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FACULTY OF SCIENCE EDUCATION

EVALUATING THE IMPACTS OF COLLABORATIVE LEARNING IN THE TEACHING AND LEARNING OF BIOLOGY AT 'O' LEVEL. A CASE STUDY OF A SELECTED SECONDARY SCHOOL IN HURUNGWE DISTRICT, MASHONALAND WEST

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BY

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IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE HONOURS DEGREE IN BIOLOGY

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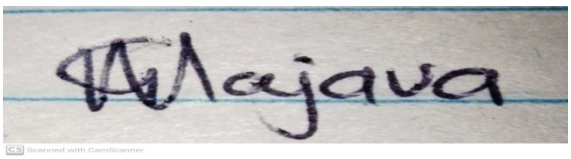
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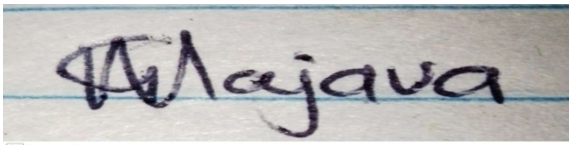
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DEDICATION

I dedicate my dissertation work to the Almighty God, to my family and friends. A special feeling of gratitude goes to my mom, Sihle Majava my brothers Mathew and Mandlenkosi Majava, and Dr Phelix Manyanga whose words of encouragement and diligence kept ringing in my ears. My fellow friends, Bernard T. Bridgenough, Lister Zhanje and Gloria Marufu,I thank you for the support and encouragement.

To my parents you are a blessing to me, you are the best parents ever in the world, and I will forever love you.

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God bless you all for making this project a mission accomplished.

ABSTRACT

This study evaluated the impact of collaborative learning in teaching and learning Biology at 'O' level in a selected secondary school in Hurungwe District, Mashonaland West. Guided by Vygotsky's social constructivism theory, the research adopted a mixed-methods approach (quantitative and qualitative). 84 students were grouped into two conditions: individualistic learning (n=42) and cooperative learning (n=42). Data was collected through focus group discussions, questionnaires, and semi-structured interviews involving 5 Biology teachers. Key findings indicate that collaborative learning developed critical thinking and problem-solving skills in students, and they actively participated in learning, improving efficiency. However, challenges such as lack of teacher competences, large class size, and resource constraints hindered implementation. The study recommends incorporating collaborative learning approaches into Biology curricula and providing teacher professional development programs to enhance effectiveness. These findings suggest that with proper support and training, collaborative learning can significantly enhance Biology education outcomes.

KEYWORDS

Cooperative learning, individualistic learning, learning effectiveness.

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CHAPTER ONE

1.1 Introduction

The chapter focuses on the background of study, statement of the problem, research questions and research objectives. Significance of the study, delimitations, limitations and definition of terms.

1.2 Background of the study

Biology is a core science subject at O' Level that requires both theoretical understanding and practical application. As a fundamental subject in the curriculum of secondary education, Biology is taught at O level to equip students with scientific knowledge, skills and attitudes that are essential for informed decision-making and problem-solving. However, teaching and learning Biology can be challenging due to its complex concepts, abstract and the need for practical skills and development in many schools. In developing countries like Zimbabwe, teaching remains largely teacher-centered, with limited student engagement.

Traditional teaching methods, often characterized by lectures and rote memorization, have been characterized for being ineffective in promoting deep understanding, critical thinking and scientific literacy among students (Muli, 2017). This has contributed to persistent challenges such as poor student performance, lack of interest in science subjects, and surface-level understanding of key biological concepts.

This strategy involves students working in small groups to complete tasks and projects (Kang et al., 2020). Moreover, problem-solving in teams have gained recognition for promoting active participation, deeper understanding, and social interaction among learners. It enhances critical thinking and problem- solving skills among Biology students (Uzoka et al., 2017).

These strategies align with the learner-centered principles outlined in the Zimbabwean Heritage-Based Curriculum Framework (2024–2025). Despite their potential benefits; collaborative learning methods are not widely implemented or assessed in many classrooms because there is limited local research on the evaluation of collaborative specifically in teaching and learning of biology at the O’ level, where content can be complex and abstract for learners.

Collaborative learning is an educational strategy where learners work interdependently in groups to solve problems, complete tasks, or create products, actively constructing knowledge through social interaction and shared inquiry, moving beyond traditional lecture-based models. The characteristics of collaborative learning includepeer interaction, positive interdependence where students rely on each other to succeed, understanding their success is tied to the group's success by sharing resources and responsibility.

Moreover, individual accountability where each member is responsible for their part, preventing "social loafing" and ensuring everyone contributes. Promote face-to-face interaction in which students actively encourage, facilitate, and support each other's learning and understanding. It develops essential communication, leadership, trust-building, and conflict-resolution skills within the group.

Biology is important in education because of the following reasons, it is the foundation of life sciences, and its study helps students understand the intricacies of living organisms and their interactions with the environment (Bokor, 2015). This understanding is crucial for making informed decisions about conservation, health, and environmental sustainability. Biology education helps students develop critical thinking and problem-solving skills, which are essential for scientific inquiry and real-world applications (National Research Council, 2015). By analyzing data, evaluating evidence, and developing hypotheses, students learn to think critically.

It prepares students for careers in science, healthcare, and related fields (WHO, 2016). The study of biology provides a foundation for understanding human health and disease, which is essential for careers in medicine, nursing, and other healthcare professions. Biology education helps students understand the natural world and the impact of human activities on the environment (Khan, 2017). This understanding is crucial for making informed decisions on environmental conservation and sustainability.

Biology is an integral part of STEM (Science, Technology, Engineering, and Mathematics) education, and its study helps students develop an appreciation for the interconnectedness of these fields. Biology education helps students understand the global challenges facing humanity, such as climate change, pandemics, and sustainable development. Students can also develop an understanding of these challenges and the skills and knowledge needed to address them. Biology education fosters curiosity and wonder about the natural world, which

is essential for inspiring future generations of scientists and science enthusiasts (Hmelo-Silver, 2016). Biology education is important and its importance can even extend to understanding life sciences, health and environmental issues to teaching and learning. Health sciences help us understand the intricacies of human health, disease, and the human body's functioning. This knowledge is essential for developing effective treatments and prevention strategies for various diseases. New treatments, therapies, and medications can be developed that can improve the quality of life for patients with various health conditions. (Murwendo, et. al., 2020)

This study seeks to bridge that gap by evaluating the impact of collaborative learning in teaching and learning of Biology at O' level. The findings are expected to provide insights for teachers, curriculum planners, and education stakeholders on enhancing science education outcomes through more interactive and inclusive methods.

1.3 Aim

The general aim of the study is to evaluate the impact of collaborative learning in the teaching and learning of Biology at O level, at a selected secondary school in Hurungwe District in Mashonaland West Province.

1.4 Statement of the problem

Traditional methods of teaching Biology at 'O' Level are still used in most schools. Alternative to practicals are used in place of hands on practical experiments. Learners are not given a chance to discover things on their own and do hands- on activities, which makes it easy for them to interact and share ideas. Some practical experiments are necessary for learners to grasp the concepts, without which they cannot be understood, this leads to loss of essential scientific skills, which should be enquired.

If traditional learning continues, the teaching and learning of Biology at O' level will be affected and the overall result will be failure of learners in some schools. It is a result of this that this project seeks to evaluate the impact of collaborative learning in teaching and learning of Biology at O' level. Some teachers may lack the skills to structure effective collaborative activities or maybe constrained by large class sizes, inadequate resources and assessment systems that prioritize individual performance (Mapuranga, 2020).

1.5 Research Objectives

The research seeks to;

1. To identify the perceptions of students towards collaborative learning in biology?
2. To examine the impact of collaborative learning of O level Biology on learner's achievement.
3. To identify the challenges and limitations of implementing collaborative learning strategies in O Level Biology.

4. To outline the strategies that should be used to counteract the challenges faced during implementation implantation of collaborative learning strategies at O level.

1.6 Research Questions

The research is guided by the following research questions

i. What are the perceptions of students towards collaborative learning in biology?
ii. How do collaborative learning strategies affect learner's performance at O' level?
iii. What challenges are faced by teachers during implementation of collaborative learning strategies at O' level?
iv. Which strategies should be used to counteract the challenges faced during implementation of collaborative learning strategies at O level?

1.7 Assumption of the study.

Biology as a curriculum subject is included in the master timetable at the school. and the Biology Laboratory at our Secondary School is poorly equipped with instructional materials. Participants (teachers and learners) will respond honestly and accurately to questionnaires. Teachers will implement collaborative learning strategies to some extent in their O level Biology, classrooms.

1.8 Significance of the study

The study will be significant to the following;

The teachers -

It will help Biology teachers to understand the impact of collaborative learning on student engagement and performance. Encouragement of adoption of learner-centered methods that improve comprehension of complex biological concepts. It reduces the workload and allowing for more focused instruction and helps them build stronger relationships with students, as they work together to facilitate learning. Can learn from one another and develop new teaching strategies through collaborative planning and reflection.

For students

It enhances student's ability to work in teams, share knowledge and develop critical thinking skills. May lead to improved academic performance and deeper understanding of Biology through peer interaction. It encourages students to communicate effectively, listen actively and resolve conflicts in a constructive manner and develop a sense of belonging and responsibility towards their peers, leading to a more positive and supportive learning environment. Students learn to analyze information, evaluate different perspectives and develop well-supported arguments.

For school administration

Informs policy decisions on curriculum implementation, teaching methodologies, implement school- wide initiatives, such as project-based learning, STEM education or literacy programs. The school administration will be equipped with knowledge on the effectiveness of collaborative learning strategies in teaching Biology as a Science subject, which can contribute to a positive and supportive school culture. Collaborative learning can help administrators allocate resources more effectively, as teachers work together to identify areas of need and develop targeted interventions.

1.9 Limitations

Some teacher's may not fully implement collaborative strategies or may favor traditional methods. The academic calendar may limit the time available to observe long-term effects of the strategies. Lack of teaching materials or overcrowded classrooms may hinder effective implementation of collaborative strategies. The differences in school's infrastructure, teacher qualifications or student backgrounds may affect results.

1.10 Delimitations

The research may be limited to a selected Secondary School in Hurungwe District in Mashonaland West Province, which is easily accessible by the researcher to collect data. The study investigates collaborative learning strategies and it is limited to Biology teachers and

students including teachers. The subject is limited to the subject of Biology only, not other Science subjects and focus is strictly on 'O' Level, (usually students in form 3 and 4)

1.11 Definition of key terms

The key terms include effectiveness, collaborative strategies, Biology, learning and teaching

Collaborative, Wenger E. (1998) defines collaborative as practices that involve mutual engagement, joint enterprise and shared repertoire.

Biology, Raven and Johnson (2019) defines Biology as, "the Scientific study of life and living organisms, including their structure, function, growth, evolution, distribution and taxonomy". (P. 1).

Learning, Iiıeris(2007) views learning as ," a process of constructing new knowledge, skills and attitude through experience, interaction and reflection ". (P. 15).

Teaching, Smith et, al (2015) view teaching as, "a complex and dynamic profession that involves ongoing learning, reflection and adaptation to the needs of students and the broader educational context". (P. 360).

1.12 Summary

The chapter presents background of study to the study which focused on evaluating the impact of collaborative learning in the teaching and learning of Biology at O- Level. The background highlighted challenges faced by students in understanding Biology concepts using traditional teacher- centered methods. The statement of the problem, aims and objectives. The significance of study which was explained in relation to teachers, students, school administration and curriculum developers. The study was limited to selected O-Level Biology classes Limitations and delimitations as well as definition of key terms.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The chapter is to refer to earlier researchers who investigated upon the issues surrounding the teaching and learning of Biology. This includes; the theoretical framework underpin the study, opportunities of collaborative learning strategies, and limitations of collaborative learning in the teaching and learning of Biology as well as intervention mechanisms that should be put in place to deal with the challenges. The summary of the chapter will be given at the end.

2.2 Theoretical Framework

The theoretical framework of collaborative learning is rooted in several educational and psychological theories that emphasize the importance of social interaction, mutual support, and collective problem-solving in the learning process. Social Constructivism is the theory, developed by Lev Vygotsky, (1978) posits that learning is a social process where knowledge is constructed through interaction with others. Social constructivism emphasizes that learners create meaning and understanding through their interactions with the environment and the people around them.Collaborative learning is a key component of social constructivism, as it promotes active learning, critical thinking, and problem-solving skills.

Vygotsky's theory sees student's mind as developing through interactions with the world (Nhemachena&Nyoni, 2021). Thus, social interactions allow the student to acquire necessary tools for thinking and learning. On the other hand, the cognitive elaboratory theory proposes that learners benefit from explaining concepts to others, as it helps to clarify and solidify their own understanding. When learners work together, they engage in cognitive elaboration, which enhances their comprehension and retention of material. This is essential in biology especially when doing practical experiments and group presentations.

2.3 Collaborative learning

It was believed that human development depends on one's social experience during childhood, and that such social factors are even more decisive in terms of human development than the traditional cognition theories, including Piaget's cognitive development (Herrera-pavo, 2021). Having social interaction with peers in the real world can boost students to reflect on their past experiences and thoughts (Fu & Hwang, 2018); collaborative learning is important for developing social experiences. Collaborative learning means a teaching method whereby learners get together to learn as a group and help each other to achieve a certain learning target (Pang et al., 2018). In practical education and research activities, collaborative learning has received great emphasis from educators and researchers for more than half a century. In the 1970s, collaborative learning was used extensively in all subjects in both in-class and outside-of-class, traditional and non-traditional learning scenarios, and kindergarten and graduate institutes (Koivuniemi et al., 2018).

2.4 Codes for collaborative learning strategies.

Hämäläinen and Vähäsantanen, (2011) pointed out eight commonly used collaborative learning ways. Accordingly, the coding scheme for collaborative learning strategies included learning together, team games tournaments, group investigation, academic controversy, jigsaw, student team achievement divisions, team assisted individualization, cooperative integrated reading and composition, other, and non-specified.

Collaborative Learning focuses on using small, cooperative groups in education which helps educators improve learning in their classes. Teachers encourage classroom collaboration by assigning students to groups to review their homework, do daily class worksheets, participate in moderated discussions, and complete hands-on activities. Chen, (2018) stated that collaboration can be applied in teaching and learning process as it enables students to be actively involved in the process and when they do so, they can better understand certain concepts or retain knowledge in their long-term memory. In addition, students apply their acquired knowledge practically when teachers' value of virtual teaching connected and worked with the real world. Hence, understanding the effectiveness of collaborative learning is an efficient path for biology teachers not only offering a suitable curriculum and environment but also developing academic progress.

2.5 Collaborative science Teaching and Learning

Collaboration means sharing ideas, cooperating with team members, and working on the same project. If students learn collaboratively, they will experience lively and successful learning process and teachers can produce students with strong academic performance (Iglesias et al., 2016). Secondary students have the opportunities to perform better and use their logical thinking abilities and be more engaged in the science classroom. Adipat and Engaging, (2021) claimed that the more controlling the teacher seemed to the students, the less autonomy they felt, and also the more informative the teacher was perceived to be in terms of the feedback given, the more competent the students felt. Students at all levels and various learning characteristics have better chances to receive needs and be educated effectively with teacher's collaborative instruction. Therefore, students have more opportunities to practice their problem-solving strategies, communication and social skills. When students work collaboratively, science learners have chances to enhance their practical skills and experience conflict on goals and tasks. For some shy students, collaborative learning encourages them to express their opinions, creates more opportunities for them to expose to science environment, and helps them to increase classroom participation. Koutrouba and Kariotaki, (2012) stated that students and teacher should engage in dialogue, investigating themes as equals and creating new understanding of the world together. Real-life material helps teachers to figure out and address students' needs, reflect collaboration between the learners and the teachers, and indirectly include regular evaluation by observing students' performances in the classroom. When teachers have the freedom and eagerness to try new things and strategies in the material and activity of language classrooms, students can profit from the creation and develop new knowledge in a practical way.

2.6 Collaborative learning methods

Collaborative learning can also be used to achieve enhanced teaching outcomes because of its peer reviewed and monitored nature (De Hei, Strijbos, Sjoer, &Admiraal, 2015). One example of CLS is the use of games. Innovative forms of collaborative learning, such as the use of games, allowed students to have fun while learning (Emblen-Perry, 2018). When learners have fun in a meaningful manner while learning new material, engagement and motivation are strengthened, which in turn improves learning outcomes (Emblen-Perry, 2018) Game-based learning can

produce enhanced teaching outcomes even in adult learners as students have been shown to be more engaged reflective of lessons. Conditions of learning like typical of students and the characteristics of course, strategy, effectiveness, efficiency and attractiveness of learning have been the influential factors on learning outcome. Collaborative learning strategies includes team games tournaments, group investigation, academic controversy, jigsaw, student team achievement divisions, team assisted individualization, cooperative integrated reading and composition, other, and non-specified.

2.7 Benefits of Collaborative Learning.

Collaborative learning is based on the construction theory that assigns an important role to students as main protagonists in the learning process. The academic, social and psychological benefits of this type of learning have been demonstrated by many authors, among them García-valcárcel et al., (2014) and Laal and Mohammad, (2012), who highlighted a long list of advantages, such as boosting mega-cognition and permitting students to feel a sense of control over what they are learning (academic benefits). Collaborative learning encourages students to see situations from different perspectives, creates an environment where they can practice social and leadership skills (social benefits), and provides a satisfactory learning experience that significantly reduces anxiety (psychological benefits). Many of these studies have focused on learning mathematics, showing that small-group learning has led to greater mathematical outcomes than traditional methods of teaching individuals (Dado & Bodemer, 2017). According to the research carried by Yücel et al., (2016), students expressed that during the assigned work, they felt responsibility of work, committed to accomplishment of each member and their group. They were afraid of losing face by bad performances. Overall, the findings reflect to most of the studies which showed that the importance of collaborative learning includes (1) collaborative learning helps not only students in learning but also assist teachers in improving teaching skills by interacting with students during classroom lecture. (2) Students' participation plays important roles in second language learning. In addition, (3) teachers can develop a supportive learning environment and motivate students learn and produce their effective second language. Numerous studies have been carried out on collaborative learning and many have shown that when students were given the opportunity to work collaboratively, they were able to perform better.

2.8 Problems students encounter when collaborating in groups

Research has shown that students encounter several problems during collaboration Le et al., (2018). In this section, we exemplify students' lack of collaborative skills as one of the common problems reported in the CL literature at various levels of education (Tatiana et al., 2022), investigating the collaborative interactions of primary school children, found low-quality coordination among group members when they participated in problem-solving tasks. Her study showed that group members did not pay attention to others' opinions, interrupted them, and rejected alternative suggestions without justification. These inappropriate behaviors inhibited group functioning and individual learning. Furthermore, (Molinillo et al., 2018) noted that the quality of students' explanations in group interaction in primary and secondary classrooms is often below a level that enables shared knowledge construction. Additionally, help-seekers may be unable to formulate effective requests for help. As a result, both help-givers and help-seekers may be unable to collaborate effectively. He also indicated the quality of group discussions as a frequent problem for most primary and secondary school students. In the higher educational context, Abdul et al., (2020) showed that communication problems, caused by a lack of collaborative skills, may inhibit first-year students in their master's program from engaging in group work and contributing to group outcomes. Taken together, these studies suggest that lack of collaborative skills may be one of the antecedents of the collaborative problems students often experience during CL (Kim et al., 2022). Further research is, however, needed to uncover whether lack of collaborative skills is the only or the most important antecedent to students' collaborative problems.

2.9 Problems teachers encounter when applying collaborative learning.

Earlier studies (Leeuwen & Janssen, 2019) have identified several problems that teachers encounter when applying CL in the classroom. We explain two problems affecting CL effectiveness: organization of collaborative activities, and assessment of learning. First, teachers often face challenges while structuring collaborative activities such as monitoring students' on-task behavior, managing group-work time, providing relevant materials, assigning individual roles, and establishing teamwork beliefs and behaviors(Stephanie &Munson, 2021). A study by (Qureshi et al., 2021), which analyzed preparation of collaborative activities of pre-service

teachers, revealed insufficient attention of teachers to organizing collaborative work such as determining group norms and facilitating activities. Furthermore, research demonstrated that a large number of primary and secondary school teachers often place students in groups and let them work together without preparing students to perform collaborative activities productively (Slavin & Schools, 2006). Second, teachers frequently find it difficult to assess students' performance and achievements as they implement CL in classrooms at all levels of education (Tatiana et al., 2022). For example, teachers at some primary and secondary schools showed uncertainty and ambiguity about what and how to assess (Le et al., 2018). Also, a study by (Tielman et al., 2012) reported that the criteria or rules for assessment lacked transparency and concreteness. Furthermore, the lack of assessment tools to measure collaborative performance of every group member may cause student disappointment about the transparency and evenness of the assessment (Warsah, 2021). Although previous studies highlighted several problems teachers encounter when applying CL, these studies have insufficiently elucidated the underlying causes or antecedents of these problems (Le et al., 2018). Furthermore, the problems that teachers encounter will likely also affect collaborating students. This relationship between problems experienced by teachers and by students is, however, rarely addressed during previous research. If teachers, for example, are unsure about how to monitor students' group discussions, and cannot adequately intervene when necessary or model appropriate collaborative behavior, this will probably affect the quality of the collaborative process as experienced by students (Le et al., 2018).

2.10 Effectiveness of Collaborative Learning

More and more researchers have confirmed the effects of collaborative learning (Tatiana et al., 2022). The main point of collaborative learning is not its effectiveness, but the reasons why and the situations in which it is most effective.(Warsah, 2021) analyzed numerous empirical studies on collaborative learning and found that group targets, individual responsibility, and group interaction are the essential factors of promoting learning achievement. In the grouping numbers in collaborative learning, some researchers have considered that efficiency will increase as the number of people in the group increases; on the other hand, some researchers believe the opposite (Retnowati et al., 2016). Alzahrani, (2023) analyzed 12 articles on the effects of learning achievement in the homogeneous and heterogeneous grouping methods for gifted

students and high-achieving students, and found that there were no consistent opinions on whether homogeneous or heterogeneous grouping led to better performance in terms of improving students' grades. Some researchers have focused on comparing the effects of different collaborative learning strategies (Koivuniemi et al., 2018). From the research, it can be found that collaborative learning is a very complex teaching activity because group targets, interaction modes, grouping numbers, group members, and collaborative learning strategies are all important factors affecting collaborative learning.

2.11 Factors that improve collaborative learning

Studies have been conducted to identify the factors that improve collaborative learning. It is generally agreed that collaborative learning requires active social interactions, group goals, and individual accountability (Retnowati et al., 2016). The use of problem-solving activities within collaborative learning classrooms has been strongly advocated, especially by science educators. According to (Tatiana et al., 2022), one view of science learning is that it is a social construction of knowledge through collaboration. An emphasis should be placed on problem solving, reasoning, and communication, forming communities of mathematical inquiry (Carpenter et al., 2023). Shared meanings of the main concepts emerge through the interactions associated with group problem solving (Gillies & Boyle, 2010), as well as learners constructing their own ideas and individual insights (Carpenter et al., 2023; Veldman & Kostons, 2010).

2.12 Summary

Collaborative learning means a teaching method whereby learners get together to learn as a group and help each other to achieve a certain learning target. Collaborative Learning focuses on using small, cooperative groups in education which helps educators improve learning in their classes. Teachers encourage classroom collaboration by assigning students to groups to review their homework, do daily class worksheets, participate in moderated discussions, and complete hands-on activities. Collaboration can be applied in teaching and learning process as it enables students to be actively involved in the process and when they do so, they can better understand certain concepts or retain knowledge in their long-term memory. Collaborative learning boosting mega-cognition and permitting students to feel a sense of control over what they are learning (academic benefits). Collaborative learning encourages students to see situations from different

perspectives, creates an environment where they can practice social and leadership skills (social benefits), and provides a satisfactory learning experience that significantly reduces anxiety (psychological benefits). Two problems affect Collaborative learning effectiveness: organization of collaborative activities, and assessment of learning. Collaborative learning requires active social interactions, group goals, and individual accountability.

CHAPTER THREE: METHODOLOGY.

3.1 INTRODUCTON.

This chapter focuses on the research techniques that will be employed to conduct the study. The study used a cross-sectional survey method with a quantitative approach. The purpose of the survey is to investigate the effectiveness of collaborative learning on o' level biology achievement. The research methodology, research approach, target population, sampling techniques, research instrument employed, data collecting procedures, data presentation, data analysis, and the validity and reliability of the research instrument were all discussed in this chapter.

3.2 Research design.

A research design is described as, the overall plan for connecting the conceptual research problems to the pertinent (and achievable) empirical research according to Creswell and Creswell, (2018.) It was a framework created to assist the researcher in achieving his or her research objectives. Therefore, research design is the general plan about what the researcher will do to answer the research questions, what instruments will be used, how the instruments will be employed and the intended means for analysing data collected.

Creswell (2018) argues that, when using people as the analytical units for an inquiry, survey methods are most frequently used. People must act as informants or responders. The best tool a

management scientist has at their disposal for describing a population that is too large to monitor directly is probably descriptive survey research. Like other modes of observation in management scientific research, surveys have certain advantages and disadvantages. The researcher has every reason to assume that the strategy is appropriate for this particular study since she thinks its benefits exceed its drawbacks.

Surveys also enable us to measure attitudes and orientations in a large population. Furthermore, there is no risk of conflicting accounts because the behavior was recorded as it occurred, as opposed to depending on prospective reports of what individuals think happened during the event. The researcher documented the events as they occurred.

The researcher used both qualitative and quantitative research designs because a descriptive survey was used. Cohen, Manion and Marrison (2018) explain that descriptive survey research provides a snapshot of the current state of affairs, collecting data to describe variables without influencing them.

Quantitative methods for example test scores, structured questionnaires help measure the impact of collaborative learning on student performance. It also reflects general outcomes across a population, while qualitative data captures individual experiences and contextual factors such as classroom engagement and student engagement.

McMillan and Schumacher (2020) are of the opinion that a major limitation of survey research is the typically low response rate, which can compromise the validity of generalizations, jeopardizing the report's conclusion. Furthermore, past instances cannot be recorded because surveys are only valid at the time of the event. The successful conclusion and suggestions of the research study may depend on knowledge from past events.

3.3 Target Population.

The target population refers to a group of individuals or objects with common characteristics that contain the information sought by the researcher (Madziri, 2017; Leedy & Omrod, 2018). In this research, the target population was 84 'O' Level students (all taking Biology) and 5 Biology teachers at the selected secondary school in Hurungwe District.

3.4 Sampling Strategy

A simple random sampling strategy was used to select participants. For students, 84 were selected by drawing 'Yes' or 'No' cards from a pool of all 'O' Level students taking Biology. This approach gave each student an equal chance of being selected. All 5 Biology teachers were included in the sample, given the small population size, to ensure representation of the entire teaching staff teaching Biology. The sample consisted of 84 students and 5 Biology teachers, providing a total of 89 participants. This sample size allows for in-depth quantitative analysis and representation of views on collaborative learning in Biology teaching and learning.

3.4 Data collection techniques.

According to Best et al. (2009), there are numerous data gathering procedures, including observations, questionnaires, and interviews. An interview is a qualitative research method where a researcher asks questions to an individual to gather in-depth information on a specific topic (Smith, 2020). This study used a mixed-methods approach. Quantitative data was collected via questionnaires with closed-ended questions, providing numerical data on the impact of collaborative learning (Best et al., 2009). Questionnaires were analyzed quantitatively.

Qualitative data was collected through semi-structured interviews with teachers and focus group discussions with students, allowing for in-depth insights into collaborative learning experiences (Kvale, 2007; Krueger, 2014). Interviews offer flexibility in questioning, enabling the researcher to probe for more information and clarify responses. Afocus group, on the other hand, is a qualitative research method where a small group discusses a specific topic, guided by a moderator (Krueger, 2014). This approach encourages open discussion and idea generation, providing diverse perspectives on the topic. Focus groups can reveal group dynamics and social norms, offering valuable insights into how people interact and respond to ideas (Morgan, 1997).

3.5 Pilot study.

According to Thomas et al., (2018) a pilot study is a preliminary study done to validate the research approach and tools. The validity and reliability of the questionnaire will be checked before it is made available to respondents. The researcher will pre-test the questionnaire on 10

Biology O- learners under consideration in order to ensure its validity and reliability. The purpose of this is to ascertain the responses, attitudes, and capacity of the respondents to respond to the demand for the instruments. To improve the relevance and suitability of the instruments for the research, changes will be made to the language and vocabulary.

One tailed t-test analysis was used to determine if cooperative learning helps student in performance achievement in Zimsec O' level biology syllabus. Wilcoxon Signed-rank analysis was also performed to test Students' Academic Achievement in homework or in-class tests. This method was used to check if collaborative learning improves student's achievement in biology. Prior to conducting the hypothesis test, the following prerequisites were verified: normality, linearity, homogeneity of variance, and multi-co linearity. To assess if collaborative learning improves student's achievement in biology, an independent-sample t-Evaluation was done. For all of the tests, SPSS version 23 was utilized.

3.5.1 Validity of instruments.

"According to Bell, "validity was concerned with making sure that the research measured or represented what it was intended to uncover (2007:87). The target group's vocabulary and phraseology understanding was chosen with consideration. "Questions were asked in an unambiguous way, with the meanings of all words clearly given, such that all respondents got the same interpretation," the study's authors write. Using the research instrument, the study made sure that key points from the research aims were conveyed.

3.6 Participants.

The students involved in this study were all secondary school students-Level biology students at Chimuti High school and Hurungwe High School, Hurungwe, Mashonaland West, Zimbabwe. Eighty-four students (38 boys and 46 girls) were randomly assigned to two learning conditions (i.e., cooperative learning or individualistic learning) stratified for academic achievement (as measured by the students' average test scores in the first term of 2025 prior to the study) in accordance with a randomized block design(Nguyen & Paschal, 2002; Olds, Moskal, &Miller, 2005). Specifically, the students were arranged in descending order of academic achievement

and then, starting from the first student, every two consecutive students were formed into a pair; giving a total of 28 pairs in all.

From each pair, one student was chosen at random and assigned to the cooperative learning condition, while the other was assigned to the individualistic learning condition. The students in the cooperative learning condition were then randomly assigned to three-member cooperative teams comprising one high-, one medium-, and one low-academic achievement student For convenience in checking the efficacy of the random assignment process in creating heterogeneous teams, the students in the individualistic learning condition were also randomly assigned to three-member "pretend-teams" stratified for academic achievement.

The students in the individualistic learning condition were not informed of this grouping process, and did not work together as a regular team. It may be more appropriate to classify students into different academic abilities using a standardized test (Hoon, Chong, & Binti Ngah, 2010). However, an alternative was adopted because there was no such standardized test was available to the author for secondary students. Given that many core topics, such as coordination and response, drug, excretion in humans, reproduction and respiration had been taught in the previous term, student performance in the previous term was used to classify students into different levels of academic ability.

3.7 Procedure

According to Kvale and Brinkmann (2019), data collection is the process of gathering and measuring information or targeted variables in an established systematic fashion, which then enables one to answer relevant questions and evaluate outcomes. The experimental stage of the study was conducted in O' level biology topics that include inheritance, variation and selection, organisms and their environment, human influence on ecosystems and biotechnology and genetic modification. During the course of term, the students were instructed in the basic principles of the selected biology topics and were expected to master the skills required to solve a range of ordinary level biology problems. The term's work was divided into four sequential teaching units with varying durations, namely Unit 1 - Inheritance (4 weeks), Unit 2 - Variation and Selection

(2 weeks), Unit 3 - Organisms and their environment, human influence on ecosystems (4 weeks), and Unit 4 - Biotechnology and genetic modification (2 weeks). In addition to the three-hour per week regular class sessions, homework sessions were arranged to carefully monitor the learning method and the time on task both in the class room and in the students' after-hours studies. A total of 11 homework sessions were arranged, i.e., Unit 1 - three sessions; Unit 2 - two sessions; Unit 3 - four sessions; and Unit 4 - two sessions. The homework sessions were arranged in such a way that one session was scheduled for every week of the course except the first two weeks of the term, the four weeks in which the students were given unit tests in their regular day-time classes, and one week for which lessons were suspended due to other school activities.

A survey given at the beginning of the study found that the students spent an average of one-and-a-half hours every evening on self-studying for all their courses provided that they had no test the following day. Accordingly, each homework session was scheduled for three hours per week. Since this time was much longer than that typically spent by the students in self-studying for the o level biology subject every week, it was reasoned that the students would not need to spend any additional time out-of-hours in self-studying for the course, i.e., the students would confine their studies to the regular classes or the homework sessions. To confirm that the students within the two learning conditions spent about the same amount of time on their studies, an anonymous survey was carried out at the end of each teaching unit in which the students were requested to indicate the number of hours they spent in private self-study during the course of the unit (see Table 2).

During the experimental stage of the study, the subjects in the two learning conditions shared the same classroom during the regular class and homework sessions and were instructed by the same teacher and teaching assistants. The teacher had five years prior experience in cooperative learning practice. However, the two teaching assistants, while both familiar with the general principles of cooperative learning, had no practical experience in its use. Therefore, each assistant was given 15 hours of basic training on cooperative learning implementation skills by the teacher before the experimental stage of the study commenced.

A survey conducted at the beginning of the Term showed that none of the students had any prior experience of the cooperative learning method. Consequently, before the experiments

commenced, the students were given two hours of instruction and training on the basic nature of their assigned learning conditions (Hmelo-Silver and DeSimone 2015,Thomas 2016). In addition, the students were asked to remain within their assigned condition throughout the entire experimental period.

3.8 Independent Variable

The independent variable in this study was the learning method (i.e., cooperative learning or individualistic learning). Students in the cooperative learning condition were instructed to work together as a team to maximize the academic success of all the team members. While cooperative learning has many different implementation models in the ZIMSEC O level biology education context, this study closely follows the well-structured model proposed by Johnson and Johnson (Slavin, 2015). This model states that five criteria must be satisfied for instruction to qualify as cooperative learning: positive interdependence, individual account ability, face-to-face promotive interaction, teamwork skills, and group processing.

On the first day of class, heterogeneous cooperative teams were formed as described in the Subjects section and the students within the same team were instructed to sit together in order to facilitate face-to-face interaction. The regular classroom sessions generally commenced with a short presentation outlining the lesson contents, explaining the basic concepts to be covered in the class, giving solution hints to the assigned problems, and so on. Thereafter, a discussion period took place in which the three members of each cooperative team took turns in playing specific roles in order to promote positive interdependence and team work. (Gillies 2016). Specifically, the student seated in the center of the team was designated as the “leader,” and was tasked with leading the team in discussing or summarizing the class contents or solving the assigned problems, while the two other members of the team were designated as “supporters,” and were asked to actively participate in the team discussions by questioning, correcting, encouraging and praising one another. Importantly, the role assignments were rotated once every two weeks such that each team member spent an equal amount of time within each role. During the discussion periods, the students assigned to the individualistic learning condition were instructed to work alone and were told to seek help only from the instructor or one of the teaching assistants if they encountered difficulties.

Following the discussion period, the instructor posed short questions to randomly selected individuals within the class (irrespective of their learning condition) in order to assure individual effort accountability Each lecture/discussion/Q&A cycle lasted for an average of 15 to 25 minutes, with the time spent on each stage of the cycle being split in a ratio of approximately 3 to 2 to 1. The out-of-hours homework sessions commenced with one of the teaching assistants presenting six biology problems to be solved during the course of the session. Note that the homework problems were deliberately presented at the beginning of the homework sessions rather than at the end of the regular classes in order to deny the students the opportunity to review the problems and prepare them in advance.

The students assigned to the individualistic learning condition took part in the same lecture and Q&A sessions as the students in the cooperative learning condition, but worked alone during the discussion, problem-solving, and practice sessions. In the event that they encountered difficulties in solving the problem, they were instructed to seek help only from the teacher or one of the teaching assistants rather than from one of their peers.

3.9 Conditions Check and Ethical Concerns

During each classroom and homework session, two teaching assistants moved around the class encouraging the students in the cooperative learning condition to engage in team discussions and reminding those in the individualistic condition to work alone. The instructor and the two teaching assistants met for 10 minutes each instructional day to review the conditions and procedures for the study. The experimental conditions were then observed during each classroom and homework session, with the instructor or teaching assistants completing a checklist to ensure that the two conditions were correctly implemented in every case. (Fraenkel, et, al., 2019). The checklist consisted of items designed to confirm that the lecture/discussion/Q&A cycle and lecture/problem solving/practice cycle were performed in the regular classes and homework sessions, respectively.

Furthermore, several specific strategies were implemented to prevent students in the individualistic learning condition from collaborating with one another: (1) the students were constantly reminded to work alone by the instructor and/or the teaching assistants, (2) the teaching assistants immediately volunteered help whenever the students encountered difficulties,

and (3) the students were requested to spread out as far as possible within the classroom. Moreover, many initiatives were taken to protect the rights of the participants (Israel and Hay 2016; Creswell and Creswell 2018). For example, at the beginning of the study, the students were explicitly informed that the purpose of the experiments was to compare the effectiveness of cooperative learning versus individualistic learning. Any students who did not wish to participate in the study were given the opportunity to take the same course from another instructor using the traditional instruction method. None of the students' names or identities was disclosed at any point of the study to protect their privacy.

Although the 84 students who participated in the experiments could not choose their assigned learning condition (as in previous related studies in the field), in the author's personal experience, it would be rare for a Zimbabwean student to resent being assigned to (and made to remain within) an individualistic learning condition rather than a cooperative learning condition, or vice versa. In fact, the individualistic learning mode closely resembles the traditional learning method used in Zimbabwe. Therefore, students assigned to this particular learning condition were fully accustomed to learning in this manner.

General Ethical Considerations

The researcher strictly adhered to the following ethical principles:

Informed Consent: Written consent was obtained from the school head, teachers, and parents/guardians of students. Students will provide their assent.

Anonymity and Confidentiality: The name of the school and all participants will be kept confidential. Pseudonyms will be used in the research report.

Voluntary Participation: Participants will be informed that their involvement is voluntary and they can withdraw at any time without penalty.

The study is designed to potentially benefit students. Care will be taken to ensure that the control group is not disadvantaged; they will receive the standard instruction, and the experimental materials can be shared with them after the study.

3.10 Dependent Variable

The experimental study involved just one dependent variable, namely the students' level of academic achievement, as measured by seven homework tests and four-unit tests. In completing each test, the students were instructed to work alone irrespective of their assigned learning condition and were awarded scores in accordance with their individual performance. The homework tests were given at the end of certain selected homework sessions in accordance with the following test timetable: Units 1 to 3 - two tests each and Unit 4 - one test. Neither the number of homework tests nor the test timetable was made known to the students in advance in order to avoid influencing their customary learning behaviors, study habits, and so on (Gresalfi and Barnes 2016).

The scores obtained over the homework tests in each teaching unit were averaged to obtain a single measure of each student's academic achievement for the corresponding unit. Each homework test lasted for 30 minutes and consisted of one or two biology problems chosen from the home work problems within the corresponding sections of the textbook (Mili and Winch 2019). In addition to these homework tests, a unit test was given at the end of each teaching unit during the regular daytime classes. Each unit test lasted for three hours and comprised six to eight biology problems covering the most important elements of the corresponding teaching materials. To ensure content validity, the test problems were selected by an experienced education teacher (Kasi et, al., 2023). For both sets of tests, the instructor prepared solution flowcharts listing the key inter mediate variables within the solution procedure for each problem and identifying the final results.

Using these flowcharts, the students were awarded partial credits even if their final solutions were incorrect. Since the instructor was also the researcher, the two teaching assistants graded the test papers independently and then compared the two sets of grades to avoid potential preferential treatment of the cooperative learning students. If the scores awarded by the two assistants were different, the papers were re-graded. Finally, the test papers and answer sheets were returned to the students for a final verification of the test score. The students also used this opportunity to conduct group processing (Ifeoma et, al.,2015).

3.11 Elimination of bias.

The major tool used was a questionnaire, which was pre-tested and changed depending on comments from others. The anonymity of the respondents could be a good indicator of how the questionnaire could have taken a balanced view of the subject. Bias was eliminated by refusing to include pilot testing participants in the final results, as evidenced by the fact that nearly all O' level biology students were represented.

3.12 Conclusion.

This chapter looked at different research approaches, research techniques, and the justification for employing a descriptive study design. The ideal sample size was chosen after taking into account the target audience. The methods used to collect the data as well as the evaluation and analysis of the data was looked at. The next chapter will cover the presentation, analysis, and interpretation of data.

CHAPTER 4 RESULTS AND DISCUSSION

Introduction

Chapter 4 presents the findings and discussion of the study on collaborative learning's impacts on 'O' Level Biology teaching and learning in a Hurungwe District secondary school. The chapter analyzes data on academic achievement, time on task, and student attitudes, comparing cooperative and individualistic learning conditions. Qualitative insights from teacher interviews and student focus groups provide context on the experiences and perceptions of collaborative learning. Results are interpreted in light of the research questions, highlighting implications for Biology education in the local context.

4.1 Teacher Interview Responses and Student Focus Group Discussion Responses

The researcher named the respondents teacher A, B, C, D, etc., to maintain anonymity and confidentiality, allowing them to share honest perspectives without fear of repercussions. This approach also avoids potential biases associated with using real names or identifiers. It simplifies referencing of quotes in the research report, focusing attention on the content of responses rather than individual identities. Teacher A described their typical approach to teaching 'O' Level Biology as involving lectures, practicals, and some group work, noting that "*students engage more when they can discuss concepts*." Again, teacher B had some experience with collaborative learning, seeing its potential for deeper understanding. They said, "*Collaborative learning helps students clarify ideas through discussion and peer teaching. They grasp concepts better*."

Teacher C highlighted the main challenges in implementing collaborative learning, including managing noise and ensuring everyone's participation, as "*some students dominate while others disengage*." Furthermore, teacher D emphasized the significant benefits of collaborative learning, noting improved communication skills, deeper understanding, and students supporting each other's learning. Once again, teacher E expressed willingness to use collaborative learning more in their future teaching, citing its benefits in "*preparing students for real-world teamwork and enhancing learning outcomes*."

4.2. Student Focus Group Discussion Responses

The researcher named the respondents S1, S12, S25, etc., to protect their privacy and encourage honest feedback, especially since they're sharing experiences about their learning environment. This approach also helps avoid any potential biases or influences associated with knowing the students' identities. It keeps the focus on their insights and experiences, making it easier to report findings without inadvertently highlighting individual students. First and foremost, S1 found learning Biology in class interesting, particularly practicals, but sometimes struggled with concepts alone, saying *"It's interesting, especially practicals. But sometimes concepts are hard to grasp alone.*" Again, S12 also described learning in groups as fun, helping them understand tough topics like ecosystems through shared ideas. They noted, *"It was fun! We helped each other understand tough topics like ecosystems."*

Moreover, S25 felt that group work was more interactive than usual lessons, allowing discussion and idea-sharing rather than just listening. They enjoyed Biology more when working in groups, finding it "*made Biology less boring*." S42 said they understood topics better when discussing them with classmates, like when they clarified cell biology concepts in their groups. S84 highlighted the best part of group learning as sharing ideas and helping friends, creating a sense of achievement. They suggested assigning roles like leader or scribe to improve group activities, saying "*Maybe assign roles like leader or scribe to keep everyone involved."* S3 mentioned that group work helped them overcome difficulties with certain topics, stating "*When I didn't understand photosynthesis, my group explained it simply."*

S21 appreciated the teamwork aspect, saying "*Working together made us support each other and learn faster."* S37 noted some challenges with group work, like differing opinions, but overall found it beneficial: *"We had disagreements sometimes, but we solved them and learned more.*" S56 liked how group activities encouraged participation: *"Everyone got involved and shared their ideas – it was cool!"* S69 felt group work improved their confidence: *"I was shy to ask questions alone, but in a group I spoke up more."* S75 said group learning made revision easier: "*We made summary notes together, it helped a lot for tests."* S31 mentioned enjoying the social aspect: "*It was nice working with friends and learning together."*

S18 found group discussions helped clarify doubts: *"If I missed something in class, my group explained it."* S43 appreciated the diverse perspectives: *"We saw topics from different angles, it was helpful."* S61 felt more motivated in groups: *"I didn't want to let my team down, so I worked harder."* S28 liked applying concepts practically in groups: *"We did experiments together and understood concepts better."* S53 highlighted improved problem-solving skills: *"We solved problems together that I wouldn't have managed alone."* S79 enjoyed teaching others: *"Explaining concepts to my group helped me understand them too."* S11 noted reduced stress: *"Group work made Biology less stressful, we shared the workload."*

4.3 Examining Time on Task

This section looks at how much time students spent engaged in learning activities under cooperative versus individualistic conditions. The data (Table 4.1 below) show students in cooperative learning spent slightly more total time on task (108.85 vs 106.65 minutes) with less variability (std dev 6.63 vs 11.23), suggesting cooperative settings led to marginally more consistent engagement across units.

Comparison of Time on Task of Students in Two Different Learning Conditions

Table 4.1 below shows the mean time on task and standard deviation for cooperative and individualistic learning conditions across various periods (regular class, homework, self-study) and units. In structured settings (regular class & homework), both conditions have nearly identical means and zero or very small standard deviations, indicating students spend the same amount of time on task regardless of condition. In self-study sessions, cooperative learning generally yields slightly lower means (for example, 9.46 versus 11.32 in Unit 1) with smaller deviations, suggesting students spend less time but with less variability. Aggregated totals show cooperative learning has a slightly higher overall mean time (108.85 versus 106.65) with a smaller standard deviation (6.63 versus 11.23), implying cooperative settings may lead to marginally more consistent time on task across units.

Table 4.1 ***Comparison of Time on Task of Students in Two Different Learning Conditions***

Period	**Session**	**Condition**	**Mean**	**Std Deviation**
	Regular class	Cooperative learning	20.00	0.00
		Individualistic learning	20.00	0.00
Unit 1	Homework session	Cooperative learning	8.00	0.00
		Individualistic learning	8.00	0.00
	Self-study	Cooperative learning	9.46	4.75
		Individualistic learning	11.32	5.98
	Regular Class	Cooperative learning	9.00	0.00
		Individualistic learning	9.00	0.00
Unit 2	Homework session	Cooperative learning	6.00	0.00
		Individualistic learning	6.00	0.00
	Self-study	Cooperative learning	6.35	1.25
		Individualistic learning	5.54	2.07

	Regular Class	Cooperative learning	14.30	1.45
		Individualistic learning	13.85	1.76
Unit 3	Homework session	Cooperative learning	11.87	0.85
		Individualistic learning	11.39	1.12
	Self-study	Cooperative learning	9.55	4.32
		Individualistic learning	8.96	4.02
	Regular Class	Cooperative learning	8.38	0.85
		Individualistic learning	8.59	1.72
Unit 4	Homework session	Cooperative learning	5.43	1.26
		Individualistic learning	5.21	1.37
	Self-study	Cooperative learning	5.43	2.99
		Individualistic learning	6.74	2.46
	Regular Class	Cooperative learning	52.05	1.97
		Individualistic learning	51.30	3.11

		Cooperative learning	32.18	1.36
		Individualistic learning	31.55	1.52
	Self-study	Cooperative learning	30.00	7.98
		Individualistic learning	31.25	11.55
	Regular Class	Cooperative learning	108.85	6.63
		Individualistic learning	106.65	11.23

The data in Table 4.1 shows that students in both cooperative and individualistic learning conditions had similar attendance in regular classes (cooperative: 52.05 hours, individualistic: 51.30 hours) and homework sessions (cooperative: 32.18 hours, individualistic: 31.55 hours) (Ledolter & Hogg, 2010; Montgomery & Runger, 2007). The 95 percent confidence interval for the difference in attendance hours includes zero, indicating no significant difference between the two conditions. This similarity in attendance patterns suggests that both groups had comparable exposure to the learning material.

Students in both conditions also spent similar time on self-study (cooperative: 30.00 hours, individualistic: 31.25 hours), with a 95 percent confidence interval including zero (Ledolter & Hogg, 2010; Montgomery & Runger, 2007). This suggests that time on task was carefully monitored, as students didn't know the study material and test schedule in advance (Gerstner & Bogner, 2009). Notably, attendance fell slightly in later teaching units, indicating a potential trend, but overall, the data indicates that any difference in academic performance between the two conditions is likely due to reasons other than class attendance or self-study time. The comparable attendance and self-study patterns across conditions provide a controlled environment for evaluating the impact of cooperative versus individualistic learning on student outcomes.

4.4 Average Scores of Teams within Different Ability Groups in the Term Prior to the Study.

The table shows the average scores of 84 students divided into two learning conditions—Individualistic learning and Cooperative learning—each with 42 students grouped into 14 teams of 3 students (High, Medium, Low ability). The scores represent team performance in the term before the study began. In both conditions, each of the 14 teams has a calculated mean score (averaging High, Medium, Low scores) and a standard deviation showing score variability within the team. The mean scores across teams in both conditions are very similar, ranging from approximately 77.33 (highest) to 68.33 (lowest), indicating comparable overall performance between Individualistic and Cooperative teams prior to the study.

The data suggest the teams were balanced in ability before the experiment, with minimal differences in average scores between the two conditions. The standard deviations (around 10–11) show moderate dispersion of scores within each team. The purpose of this pre-study assessment was to establish a baseline for comparing how Individualistic vs. Cooperative learning will affect subsequent performance in the actual study.

Table 4.2Average Scores of Teams within Different Ability Groups in the Term Prior to the Study

Condition	Team	High	Medium	Low	Mean	Std. Dev
Individualistic	Team 1	89	76	67	77.33	11.06
Individualistic	Team 2	88	75	66	76.33	11.06
Individualistic	Team 3	88	74	66	76	11.14
Individualistic	Team 4	87	74	66	75.67	10.6

Individualistic	Team 5	87	73	64	74.67	11.59
Individualistic	Team 6	86	72	64	74	11.14
Individualistic	Team 7	86	72	64	74	11.14
Individualistic	Team 8	85	71	63	73	11.14
Individualistic	Team 9	84	71	62	72.33	11.06
Individualistic	Team 10	83	70	62	71.67	10.6
Individualistic	Team 11	82	69	62	71	10.15
Individualistic	Team 12	82	68	60	70	11.14
Individualistic	Team 13	81	68	60	69.67	10.6
Individualistic	Team 14	78	67	60	68.33	9.07
Cooperative	Team 1	89	76	67	77.33	11.06
Cooperative	Team 2	88	74	66	76	11.14
Cooperative	Team 3	87	74	66	75.67	10.6
Cooperative	Team 4	87	74	66	75.67	10.6
Cooperative	Team 5	87	73	64	74.67	11.59
Cooperative	Team 6	86	72	64	74	11.14

Cooperative	Team 7	85	72	63	73.33	11.06
Cooperative	Team 8	85	71	62	72.67	11.59
Cooperative	Team 9	83	70	62	71.67	10.6
Cooperative	Team 10	83	69	62	71.33	10.69
Cooperative	Team 11	82	68	61	70.33	10.69
Cooperative	Team 12	82	68	60	70	11.14
Cooperative	Team 13	79	68	60	69	9.54
Cooperative	Team 14	78	67	60	68.33	9.07

The data in Table 4.2 show that students with different levels of academic achievement were uniformly distributed among the teams in both cooperative and individualistic learning conditions. This uniform distribution confirms the efficacy of the random assignment process in creating heterogeneous teams. A t-test examining the difference in academic abilities of students within the two conditions before the experiment revealed no significant differences in mean test scores ($t=0.27$, $p=0.7888$). This indicates that the cooperative and individualistic learning groups were comparable in terms of academic ability prior to the study, providing a level playing field for evaluating the benefits of cooperative learning.

The comparable academic abilities of the students in both conditions suggest that any differences in outcomes can be attributed to the learning approach rather than pre-existing differences in student ability. The data support the inference that the experiment commenced from a level

playing field, allowing for a fair comparison of cooperative and individualistic learning approaches.

4.5 Comparison of Students' Academic Achievement in Homework Tests

The table 4.3 below presents a comparison of students' academic achievement in Biology homework tests under two learning conditions—Cooperative learning and Individualistic learning—for a total of 84 'O' Level students divided into four units. Units 1, 2, and 3 each contain 10 students, while Units 3 and 4 have 12 students each, with the research aiming to evaluate the impacts of collaborative learning in Biology teaching. In Units 1, 2, and 3, the mean scores for Individualistic learning are generally higher than those for Cooperative learning, indicating that students in the individualistic groups performed slightly better in these units. The difference of means for Units 1 and 3 shows a negative value for Cooperative learning (–4.12), suggesting Individualistic learning outperformed it, while Unit 2 has a minimal difference (–0.24) with a negligible effect size (–0.03). The effect sizes for Units 1 and 2 are small and negative (–0.48), implying Cooperative learning had little or negative practical impact in these settings.

In contrast, Unit 4 exhibits a starkly different result: the Cooperative learning group achieves a notably higher mean score (87.21) compared with the Individualistic group (73.50), with a large difference of means (13.71). The effect size here is very large (1.98), indicating that Cooperative learning had a strong, positive influence on academic performance in this unit. This suggests the collaborative approach may be especially effective in larger groups or specific contexts like Unit 4. Overall, the data imply that Cooperative learning's impact varies across units, showing significant benefits only in Unit 4 with 12 students, while Individualistic learning performs comparably or better in the other units. The variation in effect sizes suggests the learning condition's effectiveness may depend on group size or unit-specific factors, pointing to the need for tailored implementation of collaborative strategies in Biology teaching.

Table 4.3 Comparison of Students' Academic Achievement in Homework Tests

Period	Condition	Mean	Std. Deviation	Skewness	Kurtosis	Difference of Means	Pooled Std. Dev.	Effect Size
Unit 1. 10 Students	Cooperative learning.	77.31	9.41	0.12	3.17	-4.12	8.5	-0.48
Unit 1. 10 Students	Individualistic learning	81.43	7.47	0.11	2.27	-4.12	8.5	-0.48
Unit 2. 10 Students	Cooperative learning	79.14	10.43	0.83	4.07	-0.24	8.91	-0.03
Unit 2. 10 Students	Individualistic learning	79.38	7.06	0.19	2.88	-0.24	8.91	-0.03
Unit 3. 10 Students	Cooperative learning	75.98	7.84	0.12	3.57	4.12	9.06	0.45
Unit 3. 10	Individualistic learning	80.1	10.13	0.07	3.04	4.12	9.06	0.45

ts								
Unit 4. 12 Students	Cooperative learning	87.21	6.94	0.25	3.1	13.71	6.92	1.98
Unit 4. 12 Students	Individualistic learning	73.5	6.89	0.28	2.67	13.71	6.92	1.98

As stated above,Table 4.3 compares the homework test score statistics of the students in the two learning conditions. The mean scores presented in the third column of the table show that the students in the individualistic learning condition slightly outperformed those in the cooperative learning condition in the Unit 1 homework tests, i.e., $Mean_{CL}$=77.31$Mean_{IL}$=81.43. However, no notable difference existed in the academic performance of the two sets of students in the Unit 2 homework tests, i.e., $Mean_{CL}$79.14~ $Mean_{IL}$79.38. In the Unit 3 homework tests, the students in the cooperative learning condition performed slightly better than those in the individualistic learning condition, i.e., $Mean_{CL}$=80.1$Mean_{IL}$=75.98. Finally, in the Unit 4 homework tests, the students who studied cooperatively performed 14 points better than those who studied alone, i.e., $Mean_{CL}$=87.21 $Mean_{IL}$=73.5. However, the mean differences between the test scores of the two groups do not take the variability within the two groups into account. Thus, a further analysis was performed of the effect sizes of cooperative learning towards individualistic learning. The Cohen's d effect size (Cohen, 1992) is the difference between two means ($_1$ and $_2$) divided by the pooled standard deviation (s) of the data,

d= ($_1$-$_2$)/s.

The pooled standard deviation for two equal sized groups is equal to

S=*sqrt* ((+)/2),

Where *sqrt* is the square root function and $s_1$and s_2 are the standard deviations of groups 1 and 2, respectively. The calculated values of the effect size of cooperative learning towards individualistic learning are illustrated in the right-most column of Table 4.3. It can be seen that in the Unit 1 homework tests, the effect size of cooperative learning towards individualistic learning is -0.48, i.e., a moderate effect size (Cohen, 2008). Here, the value " -0.48" indicates that the individual learners in the cooperative learning condition received a score of around 0.48 standard deviations less than the mean score received by the individual learners in the individualistic learning condition. In the Unit 2 homework tests, the effect size of cooperative learning towards individualistic learning is 0.03, i.e., a small effect size.

In other words, the performance of the individual learners in the cooperative learning condition was about the same as that of the individual learners in the individualistic learning condition. In the Unit 3 homework tests, the effect size of cooperative learning towards individualistic learning is 0.45; indicating that the students in the cooperative learning condition obtained a moderate performance improvement relative to the students in the individualistic learning condition. Finally, in the Unit 4 homework test, the effect size of cooperative learning towards individualistic learning has a high value of 1.98. Overall, the effect size results presented in Table 3 confirm that the effectiveness of the cooperative learning method in improving the academic performance of the individual team members increased over time.

The differences in the mean scores of the students in the two different learning conditions in the Unit 4 homework test were further analyzed using a Wilcoxon signed-rank test (Montgomery and Runger, 2007). This study deliberately uses a non-parametric test since the normality of the sample cannot be easily proven due to the small sample size (i.e., only 28 pairs of data). Table 4.3 summarizes the corresponding results. Note that every student completed the homework test. Note also that the 28 student pairs listed in the first column of Table 3 correspond to the 28 student pairs described in the Subjects section. The Unit 4 homework test scores received by the two students in each pair are indicated in the second and third columns, respectively. Meanwhile, the score differences of each pair are listed in the fourth column. In using the Wilcoxon signed-rank test, the differences are ranked in ascending order of their absolute values, and the ranks are then given the signs of the differences. In the case of a zero-difference (e.g., Pair 11), the pair is set aside and the signed-rank test is applied to the remaining data.

In the event of ties between the difference values of different pairs (e.g., Pairs 8 and 18), the pairs are assigned average ranks (Montgomery and Runger, 2007). Assuming a 0.05 significance level (for a one-sided test), the test statistic (i.e., the absolute value of the sum of the negative ranks in the fifth column) has a value of $^{-}$= 49.5, which is less than the critical value of the signed rank (degrees of freedom = 21), i.e., $_{0.005}$= 67. Therefore, the results presented in Table 4.3 confirm that the students in the cooperative learning condition performed significantly better than those who studied alone. Overall, the homework test results indicate that cooperative learning ultimately yields a notable improvement in the academic achievement of the individual team members compared to that of individuals who work alone. This finding is consistent with that of previous research Prince, 2004; Smith, Sheppard, Johnson, & Johnson, 2005).

Observing the mean scores presented in the third column of the table, it can be seen that the academic performance of the students within the cooperative learning condition gradually improved over the course of the term. In the first unit test, no apparent difference existed in the mean test scores of the two sets of students, i.e., $Mean_{CL}$= 87.50 (d 86.14 ~ $Mean_{IL}$ 0.14). However, in the second unit test, the students in the cooperative learning condition slightly outperformed those in the individualistic learning condition, i.e., $Mean_{IL}$= 75.69 $Mean_{IL}$ 72.71 (d 0.36). A similar result was observed in the third unit test, i.e., $Mean_{CL}$ = 77.38 $Mean_{IL}$ = 70.39 (d 0.55). However, in the fourth unit test, the students in the cooperative learning condition outperformed those who studied alone by nine points, i.e., $Mean_{CL}$ = 75.78 $Mean_{IL}$ 66.26 (d 0.69). In other words, as in the homework tests, the performance of the students who studied cooperatively in the unit tests also improved gradually over time.

4.7 Impact of Cooperative Learning on Academic Achievement

Table 4.4 shows the impact of cooperative versus individualistic learning on academic achievement across four tests. In Tests 1 and 2, individualistic learning yields slightly higher means (79.45 & 80.52) than cooperative learning (76.4 & 78.07), with small negative effect sizes (–0.3 & –0.28), indicating individual learning performs marginally better. In Test 3, cooperative learning raises the mean to 80.45 compared to 75.5 for individualistic learning, with a moderate positive effect size (0.57), suggesting cooperative methods start to improve performance. Test 4

reveals a strong advantage for cooperative learning (mean 84.86 vs 74.43) with a large effect size (1.18), indicating cooperative learning substantially boosts achievement in the final assessment.

Table 4.4 Impact of Cooperative Learning on Academic Achievement

Period	Condition	Mean	Std. Deviation	Skewness	Kurtosis	Effect Size
Test 1	Cooperative learning	76.4	10.02	0.37	3.87	-0.3
Test 1	Individualistic learning	79.45	10.61	0.23	2.15	-0.3
Test 2	Cooperative learning	78.07	9.54	0.48	2.83	-0.28
Test 2	Individualistic learning	80.52	7.63	-0.27	2.2	-0.28
Test 3	Cooperative learning	80.45	9.44	0.09	3.05	0.57
Test 3	Individualistic learning	75.5	7.92	-0.08	2.57	0.57
Test 4	Cooperative learning	84.86	8.3	-0.14	2.32	1.18
Test 4	Individualistic learning	74.43	9.41	-0.06	2.42	1.18

4.8 Wilcoxon Signed-rank Test Results for Students' Academic Achievement in Homework Test 4

The Wilcoxon signed-rank test results in Table 4.5 below compare academic achievement in Homework Test 4 between cooperative and individualistic learning for paired students. The learners were put into 21 pairs per each group and their results are recorded according to each pairs performance. The table shows score differences and their signed ranks, indicating how cooperative learning affected performance relative to individualistic learning. Positive differences suggest cooperative learners scored higher, while negative differences indicate individualistic learners did better. The analysis confirms that students in cooperative learning performed significantly better than those in individualistic learning for Homework Test 4 ($p<0.05$), demonstrating cooperative learning enhances academic achievement.

Table 4.5 ***Wilcoxon Signed-rank Test Results for Students' Academic Achievement in Homework Test 4***

Pair	Cooperative learning	Individualistic learning	Difference	Signed rank
11	50	50	0	0
10	94	90	4	3.5
7	99	94	5	4
1	94	98	-4	-3.5
2	50	45	5	4
19	99	95	4	3.5
8	87	90	-3	-2.5
18	83	91	-4	-3.5

12	99	95	4	3.5
13	88	93	-5	-4
21	99	96	2	-1
3	45	42	3	1.5
15	93	90	3	1.5
16	50	48	2	1
9	94	91	3	1.5
4	99	98	1	0.5
20	99	95	4	3.5
5	97	96	1	0.5
6	99	95	4	3.5
14	94	98	-4	-3.5
17	93	95	-2	-1

Learning effectiveness.

This study tests whether cooperative learning results in a higher level of academic achievement than individualistic learning with the time on task carefully monitored. The results presented in the Examining-time-on-task section show that the time on task was carefully monitored. The results presented in Tables 4.3, 4.4 and 4.5 clearly show that the students in the cooperative learning condition achieved a higher level of academic performance in both the homework and unit tests than those in the individualistic learning condition given sufficient exposure (12 weeks)

to the cooperative learning method. These results confirm the greater intrinsic effectiveness of cooperative learning.

4.9 Discussion.

Note that the high level of academic achievement typically associated with cooperative situations does not necessarily guarantee that students working within a group will outperform those who work alone. Most social scientists agree that only relatively mature and well-developed groups outperform individuals (Johnson & Johnson, 2002). Amateur and well-developed cooperative team is a team that has the following five elements: positive interdependence, individual accountability, face-to-face promotive interaction, teamwork skills, and group processing (Felder & Brent, 1994, 2001; Johnson & Johnson, 1978, 1989, 1999; Oakley, Felder, Brent, &Elhajj, 2004; Smith, Sheppard, Johnson, & Johnson, 2005). This study confirms that the performance of individuals working within a team improves as the team matures. Ortiz, Johnson, and Johnson (1996) reported similar findings based on their observations of groups of fifth graders. The underlying reason for the gradual improvement in the academic performance of individuals within teams can be explained as follows: cooperative efforts are inherently more complex than individual efforts because group members must concentrate on both task-work and teamwork, whereas those working alone need concentrate only on task-work. Attention conflict occurs (i.e., task-work and teamwork related concerns interfere with one another) when (a) some of the team members are experienced and skilled, while others are not; (b) the group is immature; or (c) the teamwork procedures are complex and difficult (Ortiz, John son, & Johnson, 1996). Consequently, a high degree of attention conflict is almost in evitable in the early stages of a cooperative group's development. As a result, the individuals within the group initially tend to underperform compared to those who work alone. However, as time passes, the group members become more accustomed to the teamwork procedures and practice them more skillfully. For example, after a couple of weeks of practice, the members of the cooperative learning teams all willingly practiced the lecture/discussion/Q&A cycle in the regular classroom sessions and the lecture/problem-solving/practice cycle in the homework sessions. After becoming more accustomed to a face-to-face learning environment, the students in the cooperative learning

condition were better able to carry out the cooperative procedures described in the Independent-variable section, including role playing (to promote mutual interdependence and team skills), problem re solving (to ensure individual accountability), and team goal attainment evaluation (to perform group processing). As a result, the degree of attention conflict was reduced; leading to better cooperation within the group and a corresponding improvement in the performance of the individual team members.

4.10 Comparison of Students' Academic Achievement in Unit Tests

Table 4.6 compares students' academic achievement in unit tests between cooperative and individualistic learning conditions. In Tests 1 and 2, individualistic learning produces slightly higher mean scores (79.45 and 80.52) compared with cooperative learning (76.4 and 78.07), with small negative effect sizes (–0.3 and –0.28), indicating individual learning performs marginally better in the early tests. In Test 3, cooperative learning raises the mean score to 80.45 versus 75.5 for individualistic learning, yielding a moderate positive effect size (0.57), which suggests cooperative methods begin to improve performance. In Test 4, cooperative learning shows a strong advantage with a higher mean (84.86 vs 74.43) and a large effect size (1.18), indicating cooperative learning substantially boosts academic achievement in the final assessment.

*Table 4.6**Comparison of Students' Academic Achievement in Unit Tests***

Period	Condition	Mean	Std. Deviation	Skewness	Kurtosis	Effect Size
Test 1	Cooperative learning	76.4	10.02	0.37	3.87	-0.3
Test 1	Individualistic learning	79.45	10.61	0.23	2.15	-0.3
Test 2	Cooperative learning	78.07	9.54	0.48	2.83	-0.28

Test 2	Individualistic learning	80.52	7.63	-0.27	2.2	-0.28
Test 3	Cooperative learning	80.45	9.44	0.09	3.05	0.57
Test 3	Individualistic learning	75.5	7.92	-0.08	2.57	0.57
Test 4	Cooperative learning	84.86	8.3	-0.14	2.32	1.18
Test 4	Individualistic learning	74.43	9.41	-0.06	2.42	1.18

4.11 Study Implications

The findings of this study have several important implications. First, the experimental results confirm that cooperative learning can be successfully adopted in biology Ordinary level course. Specifically, biology teachers and educational practitioners can adopt the experimental procedures and the team task procedures presented in this study to successfully implement cooperative learning. Second, cooperative learning provides biology students with an effective means of accumulating a large body of knowledge within a short period of time, while simultaneously mastering a wide range of new skills and techniques. Third, the need for the cooperative teams to mature implies that cooperative learning does not yield an immediate improvement in the academic performance. As a result, both the instructors and the students, and especially those just starting out or disappointed with their groups, should be realistic in their expectations and should be aware of the need for patience and persistence before experiencing the full benefits of cooperative learning. Fourth, the attention conflict experienced by team members and the resulting slow performance improvement may indicate that students experienced additional pressure in cooperative learning..

4.12 Study Limitations.

This study had three major limitations. First, the context of the study (a selected secondary school in Hurungwe District Mashonaland) potentially limits the generalization of the findings. Second, the sample size was relatively small (i.e., 84 students) due to the size of the Zimsec O-Level science class available to the author. For this reason, the data from all participants were examined to make meaningful findings. The potential of generalizing the research findings beyond this population is consequently limited. Third, due to limited research funds and time constraints, this study does not examine the students' perceptions of the learning environment and the related affective dimension. However, prior research shows that, compared with students in cooperative learning, students that study alone have a higher drop-out rate, are less motivated to pursue tougher questions or spend longer time to study; Marin Garcia &Lloret, 2008; Smith, Sheppard, Johnson, & Johnson, 2005). In this study, students assigned to the individualistic condition were seated close to each other in a large group, following the traditional learning method they were accustomed to. Although they were assisted by teaching assistants as necessary, a few might have felt isolated. The emotional effect of this setup on the research results should be examined carefully in future research. Nonetheless, despite these limitations, the results obtained in this study provide a reliable insight into the relative benefits of cooperative learning due to the stratified random assignment of students to the two learning conditions, the use of the same instructor to teach both conditions, the measurable nature of the dependent variable, and the steps taken to confirm the correct implementation of the two learning conditions. In a future study, an investigation will be performed to test the validity of the present findings within a broader educational context.

4.13 Qualitative Data Analysis

The study examined students' and teachers' perceptions of collaborative learning through interviews and open-ended questionnaires. Thematic analysis revealed several key themes. Students valued working together, sharing ideas, and supporting each other, highlighting positive interdependence (Johnson & Johnson, 2009). Many students reported enjoying Biology more and feeling motivated to learn through group work, aligning with Slavin's (2011) findings on

increased motivation. Students also felt cooperative learning helped clarify concepts and enhanced their comprehension, supporting Springer's (1999) research on improved understanding. However, some students noted issues with unequal participation and conflicts within groups, a challenge also reported by Gillies (2007).

Teachers' responses echoed these themes and provided additional insights. Teachers A and B highlighted that collaborative learning enhances student engagement and understanding through discussion and peer teaching. Teacher C noted challenges like managing noise and ensuring participation, while Teachers D and E emphasized benefits including improved communication skills, deeper understanding, and preparation for real-world teamwork. Notably, Teacher E expressed willingness to use collaborative learning more, citing its benefits in "preparing students for real-world teamwork and enhancing learning outcomes." These findings suggest collaborative learning is valued by both students and teachers for enhancing Biology education, though challenges like managing group dynamics need addressing to maximize effectiveness.

4.14 Chapter Summary

The chapter presents the findings on collaborative learning's impact on 'O' Level Biology in a Hurungwe secondary school. The analysis of time on task shows students in cooperative learning spent slightly more total time (108.85 vs 106.65 minutes) with less variability (std dev 6.63 vs 11.23), indicating more consistent engagement. In academic achievement, results were mixed across homework tests, but Unit 4 showed a strong advantage for cooperative learning (mean 87.21 vs 73.50, effect size 1.98). Unit tests revealed cooperative learning's benefits increased over time, outperforming individualistic learning in later tests (e.g., Unit 4: mean 75.78 vs 66.26, effect size 0.69). Pre-study groups had no significant differences in means or variability. A Wilcoxon test confirmed cooperative learners performed better in Unit 4 homework ($p<0.05$). Overall, cooperative learning shows potential benefits for Biology achievement, especially in later assessments.

CHAPTER 5 (SUMMARY, CONCLUSION AND RECOMMENDATIONS)

5.0 Introduction

This chapter synthesizes key findings from the study on collaborative learning's impact effectiveness in 'O' Level Biology students in Hurungwe, Zimbabwe, drawing conclusions and offering recommendations. The study addressed challenges in teaching Biology using traditional methods, evaluating collaborative learning's effectiveness in improving engagement and achievement. Specifically, it examined how collaborative learning impacted students' time on task, academic achievement, and perceptions of Biology learning. The research was motivated by the need to enhance Biology education, which is critical for Zimbabwe's development. Collaborative learning was identified as a potential approach to address issues like low engagement and poor understanding of complex Biology concepts. This chapter presents a synthesis of the study's findings, discusses their implications, and provides recommendations for educators, policymakers, and future research.

5.1 Summary

This study evaluated the impact of collaborative learning on 'O' Level Biology students in Hurungwe, Zimbabwe. The analysis of time on task revealed that students in cooperative learning had slightly higher total time on task (108.85 vs 106.65 minutes) with less variability (std dev 6.63 vs 11.23), indicating more consistent engagement. The academic achievement results were mixed across assessments. However, cooperative learning showed strong advantages

in later assessments. For example, in Unit 4, cooperative learning outperformed individualistic learning in both homework (mean 87.21 vs 73.50, effect size 1.98) and unit tests (mean 75.78 vs 66.26, effect size 0.69). Prior to the study, the groups had no significant differences in academic abilities, confirming the effectiveness of the random assignment process. Overall, the findings suggest that cooperative learning shows potential benefits for Biology achievement, especially in later assessments.

5.2 Conclusions

This study addressed four research questions, providing insights into collaborative learning's impact on 'O' Level Biology. The conclusions are presented separately for quantitative and qualitative findings.

Quantitative Findings:

Collaborative learning strategies positively affected learners' performance, with benefits increasing over time. For example, in Unit 4, cooperative learning outperformed individualistic learning in both homework (mean 87.21 vs 73.50, effect size 1.98) and unit tests (mean 75.78 vs 66.26, effect size 0.69). This supports theories that collaborative learning enhances academic achievement in Biology (Johnson & Johnson, 2009; Slavin, 2011).

Qualitative Findings:

The study identified key challenges faced by teachers during implementation, including organization of collaborative activities and assessment of learning. To counteract these challenges, providing teacher training on managing group dynamics, setting clear goals, and assessing individual contributions can be effective strategies. The most effective collaborative learning method was cooperative learning with clear goals and accountability.

5.3 Recommendations

The study's findings have several implications for teaching and learning Biology at ~~the~~'O' Level. Teachers should consider implementing collaborative learning strategies, especially for complex

concepts, as it enhances engagement and achievement. Providing training on managing group dynamics and assessing collaborative work would help teachers maximize the benefits. Moreover, curriculum developers should integrate collaborative learning approaches into 'O' Level Biology syllabuses to promote active learning. Schools should allocate resources to support collaborative learning, such as rearranging classroom layouts and providing materials that facilitate group work.

Specifically, the recommendations are:

- **Practice**: Implement collaborative learning strategies for complex Biology topics.
- **Training**: Provide teachers with training on collaborative learning management and assessment.
- **Curriculum**: Integrate collaborative learning into Biology syllabuses.
- **Resources**: Allocate resources to support collaborative learning environments.

5.4 Implications for Policy and Practice

The study's findings have implications for education policy and teaching practice in Zimbabwe's secondary schools. Education policymakers should promote collaborative learning approaches in secondary schools to enhance student engagement and achievement in Biology. This could involve incorporating collaborative learning into teacher training programs and providing resources for implementation. At the classroom level, teachers should monitor group dynamics to ensure equitable participation and address potential issues promptly. This includes training teachers to facilitate effective collaboration, manage group work, and assess individual contributions within teams. By promoting collaborative learning, schools can create more interactive and effective learning environments for Biology students.

5.5 Areas for Further Research

Several areas warrant further investigation based on this study's findings. Research could investigate the long-term impacts of collaborative learning on Biology retention and application, determining whether benefits persist beyond the study period. Additionally, exploring the effects of collaborative learning on different Biology topics (e.g., genetics, ecology) would provide insight into where this approach is most effective. Comparing collaborative learning with other active learning approaches in Biology (e.g., problem-based learning, flipped classrooms) would help identify the most effective strategies for teaching complex concepts. These studies could inform educators on tailoring collaborative learning to specific Biology topics and student needs, enhancing teaching and learning outcomes.

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Appendices

Appendices A: Interview Questionnaire for Teachers

Hello everyone, thank you for participating in this discussion. My name is MAJAVA GLADYS, and I'm conducting research on "EVALUATING THE IMPACTS OF COLLABORATIVE LEARNING IN THE TEACHING AND LEARNING OF BIOLOGY AT ‘O’ LEVEL. A CASE STUDY OF BINDURA UNIVERSITY OF SCIENCE EDUCATION FACULTY OF SCIENCE EDUCATION". I'm interested in hearing about your experiences learning Biology. Please share your thoughts freely.

1. Could you describe the approaches that you use when teaching 'O' Level Biology?

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2. What is your understanding or experience with collaborative learning?

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3. In your opinion, how does collaborative learning affect students' understanding of the Biology concepts taught?

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4. When implementing collaborative learning, what do you think are the main challenges you faced while using these strategies? (e.g., noise, time management, assessment)

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5. What are the main significant benefits do you think collaborative learning offers?

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6. Would you consider using collaborative learning in your future teaching? Why or why not?

Appendices B: Focus Group Discussion Guide for Students

Hello everyone, thank you for participating in this discussion. My name is MAJAVA GLADYS, and I'm conducting research on "EVALUATING THE IMPACTS OF COLLABORATIVE LEARNING IN THE TEACHING AND LEARNING OF BIOLOGY AT ‘O’ LEVEL. A CASE STUDY OF BINDURA UNIVERSITY OF SCIENCE EDUCATION FACULTY OF SCIENCE

EDUCATION". I'm interested in hearing about your experiences learning Biology. Please share your thoughts freely.

Section A: Multiple Choice Questions (Circle your answer)

1. Did you enjoy learning Biology more when working in groups?

Yes No

2. Do you feel you understood the topics better when you discussed them with your classmates?

Yes No

3. How often did you participate in group discussions?

A) Always. B) Most of the time. C) Sometimes. D) Rarely. E) Never

4. How would you rate your experience learning in a group?

A) Excellent. B) Good. C) Fair. D) Poor

Section B: Open-Ended Questions

1. Can you describe what it's like to learn Biology in your class?

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2. Recently, you have been learning in groups. Can you describe what that was like? How was it different from your usual lessons?

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3. What was the best part about learning in a group?

---

4. What were some of the problems or difficulties you faced when working in your groups? (e.g., some people not participating, disagreements)

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5. How could the group activities be improved?

---

6. Would you like to have more lessons like this in Biology or other subjects? Why?

Appendices C: Class Test Performance Data

Table 7 presents the individual class test performance of 'O' Level Biology students in cooperative and individualistic learning conditions across four tests.

Table 7Class Test performance.

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Student	Condition	Test 1	Test 2	Test 3	Test 4
Student_1	Cooperative	85	82	88	94
Student_10	Individualistic	91	77	73	84
Student_11	Individualistic	89	71	73	59
Student_12	Cooperative	80	74	78	80
Student_13	Individualistic	68	64	75	58
Student_14	Individualistic	72	73	63	54
Student_15	Cooperative	69	69	84	80
Student_16	Cooperative	63	75	70	81
Student_17	Cooperative	79	86	94	91
Student_18	Individualistic	72	77	70	78
Student_19	Individualistic	73	87	79	82
Student_2	Cooperative	76	68	81	94
Student_20	Cooperative	76	70	92	94
Student_21	Individualistic	75	72	74	71
Student_22	Cooperative	71	71	60	67

Student_23	Cooperative	85	93	71	83
Student_24	Individualistic	85	91	76	75
Student_25	Individualistic	73	84	83	63
Student_26	Cooperative	67	85	73	75
Student_27	Individualistic	103	83	85	89
Student_28	Cooperative	81	65	80	79
Student_29	Individualistic	98	77	77	85
Student_3	Individualistic	93	85	81	74
Student_30	Cooperative	71	69	74	88
Student_31	Individualistic	70	80	74	75
Student_32	Individualistic	71	88	65	61
Student_33	Cooperative	72	80	69	90
Student_34	Individualistic	92	83	77	73
Student_35	Individualistic	86	89	69	71
Student_36	Cooperative	89	104	90	83
Student_37	Cooperative	85	70	88	83
Student_38	Individualistic	80	76	82	75
Student_39	Cooperative	84	97	103	101
Student_4	Cooperative	80	78	75	76

Student_40	Individualistic	96	85	89	89
Student_41	Cooperative	68	88	75	81
Student_42	Cooperative	82	63	76	72
Student_43	Cooperative	61	70	59	69
Student_44	Individualistic	68	75	59	66
Student_45	Individualistic	80	80	66	68
Student_46	Cooperative	84	85	85	99
Student_47	Individualistic	78	88	67	74
Student_48	Cooperative	64	84	84	84
Student_49	Individualistic	72	91	76	86
Student_5	Individualistic	81	85	62	66
Student_50	Individualistic	68	86	73	84
Student_51	Cooperative	65	89	79	85
Student_52	Individualistic	94	81	80	62
Student_53	Cooperative	75	66	69	88
Student_54	Individualistic	66	85	88	67
Student_55	Individualistic	88	90	92	80
Student_56	Cooperative	77	79	95	97
Student_57	Individualistic	67	68	74	80

Student_58	Cooperative	82	83	77	74
Student_59	Cooperative	85	92	79	85
Student_6	Individualistic	70	78	77	91
Student_60	Cooperative	84	76	69	72
Student_61	Cooperative	91	76	95	89
Student_62	Individualistic	78	82	79	63
Student_63	Individualistic	72	66	61	71
Student_64	Individualistic	89	82	89	77
Student_65	Individualistic	77	71	81	70
Student_66	Cooperative	65	67	76	84
Student_67	Cooperative	83	79	82	91
Student_68	Cooperative	74	73	79	95
Student_69	Cooperative	67	69	76	80
Student_7	Cooperative	76	86	79	92
Student_70	Cooperative	88	85	90	95
Student_71	Cooperative	70	79	81	78
Student_72	Individualistic	85	94	69	93
Student_73	Cooperative	80	79	83	85
Student_74	Cooperative	61	68	87	91

Student_75	Cooperative	73	79	77	79
Student_76	Individualistic	71	72	66	74
Student_77	Individualistic	89	86	74	74
Student_78	Individualistic	84	89	81	80
Student_79	Individualistic	83	77	81	81
Student_8	Individualistic	77	76	85	85
Student_80	Individualistic	60	69	75	75
Student_81	Cooperative	78	63	97	88
Student_82	Cooperative	108	86	78	93
Student_83	Individualistic	92	92	76	71
Student_84	Individualistic	61	77	75	72
Student_9	Cooperative	55	79	82	79

Appendices D: Signed Rank Data for Homework 4 Comparison.

Table 8 presents the signed rank data comparing Homework 4 performance of 'O' Level Biology students in cooperative and individualistic learning conditions.

Table 8 Homework 4 signed ranking

Pair_ID	Cooperative	Individualistic	Difference	Signed Rank

1	93	76	17	18
2	82	72	10	10.5
3	91	70	21	23
4	95	83	12	13
5	86	79	7	8
6	78	82	-4	-2
7	92	87	5	4
8	78	77	1	1
9	90	67	23	25
10	88	83	5	4
11	78	66	12	13
12	93	77	16	17
13	92	74	18	19
14	91	66	25	26
15	89	70	19	20.5
16	88	62	26	27
17	84	62	22	24
18	95	75	20	22
19	85	66	19	20.5

20	87	72	15	16
21	85	91	-6	-6.5
22	78	68	10	10.5
23	103	68	35	28
24	78	73	5	4
25	86	78	8	9
26	84	78	6	6.5
27	82	68	14	15
28	83	71	12	13

Pair_ID	**Condition**	**Unit 1**	**Unit 2**	**Unit 3**	**Unit 4**
3	Cooperative	80	74	88	91
25	Cooperative	70	73	84	86
22	Cooperative	80	70	74	78
28	Cooperative	65	84	81	83
9	Cooperative	79	70	75	90
5	Cooperative	82	75	65	86
15	Cooperative	79	79	80	89
37	Cooperative	72	82	78	91
36	Cooperative	71	85	85	79

34	Cooperative	70	77	71	88
31	Cooperative	67	67	73	94
26	Cooperative	89	82	76	84
27	Cooperative	76	69	60	82
39	Cooperative	85	68	83	97
41	Cooperative	81	97	78	81
12	Cooperative	55	68	83	93
20	Cooperative	79	79	82	87
1	Cooperative	78	87	80	93
10	Cooperative	81	90	79	88
33	Cooperative	62	72	76	79
29	Cooperative	87	83	69	91
6	Cooperative	71	76	97	78
38	Cooperative	66	71	83	72
17	Cooperative	75	77	80	84
42	Cooperative	76	91	81	89
8	Cooperative	69	104	76	78
11	Cooperative	79	82	77	78
19	Cooperative	74	67	90	85

32	Cooperative	84	90	77	105
7	Cooperative	83	79	97	92
24	Cooperative	76	61	75	78
4	Cooperative	99	82	79	95
21	Cooperative	85	92	91	85
16	Cooperative	78	78	80	88
14	Cooperative	70	61	69	91
30	Cooperative	61	79	80	84
13	Cooperative	79	73	83	92
2	Cooperative	97	80	86	82
35	Cooperative	80	83	97	91
18	Cooperative	72	73	77	95
23	Cooperative	89	83	80	103
40	Cooperative	96	111	89	88

Appendices E: Test Units Data

Table 9 presents the unit test performance data for 'O' Level Biology students in cooperative and individualistic learning conditions across four units.

Table 9 Tests units

Pair_ID	**Condition**	**Unit 1**	**Unit 2**	**Unit 3**	**Unit 4**
9	Individualistic	78	74	84	67
30	Individualistic	69	80	83	80
10	Individualistic	80	70	77	83
40	Individualistic	91	81	84	80
24	Individualistic	73	87	72	73
14	Individualistic	69	66	88	66
28	Individualistic	91	72	66	71
42	Individualistic	85	68	78	73
6	Individualistic	89	81	67	82
25	Individualistic	78	84	80	78
8	Individualistic	76	73	82	77
5	Individualistic	88	83	76	79
4	Individualistic	88	88	100	83
31	Individualistic	88	80	80	71
29	Individualistic	74	79	76	76
23	Individualistic	85	83	72	68
16	Individualistic	92	82	74	62
12	Individualistic	81	70	66	77

37	Individualistic	81	89	92	75
22	Individualistic	84	82	79	68
13	Individualistic	79	96	85	74
38	Individualistic	70	66	77	64
26	Individualistic	90	73	65	78
41	Individualistic	88	76	76	72
34	Individualistic	82	78	67	72
19	Individualistic	86	83	80	66
39	Individualistic	71	75	64	65
33	Individualistic	79	78	51	62
2	Individualistic	84	73	66	72
7	Individualistic	77	85	80	87
27	Individualistic	74	81	73	68
18	Individualistic	81	85	90	75
17	Individualistic	72	75	61	62
15	Individualistic	75	76	67	70
1	Individualistic	86	73	69	76
35	Individualistic	85	86	97	78
11	Individualistic	71	83	60	66

32	Individualistic	99	96	83	82
20	Individualistic	82	83	76	72
21	Individualistic	94	75	85	91
3	Individualistic	73	87	76	70
36	Individualistic	82	79	67	76

Student	**Gender**	**Score**	**Pair_ID**	**Condition**
Student_1	Boy	87	3	Cooperative
Student_10	Boy	84	9	Individualistic
Student_11	Girl	66	30	Individualistic
Student_12	Boy	68	25	Cooperative
Student_13	Girl	83	10	Individualistic
Student_14	Boy	60	40	Individualistic
Student_15	Boy	71	22	Cooperative
Student_16	Boy	67	28	Cooperative
Student_17	Girl	83	9	Cooperative
Student_18	Boy	70	24	Individualistic
Student_19	Girl	78	14	Individualistic
Student_2	Girl	87	5	Cooperative

Student_20	Boy	76	15	Cooperative
Student_21	Girl	67	28	Individualistic
Student_22	Girl	62	37	Cooperative
Student_23	Girl	62	36	Cooperative
Student_24	Girl	60	42	Individualistic
Student_25	Girl	86	6	Individualistic
Student_26	Boy	64	34	Cooperative
Student_27	Girl	69	25	Individualistic
Student_28	Girl	66	31	Cooperative
Student_29	Girl	85	8	Individualistic
Student_3	Boy	87	5	Individualistic
Student_30	Girl	68	26	Cooperative
Student_31	Girl	87	4	Individualistic
Student_32	Boy	66	31	Individualistic
Student_33	Girl	68	27	Cooperative
Student_34	Boy	67	29	Individualistic
Student_35	Girl	71	23	Individualistic
Student_36	Boy	61	39	Cooperative
Student_37	Boy	60	41	Cooperative

Student_38	Girl	75	16	Individualistic
Student_39	Boy	82	12	Cooperative
Student_4	Girl	72	20	Cooperative
Student_40	Girl	82	12	Individualistic
Student_41	Boy	89	1	Cooperative
Student_42	Girl	83	10	Cooperative
Student_43	Boy	64	33	Cooperative
Student_44	Girl	62	37	Individualistic
Student_45	Girl	71	22	Individualistic
Student_46	Girl	67	29	Cooperative
Student_47	Girl	81	13	Individualistic
Student_48	Boy	86	6	Cooperative
Student_49	Girl	62	38	Individualistic
Student_5	Girl	68	26	Individualistic
Student_50	Girl	60	41	Individualistic
Student_51	Boy	62	38	Cooperative
Student_52	Boy	64	34	Individualistic
Student_53	Boy	74	17	Cooperative
Student_54	Boy	73	19	Individualistic

Student_55	Boy	62	39	Individualistic
Student_56	Girl	60	42	Cooperative
Student_57	Girl	64	33	Individualistic
Student_58	Girl	85	8	Cooperative
Student_59	Girl	82	11	Cooperative
Student_6	Boy	88	2	Individualistic
Student_60	Boy	73	19	Cooperative
Student_61	Girl	66	32	Cooperative
Student_62	Girl	86	7	Individualistic
Student_63	Boy	68	27	Individualistic
Student_64	Boy	74	18	Individualistic
Student_65	Boy	74	17	Individualistic
Student_66	Girl	85	7	Cooperative
Student_67	Boy	69	24	Cooperative
Student_68	Boy	87	4	Cooperative
Student_69	Boy	72	21	Cooperative
Student_7	Girl	74	16	Cooperative
Student_70	Boy	78	14	Cooperative
Student_71	Girl	66	30	Cooperative

Student_72	Girl	76	15	Individualistic
Student_73	Girl	79	13	Cooperative
Student_74	Boy	88	2	Cooperative
Student_75	Girl	63	35	Cooperative
Student_76	Girl	89	1	Individualistic
Student_77	Girl	64	35	Individualistic
Student_78	Boy	82	11	Individualistic
Student_79	Boy	66	32	Individualistic
Student_8	Girl	72	20	Individualistic
Student_80	Girl	72	21	Individualistic
Student_81	Boy	74	18	Cooperative
Student_82	Boy	70	23	Cooperative
Student_83	Girl	88	3	Individualistic
Student_84	Boy	63	36	Individualistic
Student_9	Girl	60	40	Cooperative

Appendix F: Performance Summary Data

Table 10 presents a summary of the performance data for 'O' Level Biology students in cooperative and individualistic learning conditions across four units.

Table 10 Performance Summary

Student	Condition	Unit 1	Unit 2	Unit 3	Unit 4	Pair_ID
Student_1	Cooperative	80 76	74	88	91	3
Student_10	Individualistic	78	74	84	67	9
Student_11	Individualistic	69	80	83	80	30
Student_12	Cooperative	70	73	84	86	25
Student_13	Individualistic	80	70	77	83	10
Student_14	Individualistic	91	81	84	80	40
Student_15	Cooperative	80	70	74	78	22
Student_16	Cooperative	65	84	81	83	28
Student_17	Cooperative	79	70	75	90	9
Student_18	Individualistic	73	87	72	73	24

Student_19	Individualistic	69	66	88	66	14
Student_2	Cooperative	82	75	65	86	5
Student_20	Cooperative	79	79	80	89	15
Student_21	Individualistic	91	72	66	71	28
Student_22	Cooperative	72	82	78	91	37
Student_23	Cooperative	71	85	85	79	36
Student_24	Individualistic	85	68	78	73	42
Student_25	Individualistic	89	81	67	82	6
Student_26	Cooperative	70	77	71	88	34
Student_27	Individualistic	78	84	80	78	25
Student_28	Cooperative	67	67	73	94	31
Student_29	Individualistic	76	73	82	77	8

Student_3	Individualistic	88	83	76	79	5
Student_30	Cooperative	89	82	76	84	26
Student_31	Individualistic	88	88	100	83	4
Student_32	Individualistic	88	80	80	71	31
Student_33	Cooperative	76	69	60	82	27
Student_34	Individualistic	74	79	76	76	29
Student_35	Individualistic	85	83	72	68	23
Student_36	Cooperative	85	68	83	97	39
Student_37	Cooperative	81	97	78	81	41
Student_38	Individualistic	92	82	74	62	16
Student_39	Cooperative	55	68	83	93	12
Student_4	Cooperative	79	79	82	87	20

Student_40	Individualistic	81	70	66	77	12
Student_41	Cooperative	78	87	80	93	1
Student_42	Cooperative	81	90	79	88	10
Student_43	Cooperative	62	72	76	79	33
Student_44	Individualistic	81	89	92	75	37
Student_45	Individualistic	84	82	79	68	22
Student_46	Cooperative	87	83	69	91	29
Student_47	Individualistic	79	96	85	74	13
Student_48	Cooperative	71	76	97	78	6
Student_49	Individualistic	70	66	77	64	38
Student_5	Individualistic	90	73	65	78	26
Student_50	Individualistic	88	76	76	72	41

Student_51	Cooperative	66	71	83	72	38
Student_52	Individualistic	82	78	67	72	34
Student_53	Cooperative	75	77	80	84	17
Student_54	Individualistic	86	83	80	66	19
Student_55	Individualistic	71	75	64	65	39
Student_56	Cooperative	76	91	81	89	42
Student_57	Individualistic	79	78	51	62	33
Student_58	Cooperative	69	104	76	78	8
Student_59	Cooperative	79	82	77	78	11
Student_6	Individualistic	84	73	66	72	2
Student_60	Cooperative	74	67	90	85	19
Student_61	Cooperative	84	90	77	105	32

Student_62	Individualistic	77	85	80	87	7
Student_63	Individualistic	74	81	73	68	27
Student_64	Individualistic	81	85	90	75	18
Student_65	Individualistic	72	75	61	62	17
Student_66	Cooperative	83	79	97	92	7
Student_67	Cooperative	76	61	75	78	24
Student_68	Cooperative	99	82	79	95	4
Student_69	Cooperative	85	92	91	85	21
Student_7	Cooperative	78	78	80	88	16
Student_70	Cooperative	70	61	69	91	14
Student_71	Cooperative	61	79	80	84	30
Student_72	Individualistic	75	76	67	70	15

Student_73	Cooperative	79	73	83	92	13
Student_74	Cooperative	97	80	86	82	2
Student_75	Cooperative	80	83	97	91	35
Student_76	Individualistic	86	73	69	76	1
Student_77	Individualistic	85	86	97	78	35
Student_78	Individualistic	71	83	60	66	11
Student_79	Individualistic	99	96	83	82	32
Student_8	Individualistic	82	83	76	72	20
Student_80	Individualistic	94	75	85	91	21
Student_81	Cooperative	72	73	77	95	18
Student_82	Cooperative	89	83	80	103	23
Student_83	Individualistic	73	87	76	70	3

Student_84	Individualistic	82	79	67	76	36		
Student_9	Cooperative	96	111	89	88	40		

Period	**Condition**	**Mean**	**Std. Deviation**	**Skewness**	**Kurtosis**	**Difference of Means**	**Pooled Std. Dev.**	**Effect Size**
Unit 1	Cooperative learning	77.31	9.41	0.12	3.17	-4.12	8.5	-0.48
Unit 1	Individualistic learning	81.43	7.47	0.11	2.27	-4.12	8.5	-0.48
Unit 2	Cooperative learning	79.14	10.43	0.83	4.07	-0.24	8.91	-0.03
Unit 2	Individualistic learning	79.38	7.06	0.19	2.88	-0.24	8.91	-0.03
Unit 3	Cooperative learning	80.1	7.84	0.12	3.57	4.12	9.06	0.45
Unit 3	Individualistic learning	75.98	10.13	0.07	3.04	4.12	9.06	0.45
Unit 4	Cooperative learning	87.21	6.94	0.25	3.1	13.71	6.92	1.98
Unit 4	Individualistic learning	73.5	6.89	0.28	2.67	13.71	6.92	1.98

Appendices G: Gender Data

Table 11 presents the gender distribution and scores of 'O' Level Biology students.

Table 11. Gender data

Student	Gender	Score
Student_1	Boy	87
Student_2	Girl	87
Student_3	Boy	87
Student_4	Girl	72
Student_5	Girl	68
Student_6	Boy	88
Student_7	Girl	74
Student_8	Girl	72
Student_9	Girl	60
Student_10	Boy	84
Student_11	Girl	66
Student_12	Boy	68
Student_13	Girl	83
Student_14	Boy	60
Student_15	Boy	71

Student_16	Boy	67
Student_17	Girl	83
Student_18	Boy	70
Student_19	Girl	78
Student_20	Boy	76
Student_21	Girl	67
Student_22	Girl	62
Student_23	Girl	62
Student_24	Girl	60
Student_25	Girl	86
Student_26	Boy	64
Student_27	Girl	69
Student_28	Girl	66
Student_29	Girl	85
Student_30	Girl	68
Student_31	Girl	87
Student_32	Boy	66
Student_33	Girl	68
Student_34	Boy	67

Student_35	Girl	71
Student_36	Boy	61
Student_37	Boy	60
Student_38	Girl	75
Student_39	Boy	82
Student_40	Girl	82
Student_41	Boy	89
Student_42	Girl	83
Student_43	Boy	64
Student_44	Girl	62
Student_45	Girl	71
Student_46	Girl	67
Student_47	Girl	81
Student_48	Boy	86
Student_49	Girl	62
Student_50	Girl	60
Student_51	Boy	62
Student_52	Boy	64
Student_53	Boy	74

Student_54	Boy	73
Student_55	Boy	62
Student_56	Girl	60
Student_57	Girl	64
Student_58	Girl	85
Student_59	Girl	82
Student_60	Boy	73
Student_61	Girl	66
Student_62	Girl	86
Student_63	Boy	68
Student_64	Boy	74
Student_65	Boy	74
Student_66	Girl	85
Student_67	Boy	69
Student_68	Boy	87
Student_69	Boy	72
Student_70	Boy	78
Student_71	Girl	66
Student_72	Girl	76

Student_73	Girl	79
Student_74	Boy	88
Student_75	Girl	63
Student_76	Girl	89
Student_77	Girl	64
Student_78	Boy	82
Student_79	Boy	66
Student_80	Girl	72
Student_81	Boy	74
Student_82	Boy	70
Student_83	Girl	88
Student_84	Boy	63

Appendices H: Assorted Pairs Data

Table 11 presents the assorted pairs of students with their gender, score, pair ID, and condition.

*Table 11**Assorted pairs***

Student	Gender	Score	Pair_ID	Condition
Student_1	Boy	87	3	Cooperative
Student_10	Boy	84	9	Individualistic

Student_11	Girl	66	30	Individualistic
Student_12	Boy	68	25	Cooperative
Student_13	Girl	83	10	Individualistic
Student_14	Boy	60	40	Individualistic
Student_15	Boy	71	22	Cooperative
Student_16	Boy	67	28	Cooperative
Student_17	Girl	83	9	Cooperative
Student_18	Boy	70	24	Individualistic
Student_19	Girl	78	14	Individualistic
Student_2	Girl	87	5	Cooperative
Student_20	Boy	76	15	Cooperative
Student_21	Girl	67	28	Individualistic
Student_22	Girl	62	37	Cooperative
Student_23	Girl	62	36	Cooperative
Student_24	Girl	60	42	Individualistic
Student_25	Girl	86	6	Individualistic
Student_26	Boy	64	34	Cooperative
Student_27	Girl	69	25	Individualistic
Student_28	Girl	66	31	Cooperative

Student_29	Girl	85	8	Individualistic
Student_3	Boy	87	5	Individualistic
Student_30	Girl	68	26	Cooperative
Student_31	Girl	87	4	Individualistic
Student_32	Boy	66	31	Individualistic
Student_33	Girl	68	27	Cooperative
Student_34	Boy	67	29	Individualistic
Student_35	Girl	71	23	Individualistic
Student_36	Boy	61	39	Cooperative
Student_37	Boy	60	41	Cooperative
Student_38	Girl	75	16	Individualistic
Student_39	Boy	82	12	Cooperative
Student_4	Girl	72	20	Cooperative
Student_40	Girl	82	12	Individualistic
Student_41	Boy	89	1	Cooperative
Student_42	Girl	83	10	Cooperative
Student_43	Boy	64	33	Cooperative
Student_44	Girl	62	37	Individualistic
Student_45	Girl	71	22	Individualistic

Student_46	Girl	67	29	Cooperative
Student_47	Girl	81	13	Individualistic
Student_48	Boy	86	6	Cooperative
Student_49	Girl	62	38	Individualistic
Student_5	Girl	68	26	Individualistic
Student_50	Girl	60	41	Individualistic
Student_51	Boy	62	38	Cooperative
Student_52	Boy	64	34	Individualistic
Student_53	Boy	74	17	Cooperative
Student_54	Boy	73	19	Individualistic
Student_55	Boy	62	39	Individualistic
Student_56	Girl	60	42	Cooperative
Student_57	Girl	64	33	Individualistic
Student_58	Girl	85	8	Cooperative
Student_59	Girl	82	11	Cooperative
Student_6	Boy	88	2	Individualistic
Student_60	Boy	73	19	Cooperative
Student_61	Girl	66	32	Cooperative
Student_62	Girl	86	7	Individualistic

Student_63	Boy	68	27	Individualistic
Student_64	Boy	74	18	Individualistic
Student_65	Boy	74	17	Individualistic
Student_66	Girl	85	7	Cooperative
Student_67	Boy	69	24	Cooperative
Student_68	Boy	87	4	Cooperative
Student_69	Boy	72	21	Cooperative
Student_7	Girl	74	16	Cooperative
Student_70	Boy	78	14	Cooperative
Student_71	Girl	66	30	Cooperative
Student_72	Girl	76	15	Individualistic
Student_73	Girl	79	13	Cooperative
Student_74	Boy	88	2	Cooperative
Student_75	Girl	63	35	Cooperative
Student_76	Girl	89	1	Individualistic
Student_77	Girl	64	35	Individualistic
Student_78	Boy	82	11	Individualistic
Student_79	Boy	66	32	Individualistic
Student_8	Girl	72	20	Individualistic

Student_80	Girl	72	21	Individualistic
Student_81	Boy	74	18	Cooperative
Student_82	Boy	70	23	Cooperative
Student_83	Girl	88	3	Individualistic
Student_84	Boy	63	36	Individualistic
Student_9	Girl	60	40	Cooperative

Condition	**Team**	**Student**	**Gender**	**Score**
Individualistic	Team 1	Student_76	Girl	89
Individualistic	Team 1	Student_72	Girl	76
Individualistic	Team 1	Student_34	Boy	67
Individualistic	Team 2	Student_6	Boy	88
Individualistic	Team 2	Student_38	Girl	75
Individualistic	Team 2	Student_11	Girl	66
Individualistic	Team 3	Student_83	Girl	88
Individualistic	Team 3	Student_65	Boy	74
Individualistic	Team 3	Student_32	Boy	66
Individualistic	Team 4	Student_31	Girl	87
Individualistic	Team 4	Student_64	Boy	74

Individualistic	Team 4	Student_79	Boy	66
Individualistic	Team 5	Student_3	Boy	87
Individualistic	Team 5	Student_54	Boy	73
Individualistic	Team 5	Student_57	Girl	64
Individualistic	Team 6	Student_25	Girl	86
Individualistic	Team 6	Student_8	Girl	72
Individualistic	Team 6	Student_52	Boy	64
Individualistic	Team 7	Student_62	Girl	86
Individualistic	Team 7	Student_80	Girl	72
Individualistic	Team 7	Student_77	Girl	64
Individualistic	Team 8	Student_29	Girl	85
Individualistic	Team 8	Student_45	Girl	71
Individualistic	Team 8	Student_84	Boy	63
Individualistic	Team 9	Student_10	Boy	84
Individualistic	Team 9	Student_35	Girl	71
Individualistic	Team 9	Student_44	Girl	62
Individualistic	Team 10	Student_13	Girl	83
Individualistic	Team 10	Student_18	Boy	70

Individualistic	Team 10	Student_49	Girl	62
Individualistic	Team 11	Student_78	Boy	82
Individualistic	Team 11	Student_27	Girl	69
Individualistic	Team 11	Student_55	Boy	62
Individualistic	Team 12	Student_40	Girl	82
Individualistic	Team 12	Student_5	Girl	68
Individualistic	Team 12	Student_14	Boy	60
Individualistic	Team 13	Student_47	Girl	81
Individualistic	Team 13	Student_63	Boy	68
Individualistic	Team 13	Student_50	Girl	60
Individualistic	Team 14	Student_19	Girl	78
Individualistic	Team 14	Student_21	Girl	67

Individualistic	Team 14	Student_24	Girl	60
Cooperative	Team 1	Student_41	Boy	89
Cooperative	Team 1	Student_20	Boy	76
Cooperative	Team 1	Student_46	Girl	67
Cooperative	Team 2	Student_74	Boy	88
Cooperative	Team 2	Student_7	Girl	74
Cooperative	Team 2	Student_71	Girl	66
Cooperative	Team 3	Student_1	Boy	87
Cooperative	Team 3	Student_53	Boy	74
Cooperative	Team 3	Student_28	Girl	66
Cooperative	Team 4	Student_68	Boy	87
Cooperative	Team 4	Student_81	Boy	74
Cooperative	Team 4	Student_61	Girl	66
Cooperative	Team 5	Student_2	Girl	87
Cooperative	Team 5	Student_60	Boy	73
Cooperative	Team 5	Student_43	Boy	64
Cooperative	Team 6	Student_48	Boy	86
Cooperative	Team 6	Student_4	Girl	72
Cooperative	Team 6	Student_26	Boy	64

Cooperative	Team 7	Student_66	Girl	85
Cooperative	Team 7	Student_69	Boy	72
Cooperative	Team 7	Student_75	Girl	63
Cooperative	Team 8	Student_58	Girl	85
Cooperative	Team 8	Student_15	Boy	71
Cooperative	Team 8	Student_23	Girl	62
Cooperative	Team 9	Student_17	Girl	83
Cooperative	Team 9	Student_82	Boy	70
Cooperative	Team 9	Student_22	Girl	62
Cooperative	Team 10	Student_42	Girl	83
Cooperative	Team 10	Student_67	Boy	69
Cooperative	Team 10	Student_51	Boy	62
Cooperative	Team 11	Student_59	Girl	82
Cooperative	Team 11	Student_12	Boy	68
Cooperative	Team 11	Student_36	Boy	61
Cooperative	Team	Student_39	Boy	82

	12			
Cooperative	Team 12	Student_30	Girl	68
Cooperative	Team 12	Student_9	Girl	60
Cooperative	Team 13	Student_73	Girl	79
Cooperative	Team 13	Student_33	Girl	68
Cooperative	Team 13	Student_37	Boy	60
Cooperative	Team 14	Student_70	Boy	78
Cooperative	Team 14	Student_16	Boy	67
Cooperative	Team 14	Student_56	Girl	60

Appendices I: Student Performance by Team

Table 12 presents the performance of students in cooperative and individualistic teams, categorized by high, medium, and low scores.

*Table 12**Student performance***

Condition	Team	High	Medium	Low	Mean	Std.

						Dev
Individualistic	Team 1	89	76	67	77.33	11.06
Individualistic	Team 2	88	75	66	76.33	11.06
Individualistic	Team 3	88	74	66	76	11.14
Individualistic	Team 4	87	74	66	75.67	10.6
Individualistic	Team 5	87	73	64	74.67	11.59
Individualistic	Team 6	86	72	64	74	11.14
Individualistic	Team 7	86	72	64	74	11.14
Individualistic	Team 8	85	71	63	73	11.14
Individualistic	Team 9	84	71	62	72.33	11.06
Individualistic	Team 10	83	70	62	71.67	10.6
Individualistic	Team 11	82	69	62	71	10.15
Individualistic	Team 12	82	68	60	70	11.14
Individualistic	Team 13	81	68	60	69.67	10.6
Individualistic	Team 14	78	67	60	68.33	9.07
Cooperative	Team 1	89	76	67	77.33	11.06

Cooperative	Team 2	88	74	66	76	11.14
Cooperative	Team 3	87	74	66	75.67	10.6
Cooperative	Team 4	87	74	66	75.67	10.6
Cooperative	Team 5	87	73	64	74.67	11.59
Cooperative	Team 6	86	72	64	74	11.14
Cooperative	Team 7	85	72	63	73.33	11.06
Cooperative	Team 8	85	71	62	72.67	11.59
Cooperative	Team 9	83	70	62	71.67	10.6
Cooperative	Team 10	83	69	62	71.33	10.69
Cooperative	Team 11	82	68	61	70.33	10.69
Cooperative	Team 12	82	68	60	70	11.14
Cooperative	Team 13	79	68	60	69	9.54
Cooperative	Team 14	78	67	60	68.33	9.07