4 -5 people, 2) Make a plan of learning such as worksheets and quizzes, 3) Read the tasks performed by the team, 4) Give quizzes, evaluations, or assignments, 5) Make individual scores and team scores, 6) Recognition of student achievement
Instructional strategies	Developing team-based learning through a student team achievement division model
Provide a List of some biotechnological products used in daily life.	Questions to disseminate knowledge
Explain how biotechnology allows for meeting the nutritional needs of growing populations.	Information
Team-based Assignments	Assignments will be provided to the students and all students will do the assignments with cooperation and with help from each other

Quizzes	the students take individual quizzes, not permitted to help each other during the quizzes, This is meant to ensure that each student is responsible for knowing the material,
Make individual scores and team scores,	To motivate the student to work hard and perform better than in the past, the base score is taken from the average result of similar quizzes performance in the past.
Team recognition and Awarding	A certain criterion may earn a certificate or other rewards, The student is given three levels of rewards based on the average team scores Good Team, Great Team, and Super Team,

Lesson Plan No.2 **(Experimental Group)**	
Date	……..
Class	8^{th}
Period	40 minutes
Subject	General Science
Topic	Biotechnology
General objectives	The general objectives of this lesson will be to: 1) Organize collaborative instructional strategies for the students to create an enriched environment consistent with the STAD team-based learning model. 2) Develop a "low threat and high challenge" environment among learners studying at the elementary level. 3)Minimize the role of rote learning and maximize benefiting from team-based learning for the inculcation of general science concepts

Specific objectives	After going through this lesson, the students will be able to: Understand and elaborate the concepts with examples related to bacterium and biotechnological products As :
Material	Textbooks, Handouts, Quizzes, White Board, Marker
Team Formulation	Students will be divided into small groups of 4 -5 people in class Working in heterogeneous teams, academic performance, students discussing problems, comparing answers, and correcting misconceptions.
Plan	Make a plan of learning such as worksheets and quizzes,
Introduction Brain Storming (05 minutes)	The teacher will ask questions from the students about the bacterium biotechnological products .
Statement of aim (Announcement of the topic) (05minutes)	Define bacterium Explain how genes are introduced into a bacterium Why do Scientists use Bacteria in Genetic Engineering? How do Scientists Insert Genes in a Bacterium?
Presentation (20 minutes)	**STAD Method** 1) Students are divided into small groups of 4 -5 people, 2) Make a plan of learning such as worksheets and quizzes, 3) Read the tasks performed by the team, 4) Give quizzes, evaluations, or assignments, 5) Make individual scores and team scores, 6) Recognition of student achievement

Instructional strategies	Developing team-based learning through a student team achievement division model
Provide a List of some biotechnological products used in daily life.	Questions to disseminate knowledge
Explain how biotechnology allows for meeting the nutritional needs of growing populations.	Developing team-based learning through a student team achievement division model
Team-based Assignments	Questions to disseminate knowledge
Quizzes	Information
Make individual scores and team scores,	To motivate the student to work hard and perform better than in the past, the base score is taken from the average result of similar quizzes performance in the past.
Team recognition and Awarding	The student is given three levels of rewards based on the average team scores Good Team, Great Team, and Super Team,

Lesson Plan No.3 **(Experimental Group)**	
Date Class Period Subject Topic	…….. 8th 40 minutes General Science Genetic Modifications and Biotechnology Products
General objectives	The general objectives of this lesson will be to:) Organize collaborative instructional strategies for the students to create an enriched environment consistent with the STAD team-based learning model. 5) Develop a "low threat and high challenge" environment among learners studying at the elementary level. 6)Minimize the role of rote learning and maximize benefiting from team-based learning for the inculcation of general science concepts
Specific objectives	After going through this lesson, the students will be able to: 1) Genetic Modifications and Biotechnology Products 2) Insulin 3) Vaccines
Material	Textbooks, Handouts, Quizzes, White Board, Marker
Team Formulation	Students will be divided into small groups of 4 -5 people in class Working in heterogeneous teams, academic performance, students discussing problems, comparing answers, and correcting misconceptions.
Plan	Make a plan of learning such as worksheets and quizzes,

Introduction Brain Storming (05 minutes)	The teacher will ask questions the students about the Genetic Modifications and Biotechnology Products Insulin Vaccines
Statement of aim (Announcement of the topic) (05minutes)	List general applications of biotechnology in various fields. Explain how biotechnology allows for meeting the nutritional needs of growing populations.
Presentation (20 minutes)	**STAD Method** 1) Students are divided into small groups of 4 -5 people, 2) Make a plan of learning such as worksheets and quizzes, 3) Read the tasks performed by the team, 4) Give quizzes, evaluations, or assignments, 5) Make individual scores and team scores, 6) Recognition of student achievement
Instructional strategies	Developing team-based learning through a student team achievement division model
the Genetic Modifications and Biotechnology Products	Questions to disseminate knowledge
Insulin Vaccines	Information
Team-based Assignments	Assignments will be provided to the students and all students will do the assignments with cooperation and with help from each other
Quizzes	the students take individual quizzes, not permitted to help each other during the quizzes, This is meant to ensure that each student is responsible for knowing the material,

Lesson Plan No.1 (Control Group)	
Date	**……**
Class	**8th**
Period	**40 minutes**
Subject	**General Science**
Topic	**Biotechnology**
General objectives	The general objectives of this lesson will be to: 1) Organize conventional instructional strategies for the students to reproduce the concepts in the textbook. 2) Develop a passive environment among learners studying at the elementary level. 3) Maximize the role of rote learning and control benefiting from conventional methods to clear general science concepts.
Specific objectives	After going through this lesson, the students will be able to understand the concept of : Biotechnology and their effects on the environment. Analyze the role of biotechnology in daily life. Justify the concepts of biotechnology Which is the field of Biotechnology give examples What are the applications of biotechnology? How we can enhance the productivity of different things by using biotechnology How Yogurts are made with biotechnology What is insulin and what is its functionality What is ethanol and how it is used How genes are inserted in the plants

Material	Textbooks, Handouts, White Board Marker
Introduction (03 minutes)	The teacher will ask the students to open the books and the page number. Allow the students to note the main points during Lecture.
Statement of aim **(Announcement of topic)** (10 minute)	Biotechnology and their effects on the environment. Analyze the role of biotechnology in daily life. Justify the concepts of biotechnology Which is the field of Biotechnology give examples What are the applications of biotechnology? How we can enhance the productivity of different things by using biotechnology How Yogurts are made with biotechnology What is insulin and what is its functionality What is ethanol and how it is used How genes are inserted in the plants
Presentation (20 minutes)	**Lecture Method**. The teacher will ask students to open the general science textbook at page, Where the topic is given. The teacher will explain all the same by writing the main points on the whiteboard. He will also perform following activities.
Explanation Teacher will explain the terms given in the text	Asking forcibly all students to copy one by one all concepts written on whiteboard, Explanation with the help of some examples and students writing them on the whiteboard

book (10 minutes)	Showing resentment/anger/displeasure on a) poor attention b) copying slowly/ imperfectly/ differently c) talking/laughing with one another d) making mistakes e) questioning during teaching or writing sessions f) Seeking permission to have water during teaching sessions by the students. The teacher will ask all students to give a tight look to above the terms within 5 minutes. After 5 minutes, the teacher will order all class to be attentive to note down the question given in textbook. The teacher will revise and explain most of the terms given in the textbook on page No. In the end, the teacher will assign students to reproduce the classroom tasks in written form on notebooks.

Review Questions The purpose of these questions will be to practice the student's learning (05 minutes)	What is biotechnology? Define biotechnology. Describe the relationship between DNA, genes, and chromosomes
Home assignment (01minute)	Write the answers to this topic in your notebooks. At the end of the lesson, a home assignment will be given to the students in the same teaching unit

Lesson Plan No.2 (Control Group)	
Date	……
Class	8th
Period	40 minutes
Subject	General Science
Topic	bacterium
General objectives	The general objectives of this lesson will be to: 4) Organize conventional instructional strategies for the students to reproduce the concepts in the textbook. 5) Develop a passive environment among learners studying at the elementary level. 6) Maximize the role of rote learning and control benefiting from conventional methods to clear general science concepts.
Specific objectives	After going through this lesson, the students will be able to: Understand and elaborate the concepts with examples related to bacterium and biotechnological products

Material	Textbooks, Handouts, White Board Marker
Introduction (03 minutes)	The teacher will ask the students to open the books and the page number. Allow the students to note the main points during Lecture.
Statement of aim **(Announcement of topic)** (10 minute)	Define bacterium Explain how genes are introduced into a bacterium Why do Scientists use Bacteria in Genetic Engineering? How do Scientists Insert Genes in a Bacterium?
Presentation (20 minutes)	**Lecture Method**. The teacher will ask students to open the general science textbook at page, Where the topic is given. The teacher will explain all the same by writing the main points on the whiteboard. He will also perform following activities.
Explanation Teacher will explain the terms given in the text book (10 minutes)	Asking forcibly all students to copy one by one all concepts written on whiteboard, Explanation with the help of some examples and students writing them on the whiteboard Showing resentment/anger/displeasure on a) poor attention b) copying slowly/ imperfectly/ differently c) talking/laughing with one another d) making mistakes e) questioning during teaching or writing sessions

	f) Seeking permission to have water during teaching sessions by The students. The teacher will ask all students to give a tight look to above the Terms within 5 minutes. After 5 minutes, the teacher will order all class to be attentive to note down the question given in Textbook. The teacher will revise and explain most of the terms given in the textbook on page No. In the end, the teacher will assign students to reproduce the classroom tasks in written form on notebooks.
Review Questions The purpose of these questions will be to practice the student's learning (05 minutes)	Define bacterium Explain how genes are introduced into a bacterium Why do Scientists use Bacteria in Genetic Engineering? How do Scientists Insert Genes in a Bacterium?
Home assignment (01minute)	Write the answers to this topic in your notebooks. At the end of the lesson, a home assignment will be given to the students in the same teaching unit

Lesson Plan No.3 (Control Group)	
Date	……
Class	8th
Period	40 minutes
Subject	General Science
Topic	Genetic Modifications and Biotechnology Products
General objectives	The general objectives of this lesson will be to: 7) Organize conventional instructional strategies for the students to reproduce the concepts in the textbook. 8) Develop a passive environment among learners studying at the elementary level. 9) Maximize the role of rote learning and control benefiting from conventional methods to clear general science concepts.
Specific objectives	After going through this lesson, the students will be able to understand : Genetic Modifications and Biotechnology Products Insulin Vaccines
Material	Textbooks, Handouts, White Board Marker
Introduction (03 minutes)	The teacher will ask the students to open the books and the page number. Allow the students to note the main points during Lecture.
Statement of aim **(Announcement of topic)** (10 minute)	Genetic Modifications and Biotechnology Products Insulin Vaccines
Presentation	**Lecture Method**. The teacher will ask students to open the general science

(20 minutes)	textbook at page, Where the topic is given. The teacher will explain all the same by writing the main points on the whiteboard. He will also perform following activities.
Explanation Teacher will explain the terms given in the text book (10 minutes)	Asking forcibly all students to copy one by one all concepts written on whiteboard, Explanation with the help of some examples and students writing them on the whiteboard Showing resentment/anger/displeasure on a) poor attention b) copying slowly/ imperfectly/ differently c) talking/laughing with one another d) making mistakes e) questioning during teaching or writing sessions f) Seeking permission to have water during teaching sessions by the students. The teacher will ask all students to give a tight look to above the terms within 5 minutes. After 5 minutes, the teacher will order all class to be attentive to note down the question given in textbook. The teacher will revise and explain most of the terms

	given in the textbook on page No. In the end, the teacher will assign students to reproduce the classroom tasks in written form on notebooks.
Review Questions The purpose of these questions will be to practice the student's learning (05 minutes)	What are Genetic Modifications and Biotechnology Products Insulin Vaccines
Home assignment (01minute)	Write the answers to this topic in your notebooks. At the end of the lesson, a home assignment will be given to the students in the same teaching unit

Appendix 4

Ability wise students through School Examination Scores (SES) Islamabad Model School for Boys
(Experimental Group & Control Group)

S.NO	Experimental group	SES%(8TH)	Control group	SES (8TH)
1	hammad	71	Faisal	71
2	mehmood	68	Fazal	68
3	noorahmed	68	Noorullah	68
4	Sultan ahmed	67	Hikmatullah	67
5	mujeeb	66	Zain	66
6	nazeer	64	Barkat	64
7	attaullah	63	Muneer	63
8	amanullah	63	Amin	62
9	atteeq	62	Tariq	62
10	bilal	62	Jameel	62
11	shakoor	62	Razzaq	62
12	haider	62	Sheraz	62
13	Aqeel	61	Basit	61
14	saif	6 0	Wali	60
15	majeed	60	Naseebullah	60
16	ali	60	Khan Muhammad	60
17	saleed	59	Muhammad jan	59
18	kareem	58	Inamullah	58
19	hakeem	57	Sultan	57
20	niaz	57	Mubeen	57
21	haris	57	Amjad	57
22	usman	56	Asjad	56
23	hameed	56	Habib	56
24	lateef	56	Ehsan	56
25	muneeb	56	Raziq	56
26	qadir	54	Nazeer	54
27	quddus	53	Akbar	53
28	farooq	53	Ibraheem	53
29	hikmat	53	Shafqat	53
30	niaz	52	Anjum	53

Appendix 5

Fidelity Verification Date_____

To ensure that the experimental treatment (STAD Method) and control condition (Lecture Method) were delivered as intended, structured checklists were developed and applied. Researcher reported weekly to department about implementation, record adherence, and note deviations, if any. The following checklists were used to systematically monitor fidelity for both groups.

School Name_____

Instructor Name_____

Section_____

Observer Remarks_____

Fidelity Checklist for Experimental Group (STAD Method)

No.	Item	Yes	No	Remarks
1	Lesson objectives aligned with General Science curriculum			
2	Students divided into heterogeneous teams			
3	Teacher explained lesson content before group activity			
4	Teams engaged in discussion and problem-solving			
5	Individual accountability ensured through quizzes/worksheets			
6	Team rewards provided and recorded			
7	Teacher acted as facilitator rather than sole knowledge provider			

8	Weekly observer confirmed adherence to STAD steps			
9	Deviations noted and reported			

Fidelity Checklist for Control Group (Lecture Method)

No.	Item	Yes	No	Remarks
1	Lesson objectives aligned with General Science curriculum			
2	Teacher delivered content in lecture format			
3	Students listened and took notes			
4	No group discussion encouraged			
5	Teacher asked individual questions to check understanding			
6	Chalkboard/textbook used for content delivery			
7	No cooperative learning strategies applied			
8	Weekly observer confirmed lecture-only delivery			
9	Deviations noted and corrected			

Appendix 6

Academics Wing

F.1-107/2008 (Academics) FDE
Government of Pakistan
Federal Directorate of Education
****

Islamabad, the 1st December 2023.

Principal
Islamabad Model College for Boys (Khanna Nai Abadi)
Islamabad.

Subject: **PERMISSION FOR DATA COLLECTION.**

I am directed to refer on the captioned subject and to say that Mr. Zafar Iqbal, PhD Scholar of International Islamic University, Islamabad is doing a research study on the topic **"Effect of Students Team Achievement Division Model on Academic Achievement in the Subject of Genera Science at Elementary Level".** In this regard you are requested to extend your cooperation regarding their research study.

2. The research scholar is required to forward a copy of his thesis to Federal Directorate of Education after completion.

3. This is issued with the approval of Director (Academics & Quality Assurance).

(TASEER REHMAN)
Deputy Director (Academics)
Phone #. 051-9262743

Copy to:
- PA to Director (Academics & QA).