

**SUSTAINABLE LEARNING STRATEGIES FOR IMPROVING STUDENTS'
PARTICIPATION IN BIOLOGY TEACHING AND LEARNING PROCESSES:
A CASE OF LUTEETE SECONDARY SCHOOL**

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**A DISSERTATION SUBMITTED TO THE DIRECTORATE OF RESEARCH
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REQUIREMENT FOR THE AWARD OF MASTERS DEGREE IN
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DECLARATION

I, **Njogedde Juliet**, hereby declare that this thesis entitled, ‘Sustainable Learning Strategies for Improving Students’ Participation in Teaching and Learning Processes: A Case of Luteete Secondary School’ is my original piece of work and has never been presented before to any institution of higher learning for an academic reward.

Signature.....

Date.....

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APPROVAL

This dissertation entitled “Sustainable Learning Strategies for Improving Students’ Participation in Biology Teaching and Learning Processes: A Case of Luteete Secondary School”, submitted for an award of a Masters’ degree in Vocational Pedagogy was under our supervision.

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DEDICATION

To the Holy Spirit who has been my guide throughout this study.

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LIST OF ABBREVIATIONS

BOT	Beginning of Term Examinations
CBC	Competence Based Curriculum
CL	Cooperative Learning
CPD	Continuous Professional Development
EOT	End of Term Examinations
ESD	Education Sustainable Development
ESSSP	Education and Sports Sector Strategic Plan
FW	Future Workshop
MKO	More Knowledgeable One
MoES	Ministry of Education
MVP	Masters in Vocational Pedagogy
NDP	National Development Plan II
NHT	Numbered Heads Together
NRM	National Resistance Movement
PAR	Participatory Action Research
SDG	Sustainable Development Goals
SE	Sustainable Education
SESEMAT	Secondary Science and Mathematics Teachers
UCE	Uganda Certificate of Education
UNEB	Uganda National Examination Board
UNESCO	United Nations Education of Scientific and Cultural Organization
ZPD	Zone of Proximal Development

ABSTRACT

The purpose of this study was to improve participation of learners in classrooms through the use of Numbered Heads Together (NHT) and jigsaw strategies supported in cooperative learning (small discussion groups) at Luteete secondary school. The study was premised on the theory of social constructivism opined by Lev Vygotsky. A Participatory Action Research (PAR) design was used to carry out the study using qualitative methods of data collection that included: future workshop, focus group discussion, interviews, observation and document analysis. Twenty-five (25) participants were involved including an administrator, teachers, laboratory technician and students who were selected purposively. Findings of the study revealed, lecture method, demonstration, group learning and practical methods as the most employed approaches in the school. NHT cooperative strategy was more significant in engaging students qualified with improved individual scores, better communication, leadership, presentation, problem-solving and observation skills. In conclusion, teachers should defy the traditional teaching methods that render the learners passive, and take on active participation approaches which motivate learners in class and train them in employable skills in preparation for the world of work. The researcher recommends incorporation of suitable strategies such as project based learning and think pair share in cooperative learning to ensure participation of all learners in the classroom. Further studies should investigate the progressive assessment of each individual member in a group.

CHAPTER ONE: INTRODUCTION

1.0 Overview

This chapter presents the background to the study focusing on, ‘‘Sustainable Learning Strategies for Improving Students’ Participation in Biology Teaching and Learning Processes: A Case of Luteete Secondary School in Luweero District in Uganda’’.

The introductory chapter of this thesis focuses on; the background to the study, situation analysis, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, scope of the study and definition of operating terms.

1.1 Background to the study

The background to the study is organized in three sub-sections; background to the fields of vocational education and vocational pedagogy, personal background and experience, and motivation of the study.

1.1.1 Vocational education and vocational pedagogy

Vocational education is any type of training, usually in the form of courses and hands-on instructional lessons that teaches students the specialized skills required to perform a specific job (Indeed Editorial Team, 2021). In this definition, the term ‘‘usually’’ denotes that it may not always be the case that ‘‘vocational education discreetly involves courses requiring specialized skills to perform a specific job’’. The researcher wishes to suggest a definition in context to this study as; ‘Vocational education is the ‘‘hands-on’’ and ‘‘minds-on’’ learners’ experience in the teaching/learning process involved in the acquisition of knowledge and skills. It could be asserted that all education is about engagement in attaining of a standard which may be ‘academic’ or ‘vocational’ (Addis & Winch, 2019). Therefore, education can be taken as involvement with various forms of know that and know-how (Winch, 2010), and

this could be true about Biology as much as for Plumbing or Hairdressing. The differences are in how the knowledge is organized whether academic or vocational and the diversity of methods used to ensure learner's participation (Young & Hordern, 2022).

On the other hand, vocational pedagogy is defined as a learner-centred approach to teaching and learning in which the relation between the student and the task is central (Mjelde, 2013).

According to Lucas (2014), vocational pedagogy is the totality of all choices that vocational teachers make while they instruct, modifying their methods to suit the demands of their students and the environment at hand. Team (2019), clarifies that vocational pedagogy inspires the methodology, tools and models to be used by the teachers in order to impart theoretical and vocational knowledge more effectively. In the researcher's view, vocational pedagogy is that thoughtful and purposeful approach of the teacher of how best the learner will interact with the content to make meaning out of it.

The core of the learning process is, 'learning by doing', because learning is perceived as something a learner does (Applebaum, 1992), and not something done to the learner.

Applebaum affirms that one learns best when he/she is involved in an activity.

In Uganda, the education system had for long produced graduates trained for the white collar jobs and as such, trained using traditional teaching methods. The resultant graduates were inexperienced, half-baked, so naïve and therefore incompetent in the world of work (Wandero, 2020). In my own opinion, traditional teaching methods deprive its subjects of wholesome transformation that education is expected to give, and thus results in inexperienced, timid, dull and unproductive graduates.

Therefore, the integration of several local and international policies came to the rescue of the obsolete, abstract and poorly adaptable education curriculum in Uganda's education system. The policies included: UNESCO Education Strategy (2014-2021), Uganda Vision 2040, NDP, SDG 4, National Development Plan (NDP) III, National Resistance Movement (NRM) Manifesto (2016-2021) (Wanyama, 2021) and Education and Sports Sector Strategic Plan (ESSP) (2017-2020). This body entrusted the Ministry of Education and Sports (MoES) through the National Curriculum Development Centre (NCDC) to review the lower secondary curriculum to foster deep learning by putting the learner at the centre of the learning experience (NCDC, 2018). The new curriculum had to transit from knowledge based curriculum to a competence and skill based curriculum which aims at employing learner-centred rather than teacher-centred approaches. This is because learner-centred approaches are so instrumental in making the learner active during classroom activities. Similarly, this fleshy curriculum is to see Uganda in good progress towards SDG 4 that aims to see inclusive, equitable, quality education. By quality education, the Education Sustainability Development body under SDG believes teachers to employ an action-oriented transformative pedagogy (Byun, Heiss, & Leicht, 2018).

According to Lucas (2014), all educational systems strictly depends on the quality of instruction provided in the classrooms, workshops, laboratories and other settings where learning takes place. The real answers to improving the end products of vocational education lies in the 'classroom', in understanding the many decisions teachers take as they interact with the students, which decisions likewise influence students to interact with the content.

Conceptualizing Sustainable Learning Strategies and Students' Participation

To meet the SDG 4 goal, the NCDC (2018) designed a competence and skills based curriculum for lower secondary school whose objectives are suitably achieved in small discussion groups. So classes were structured into small discussion groups, where members collaborate in accomplishing classroom tasks (Cooper, J., et al 2023). This practice is termed cooperative learning, where a variety of cooperative learning strategies are applied to encourage students' effective collaboration (Corebima, 2017) during knowledge construction. These cooperative learning strategies must be practical, maintainable and offer lifelong skills to students to constitute sustainable learning strategies. In this study, two of these strategies were exhibited including numbered heads together (NHT) and jigsaw. With numbered heads together strategy, in a six membered group, each student assumed a number from 1 to 6. The students worked as a team to solve a problem and ensure that all members understand it. Afterward, the teacher randomly called out a number and the person with the number explained how the team solved the problem (Hunter, 2013). On the other hand, jigsaw strategy involved the teacher splitting the days content into segments. Each student received a segment to read, learn and later teach other group members.

Furthermore, cooperative learning involves group members making contributions in the event of knowledge construction (Johnson, et al, 2014). Lange, et al (2016) cited Dewey (1916), who claimed that knowledge is inseparable with participation through experiences. Lange, et al (2016) also cited Vygotsky (1978) who envisaged that knowledge can be socially constructed by students through participatory interaction with others. Additionally, within cooperative learning, it has been shown that learners' achievement levels increase the more actively they participate (Tsay, M., & Brady, M, 2012). Therefore, this study targeted students' participation as a way of effective knowledge construction, thus content mastery,

through deliberate activities such as students' contributions, cooperation, asking questions, homework completion, notes making, manipulation of apparatus, discussions, plenary presentation and facial expression. Such attributes denoted that students were interacting with content/ task (Mjelde, 2013), thus making meaning out of it. In this study, participation is synonymous to involvement, engagement and active learning.

1.1.2 Personal background and experience

The researcher is a graduate teacher of Biology and Chemistry with a reasonable serving experience in the teaching of Biology at Luteete Secondary School. In her years of teaching, she had an opportunity of training with Secondary Science and Mathematics Teachers (SESEMAT). SESEMAT was a Ministry of Education and Sports (MoES) organisation that annually held continuous professional development workshops (CPD) for all Science and Mathematics teachers since 2005 (Komakech, 2014) with the purpose of improving the teaching ability of science and mathematics teachers in secondary schools. The core value of SESEMAT was to encourage learner-centred approaches in the teaching/learning process of mathematics and sciences, after a realisation of poor performance in science and mathematics subjects in national examinations. This poor performance was envisaged to be due to teacher-centered methodologies (Anziku, 2016). The SESEMAT training workshops were based on the principles of an Activity based, Learner-centred, Encouragement, Improvisation (ALEI) lesson plan. The researcher joined SESEMAT organisation as a trainee in the year 2009 but was later promoted to a regional trainer in 2011.

As a trainee in SESEMAT, the researcher found the workshops helpful and meaningful, because it advocated for 'hands-on' and 'minds-on' activities in the teaching/learning process which enhance students' cognitive achievement (Sulaiman & Thakur, 2022). However, this

approach demanded more time for implementation than that allotted for the subject on the school timetable, yet Biology has a wide syllabus. In addition, inadequate instructional materials and large classes, led to minimal impact of the wonderful intentions of SESEMAT (Anziku, 2016). Besides, the school administration tirelessly demanded for completion of syllabus. So, the teacher-centred approaches were more popular in classroom activities (Schweisfurth, 2011), which rendered the learner passive in the teaching-learning process.

As regional trainers in SESEMAT, the researcher and her colleagues used to make impromptu school visits to find out whether science and mathematics teachers were implementing the ‘hands on’ and/or ‘minds-on’ active learning in their lessons as directed during SESEMAT INSET workshops. Unfortunately, majority of the teachers would only stage the “hands-on” activities; for example, one would witness a teacher panicking to collect a few apparatus, putting them together to forge a practical lesson. This meant that teachers were not ordinarily employing learner-centred strategies in their lessons (Carla, Johnson, & Manx, 2018). More so, in the researcher’s personal experience as a subject teacher, she found herself compelled into teacher-centred approaches due to the tireless demand to complete the syllabus by administrators. However, the researcher kept on being haunted by the unending teacher-led methodologies thus was pushed into seeking audience with MVP programme. The researcher hoped for a possible remedy in learner centred approaches that override the various challenges encountered by the teacher yet influencing the learner in the teaching/learning process.

The researcher’s enrolling for Masters in Vocational Pedagogy exposed her to modules like teaching and learning processes in vocational pedagogy where she was trained in exploration

of learning processes and experiences, problem identification and research activities, vocational pedagogy in working life and schools, field work, working in learning groups only to mention but a few. Exploration of learning processes further exposed the researcher to an extensive study of learning methods, especially working in learning groups. It was emphasized that for the teacher to facilitate learning groups, every student must be given a chance to contribute in the discussions without getting a ‘free-ride’ (Child to Child-Uganda, 2018). A ‘free-ride’ is an individual in a group who gains from the efforts of other group members’ contribution without putting in his/her own efforts (El Massah, 2018). These ‘free-riders’ in learning groups are checked by using cooperative learning strategies within cooperative groups such as Numbered Heads Together(NHT), jigsaw, think pair share strategies. These cooperative learning strategies are known to foster effective teaching (MoES, 2005), by ensuring participation of all learners in a small discussion group. The collaboration of all these virtues endowed the researcher with the authentic working tools into learner-centred pedagogies. The thorough equipment and richness of a variety of attributes in MVP enabled the researcher to successfully conduct this action research project.

1.1.3 Statement of Motivation

A results orientated teacher would desire to know the trend of performance in the subject in national examinations. In this vein, the researcher as an academic staff in the school accessed Uganda Certificate Education (UCE) Biology results of the four preceding years to the future workshop. Table 1 showed the UCE Biology results with candidates who scored between D1 – C6 from 2014 to 2018:

Table 1: UCE Biology results for the four preceding years to the future workshop.

Year of UCE sitting	Percentage pass between D1-C6
2014	56
2016	09
2017	21
2018	22

UNEB: Luteete secondary school UCE results

The Uganda National Examination Board (UNEB) UCE results revealed an unsatisfactorily below average performance in Biology. This challenge could possibly be due to methods employed by teachers in the teaching/learning process or from any unbecoming attributes of the students. Fortunately, my study in the field of vocational pedagogy introduced me to action research as a problem solving approach in communities. Action research is solution based in that the researcher together with the stakeholders convene to identify a challenge and its underlying cause, and lay out strategies for redress, implement the strategies and evaluate the effectiveness of the strategies (Cresswell, 2009). The researcher therefore brainstormed with the stakeholders in the department to identify and implement strategies for improving the performance of learners in Biology.

1.2 Situation analysis

Situation analysis is a process carried out in any organization to identify its strengths, weaknesses and opportunities (Guthrie, 2022). Guthrie encourages this exercise, to analyse the products and services of that organization, rendered to the society even as ideas are being gathered of how to make positive progression. In Luteete secondary school, the researcher carried out a situation analysis of the teaching and learning process employed in the

department of Biology, to identify gaps responsible for poor performance in Biology for UCE results. These gaps were established through: interviews with the teachers and technicians in the department, a focus group discussion (FGD) with students, teachers, technicians and administrator and an analysis of the work process involved in the production of students.

The situation analysis revealed the following: students dodging lessons, coming late for classes, sluggishness in completing assignments, too much Biology notes, difficult Biology technical terms, lack of remedial lessons, incomplete syllabi, large classes, inadequate instructional materials, very few lessons on the time-table and uninterested students.

The interviewees elaborated on some of the challenges thus: One of the teachers commented that lack of adequate equipment impedes practical method which would have made Biology better understood by the students. Students are then left with rote learning as a way of presenting Biological concepts. One other colleague complained of the way students refrain from doing assignments. He reported that learners detest assignments to the extent of rather missing classes in anticipation of teachers requesting for homework assignment. More still, students decried Biology as a very wide subject with too much notes to copy and read. One learner said,

“Somehow I get disgusted about the bulky notes with complicated terminologies, and may decide to revise other subjects, but by the time I choose to concentrate on Biology it will be too late to evoke understanding, so I end up cramming the Biology. Therefore, my grades in Biology have been so poor, making me loose interest in the subject”.

From this situation analysis, stakeholders agreed to improve performance in Biology by addressing students' motivation towards the subject. This was the basis of conducting a future workshop (FW) as shown in figure 1.



Figure 1: A future workshop meeting showing teachers and learners participants.

Source: Field data (2022)

The FW tool which is highly employed in action research was developed by Robert Jungk (Jungk & Mullert, 1987). Jungk and Mullert defined a future workshop as a technique to address real-life problems by discussing unfavorable circumstances in the community and by dreaming about a better future. Therefore, a future workshop was planned and organized in the staffroom. The future workshop was used to engage the cause identified to poor performance (uninterested students) and lay strategies for making students motivated in the teaching/learning process.

According to Vidal (2006), FW consists of five (5) phases namely: The preparation phase, critique phase, fantasy phase, reality phase and follow-up phase. The preparation phase is concerned with organization, planning and management of the workshop. In the critique phase, a question is generated from the situation analysis and challenges identified. The causes of the challenges are brainstormed, clustered and presented to the next stage. Fantasy

phase has the clustered ideas exaggerated into future possibilities. In the reality phase, prioritization of the most implementable possibility is done, implementation strategies are developed and it ends with an action plan that specifies who does what, where, when and how. Then finally, the follow up phase involves monitoring the action plan, looking out for any changes if they are feasible and then planning for a new future workshop if need be.

Preparation Phase: An introductory letter from the MVP Program Kyambogo was submitted to the school administration by the researcher (See Appendix 1). The purpose and sitting of the FW was discussed with the administrators. The researcher invited the stakeholders (Appendix II) including the Head of Biology Department as an overseer of the subject in the school, director of studies to represent the administrators, teachers as key personnel in facilitating the teaching and learning process and students as immediate beneficiaries of this study. The researcher briefed the stakeholders about the purpose of the future workshop, explained the ground rules to be followed and introduced the critical question;” Why is there less involvement of students in the Biology classes?”

Critical Phase: The participants critically and thoroughly investigated why students were less involved in the teaching/learning process of Biology. Brainstorming on the critical question yielded a good number of issues which were clustered into the following sub themes;

Lack of interest in students, lack of proper balance between theoretical and practical teaching, teachers overlooking slow learners, lack of team work amongst teachers, poor student-teacher relationship, lack of revision questions and specimens, bright students refusing to help slow learners, tired students as a

result of walking long distances and failure of parents to provide practical dissecting kits to their children.

Fantasy Phase had stakeholders believing beyond all possible constraints that the desirable is achievable and therefore turning the negatives into positives thus: *students are interested in the subject, there's proper balance between theory and practical teaching, there is team work amongst teachers, there is good student- teacher relationship, Question bank books and specimens are available, bright students are willing to help slow learners and parents provide practical dissecting kits to their children.* Stakeholders went ahead to brainstorm objectives to achieve the desirable situation.

For students to acquire interest in the subjects, stake holders suggested that small discussion groups would enable students to interact amongst themselves, exchanging ideas about Biology to improve their understanding, thus making students interested. Students understanding of the subject would foster research and stimulate them into higher order thinking skills. For proper balance between theoretical and practical teaching, it was suggested, hands-on activities conducted alongside theory to enhance better understanding that the myth of congesting practical lessons in candidate classes comes to an end.

To encourage teamwork amongst teachers, it was suggested teachers to make joint scheme of work and notes, switching topics in accordance to who can better deliver and encouraging students to consult all available departmental teachers. With good student- teacher relationship, stake holders suggested to introduce students to guidance sessions to make them realize the relevance of close relationship with their teachers. Teachers were also encouraged to endeavor closing the gap by securing time to build the relationship.

For availability of question book banks and specimens, stakeholders suggested guidance sessions conducted on how to effectively benefit from the available question book banks, and for teachers to make requisitions early enough to allow proper procession. Improvisation with local materials and cost- sharing would also be feasible to avail the necessary specimens. For bright students to help slow learners, small discussion groups were suggested to ease the understanding of the subject.

Reality Phase: Stakeholders went ahead to group the generated innovations into short-term and long-term solutions where short term would require minimal resources and time to be effected. The short term solutions included the : (1) Teachers to integrate practical activities within theory (2) Providing career guidance to the students (3) Inquisitive teaching skills methodologies (4) Establishing small discussion groups (5) Re-streaming classes. The mentioned interventions constituted the idea store captured in Appendix III.

Stakeholders prioritized the short term solutions and selected small discussion groups through the pairwise ranking (See Appendix IV). It was believed to enable fast learners assist slow learners in understanding content, give voice to ideas of all individuals in the group to build their confidence, as interest is also building in the learners.

In addition to the selected small discussion groups, the endowed researcher with MVP program virtues, sensitized stakeholders of the use of group learning strategies which ensure active participation of all students within a group. This sensitization is in line with what Vidal (2006) pointed out, that more information may be required in form of expertise for an effective implementation phase to be realised. Stakeholders were sensitized about the various learning strategies, their explicit purposes and mode of operation within small discussion groups. Several learning strategies were discussed and stakeholders finally picked on

numbered heads together (NHT) and jigsaw cooperative learning strategies. Stakeholders chose the two learning strategies, because they are cost effective and simple to implement in the Luteete context.

Then the researcher together with stakeholders brainstormed and came up with action points towards engaging learners in the teaching and learning process using NHT and jigsaw strategies (Appendix V). The strategic action points were graded following the objectives of the study.

1.3 Statement of the problem

Learner-centred methodologies in the teaching and learning process stimulate learners into active participation in classroom activities, to enable knowledge construction. However, the outcomes of learner centred approaches advocated by SESEMAT through activity-based, learner centred, encouragement and improvisation (ALEI) lesson plans took teachers back to teacher centred methodologies leading to demotivated students. In the future workshop held, it was deduced that the critical issue that needed to be solved was the uninterested students. The study therefore sought to use NHT and jig saw strategies supported in cooperative learning (small discussion groups) in order to address the uninterested learners into active participants during the learning process.

1.4 Purpose of the study

The purpose of this study was to improve participation of students in the teaching/learning process, through the use of NHT and jigsaw strategies supported in cooperative learning.

1.5 Objectives of the study were:

- i) To assess the current methods of teaching and learning of Biology in Luteete secondary School
- ii) To adapt active participation learning strategies, NHT and jigsaw in cooperative groups.
- iii) To implement the adapted active participation strategies in cooperative learning.
- iv) To evaluate the outcomes of these cooperatives learning strategies in cooperative learning.

1.6 Research questions

The research questions to this study were:

- i) What are the existing teaching and learning processes of Biology in Luteete Secondary School?
- ii) Which adapted active participation learning strategies enhance students' participation during teaching and learning of Biology?
- iii) How are the adapted learning strategies utilised to enhance students' participation in the teaching and learning of Biology?
- iv) What is the outcome of utilising the adapted learning strategies in the teaching and learning of Biology?

1.7 Justification of the study

Since 2009, after SESEMAT gained national expansion, science and mathematics teachers have been attending annual continuous professional development workshops that emphasize learner-centred approaches. In addition to this, the school termly conducted academic parades on which the best and worst students were publically rewarded and every term, BOT and EOT

were conducted to ensure constant revision. All such efforts in the school, aimed at enhancing students' performance did not yield fruitful results in the learners' performance in Biology as revealed by UNEB, UCE Biology results in section 1.2.2. On the contrary, no one has ever conducted an action research on students' learning, or even ever dared employing learning strategies within cooperative groups as a teaching method in the school. This study therefore focused on ensuring students' engagement using NHT and jigsaw strategies in cooperative learning, to increase their participation, in order to foster effective learning.

1.8 Significance of the study

The study greatly improved the learners' participation in classroom activities which resulted into several benefits including: improved individual scores especially of the low and average achieving students, improved communication, leadership, presentation, problem-solving, manipulation and observation skills, improved relationship between learner and teacher, stimulated students' desire to employ cooperative learning in other science subjects and challenged the high achieving students into considering cooperative learning. The study also improved on the researcher's competences to conduct research and stimulated her intrinsic desire to explore more learning strategies which engage all students during cooperative learning. It also stimulated colleague teachers into adoption of cooperative learning strategies that ensure engagement of all students in the teaching/learning process.

This study also informs other teachers and educational institutions to incorporate strategies within cooperative learning especially in the new lower secondary school curriculum so as to engage all students in a group in the process of knowledge construction. It also enlightens the government of Uganda, MoES and local schools to tighten supervisory measures of ensuring

implementation of learner-centred approaches at classroom level, since a majority of teachers are so bent on traditional teaching pedagogies. More still, it informs teacher training institutions to integrate cooperative learning and strategies in the pre-service curricular of training teachers.

1.9 Scope of the study

This study was organized under three sections as follows:

1.9.1 Content scope

The study was limited to ensuring active participation of learners in the teaching/ learning process. This was achieved through dividing learners into heterogeneous small groups within which two strategies, NHT and jigsaw, were employed to encourage learners into active participation during the teaching/ learning process. NHT strategy is a unique teacher questioning technique where all learners must have answers to the questions. Jigsaw strategy prepares a learner to teach other learners. The effect of these two strategies on the learners' participation was then evaluated.

1.9.2 Geographical scope.

The study was conducted at Luteete Secondary School located in Luweero District, Bamunanika County, Bamunanika subcounty, approximately 42 miles on Gulu road in Uganda. Choice of this location was in support of one of the principles of action research which advocates for improvement of workplaces and communities where the researcher works or resides.

1.9.3 Time scope of the study

This study was conducted from March 2021 to December 2022, when students were actively involved in the learning process.

1.10 Limitations of the study

The greatest challenge that was encountered in this study was the limited number of periods assigned to Biology subject on the school time table. Biology experiments usually operate within a given, specified time frame. On several occasions, a lesson would end before the observations were recorded robbing the learner of chances to manipulate material and thus affecting the building of knowledge. However, it was democratically decided, learners to record observations of experiments outside the stipulated lesson time. We improvised by using time allocated to library use, guidance and counseling on the school time table or time after classes.

1.11 Definition of operating terms

Cooperative learning strategy: Is a set of unique procedures designed to ensure active engagement of all learners within a small group.

Numbered Heads Together: Is a cooperative learning strategy, which motivates and compels all learners to have answers to the teacher's question.

Jigsaw: Is a cooperative learning strategy where a learner is prepared to teach other group members.

Learning: Is the active participation of a learner in classroom activities to enable knowledge construction.

Teaching: Is the art of guiding or facilitating a learner into construction of his/her own knowledge.

Biology: Is the study of life through social interactions of learners within a group.

Participation: Is the act of being involved with others in doing something. It is synonymous with: engagement, involvement, cooperation, motivation and sharing.

Sustainable: Is the ability of a cooperative learning strategy to uphold/maintain active participation of learners to enable knowledge construction as well as equipping learners with soft skills such as cooperation, critical thinking, problem solving and communication.

CHAPTER TWO: LITERATURE REVIEW

2.0 Overview

This chapter presents the scholarly literature on the underpinning theory behind the study and the four objectives guiding the study namely; teaching methods used in Biology education, the adapted cooperative strategies, cooperative learning and the effect of NHT strategy on the teaching/learning process of Biology.

2.1 Theoretical Framework

A teacher's vital role in the teaching and learning process is to guide, facilitate or mentor the learner to construct knowledge rather than transmitting knowledge. According to Mazarin (2015), a teacher is a guide in the learning process who encourages learners to own their learning and facilitates them to construct their own knowledge.

This study was based on Lev Vygotsky's social learning theory. Culatta (2019) revealed that the major idea of Vygotsky's theory lies in social interaction which is fundamental in the development of knowledge.

Schreiber & Valle (2013) cited Vygotsky (1978) that every child's cultural development appears twice; first on the social level and later on the individual level. At the social level the child interacts with other people (parents, peers, teachers) and at individual level, the child processes the perceived or discussed information inside him/her through reflection. He further mentioned that much important learning by the child occurs through social interaction with a skillful person. This skilled person's behaviors may be appealing to the child or he/she gives instructions to the child. Vygotsky referred to this as cooperative dialogue. The child then reflects on the behaviors or instructions provided by the skilled person (parent or

teacher), internalises the information, using it to guide or regulate their own performance (McLeod, 2016). In this way, the child makes meaning (knowledge) out of the behavior or provided instruction. This qualifies the chosen theory relevant to the study because it supports group learning, an action suggested in the future workshop to enhance students' active participation. McLeod (2016) said, in this theory of knowledge development, two main principles are paramount; the More Knowledgeable One (MKO) and the Zone of Proximal Development (ZPD).

Vygotsky referred to the MKO as someone with better knowledge or experience about particular concepts than the learner. However, this MKO may be the teacher, parent, child's peer or an adult's children.

He related the MKO with the second important principle, the Zone of Proximal Development, where the Zone of Proximal Development is the difference between what a child can achieve on its own and what a child can achieve with guidance from a skilled partner. The ZPD is the stage at which the MKO gives guidance or instructions to evoke discussions, debates, explanation, reasoning, manipulation of apparatus, and application of technology to facilitate the process of knowledge construction. ZPD is demonstrated in figure 2.

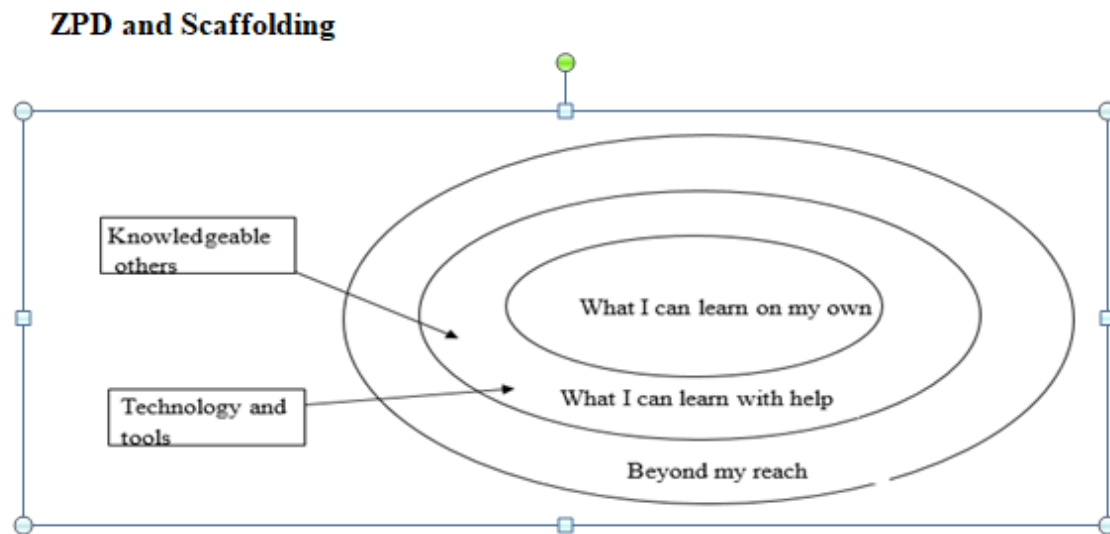


Figure 2: Showing ZPD and scaffolding (Wheeler, 2003)

Vygotsky (1978) saw the ZPD as the area where instruction or guidance should be given to the child allowing it to develop skills they will use on their own. Vygotsky believed interaction between peers to be instrumental in developing skills. He suggested that teachers use cooperative learning exercises where more competent child develops with less competent child - within the zone of proximal development. The two concepts, the MKO and the Zone of Proximal Development merge in a dialogue, a phenomenon demonstrated in exchange of ideas, which ideas after being processed by an individual will produce knowledge. In a classroom environment, such dialogue can be accomplished in group work where activities are performed through the guidance of a facilitator.

However, there are two major types of constructivism theories implementable in the classroom (Kalina, 2009); cognitive or individual constructivism pioneered by Piaget's theory and social constructivism depending on Vygotsky theory. According to Akpan (2020) Piaget's cognitive constructivism theory takes knowledge as what students

construct by themselves based on experiences they gather from their environment. Piaget emphasized that it is the student who is of paramount importance in knowledge construction, and not the environment as Vygotsky puts it (Iftikhar& Khan, 2016).

However, in agreement, all constructivists hold that the development of understanding requires active engagement of the learner (Jenkins, 2000). In other words, one of the most common ideas of constructivism that runs across all definitions is the notion that development of understanding requires the learner to actively engage in meaning-making. Thus constructivists are more inclined on how the learner arrives at the solution than the solution itself. The common core of constructivist theory is that we do not find knowledge, we construct it. The task of the educator is not to dispense knowledge but to give students opportunity to build it up (Glasserfeld, 2005).

Kelly (2012) as cited by Akpan (Akpan et al, 2020) suggested that social constructivism could be applied in the classroom using such instructional methods as case studies, research projects, problem-based learning, brainstorming, collaborative learning, group work, guided discovery, learning simulations among others. Kalina (2009) further wrote that to run an effective classroom, a teacher ought to employ methods of both cognitive and social constructivism.

2.2 Teaching methods used in Biology education

Teaching and learning methods are various instructional strategies employed by teachers to achieve the desired lesson objectives (Jeronen et al, 2017). More than twenty teaching methods are known to facilitate the teaching/learning process in Biology. Choice of a given teaching/learning method or strategy to be used in given lesson may be influenced by several notions including level of students, topic or subtopic, complexity of content, availability of

instructional materials or human resource, objectives of the curriculum, policies governing the education system and the nation at large.

2.2.1 Teaching methods used in Biology education globally

Globally, education is guided by a set of principles established by United Nations Education, Scientific and Cultural Organization (UNESCO) in collaboration with other international bodies. Since 2005 to-date, the principles guiding education embedded in the Sustainable Development Goal (SDG) were adopted to end poverty in all its form by 2030 and to balance the three dimensions of sustainable development, the economic, social and environment (Avila, 2019).

This SDG aims at merging principles, values and practices of sustainable development into all aspects of education and learning (UNESCO, 2009). According to UNESCO (2016), education for sustainable development is about empowering people with skills to harness global challenges. Learning in education for sustainable development usually ensures that the learner attains knowledge, understanding, skills, values and right attitudes related to sustainable development. Such attributes offer learners the urge to actively participate in solving societal challenges with a concern about the environment and economic systems. Therefore, values of environmental conservation are instilled in learners which are later harnessed at opportune time. Jeronen et al (2017) reveals that, in Finland sustainable education principles are embedded in the curriculum for basic education at all levels.

When Biology education is given in relation to Sustainability Education (SE), teaching methods such as experiential, collaborative, problem-based learning and computer assisted

methods are employed, contrary to the traditional methods of teaching which encourage passive learning leading to memorization by students.

Consequently, Scotland took up to outdoor education embracing approaches such as outdoor learning, experiential learning, teaching by projects and other active pedagogies, giving rise to a more interactive education system (Scottish Government, 2014 cited by Agirreazluenaga 2020). Currently, Scotland has evidence of excellence in its curriculum because of outdoor learning.

In Finland, an investigation to find out students' performance and attitudes to learning Biology in 97 secondary schools showed that learner-centered approaches such as inquiry-based learning and collaborative learning enhanced performance and a positive attitude to Biology as a school subject (Karna, 2014). However, teacher centred methods correlated most strongly with the liking of Biology as a school subject. It was recommended teachers to use the most appropriate methods to optimise students' involvement in the class for a more meaningful learning process (Krapp, 2011).

2.2.2 Teaching methods of Biology education in Africa

The SDG principles flow through continents, regions, nations and specific local areas where humans impact the environment (Nations, 2016). This is because, integrated with social and economic development, all individuals are entitled to an ecologically stable environment. Therefore, education is demanded of knowledge on how to sustain this environment, which constitutes life- long learning, embedded in transformative pedagogies (Boeren, 2019).

In South Africa, Colleen (2015) reported a shift to active learning methods with a first-year Biology course. In this investigation, a reduction in the number of lectures visa vie an

increase in cooperative learning approaches in tutorials left a preference to practical-based learning by both students and staff.

Ajaja (2013), in Nigeria, realised a decline in interest among science students which was attributed to the transmissive method of teaching. This unhealthy development sparked a search for alternative teaching methods that stimulate interest in students. Lack of contentment with the employed lecture methods drove the researcher into Sustainability Education that emphasizes methods that enhance active participation of students in knowledge construction. Findings showed that concept mapping, cooperative learning and learning circles had significant effect on student's achievement, while lecture method produced no significant effect.

Mwangu (2017), in Zimbabwe, unveiled challenges encountered in attempts of conducting practical lessons alongside theory. Factors such as unavailability of science teachers in schools, shortage of text books, lack of allocated practical lesson time and irregularities of carrying out practical Biology lessons by teachers, affect students' performance and understanding (Ahmad, 2014). Again, some teachers stuck in traditional teaching methods like "chalk and talk" which does not boost the teaching and learning of Biology. This laxity in using activity-based approach of instructional delivery has made Biology become abstract resulting in making students passive and more inclined to rote memorisation (Chinwe, 2012).

2.2.3 Teaching methods of Biology education in East Africa

In Kenya, Njiru (2012) reported a perpetual decline in performance in science subjects, caused by the negative attitude of students, the type of national curriculum followed, the unreadability of textbooks and the kind of pedagogy approaches employed by teachers. That

teachers focused on methods geared towards syllabus coverage and ignored hands-on activities. In such a scenario the government of Kenya in collaboration with the government of Japan through JICA, started a project SMASSE, to strengthen mathematics and science in secondary education. Unfortunately, even after twenty years of project implementation, teachers were still locked in the transmissive method.

Paulo and Tilya (2014) said, classroom teaching in most secondary schools in Tanzania has remained traditional contrary to the once introduced competence based curriculum (CBC), way back in 2005. This CBC had the following mandate: training teachers in pre and in-service on the principles of CBC, formative assessment process done formally and informally before, during and after the learning process (Wisselink, 2007), using authentic assessment such as portfolios, interviews, performances, writing essays and peer assessment (Kouwenhoven, 2003), provision of continuous, timely and constructive feedback to learners (Black, 1998).

However, Timothy (2011) cited in Paulo and Tilya (2014), revealed that only a handful of teachers received the in-service trainings and the pre service trainings in teachers' colleges were taught theoretically. This means that most secondary school teachers had low understanding of the revised curriculum. Other factors which contributed to the collapsing of the revised curriculum included: the CBC then, employed more of behavioristic approaches other than constructivism approaches, large class size (Shemwelekwa, 2008), shortage of time, lack of learning resources relevant for implementation of CBC such as textbooks, laboratory supplies and equipment, models and charts (Kahwa, 2009). This resulted into use of traditional teacher-centred methods along with paper and pencil forms of assessment (Paulo, 2014).

2.2.4 Teaching methods of Biology education in Uganda

Uganda's education system has been greatly influenced by the examination systems (Weerhe, 2007) to the extent of teachers rejecting learner-centred approaches so that they can drill and coach students to pass the national examinations. These were findings of a study carried out in the Central region of Uganda within Kampala city area (Bakaira, Maani & Otaala, 2013). Data showed that most teachers reported employment of learner-centred teaching methods such as demonstration, group work and practical lessons. However, students did not provide evidence of the use of learner-centred methods. Teachers largely engaged lecture method with dictated notes. Some teachers claimed that these were the methods university lectures used to teach them.

2.3. The adapted cooperative learning strategies.

The term “cooperative learning strategy” is used interchangeably with cooperative learning model (Corebima, 2017), group learning structure, cooperative learning structure (Theodore, 1999; Baker, 2013) and cooperative learning technique (Lee et al, 2018).

According to Corebima (2017), a cooperative learning model encourages the students to cooperate in a group so well that it creates meaningful learning process and enhances the students' cognitive achievement. Theodore (1999) said that cooperative learning structures are a creative manner of organizing effective social interaction amongst learners in the classroom. The researcher's opinion about cooperative learning strategies is that it is a set of steps undertaken by students working in groups, guided by the teacher, to cause effective student interactions as they construct knowledge.

A variety of cooperative learning strategies, following student-centred approach, are promising tools in active learning, such as project based learning (Gavin, 2011), flip teaching (Bergmann, 2012), student teams achievement divisions (STAD) (Lim et al, 2016), think pair share (Lee et al, 2018), jigsaw (Hernandez-Perez et al, 2020), snowballing effect (Duraman et al, 2015), thinking aloud pair problem solving (Kani & Shahril, 2015), team games tournament (Astarini et al, 2019), numbered heads together (Hunter, 2013) and many more others.

Kagan (1990) said that the most important considerations for choice of a strategy to employ in a lesson are:

1. What kind of academic competence(s) does it foster?
2. What kind of social skills does it foster?
3. Where in the lesson plan does the strategy best fits?

Because each structure has distinct usefulness and can more efficiently reach some but not other academic and social goals, the efficient design of lessons involves using a variety of strategies, each chosen for goals it best accomplishes. Reliance on any one strategy, limits the academic and social learning of students.

This study focused on numbered heads together and jigsaw cooperative learning strategies to enhance participation of learners.

2.3.1 Numbered heads together cooperative learning strategy

Numbered heads together (NHT) was first developed by Spencer Kagan in 1992. It is a strategy that makes each student responsible for learning the material. It aims at improving reading comprehension (Wilanda & Iman, 2017). Since Biology is a subject where

comprehension is imperative, NHT suits the purpose. NHT is a teacher questioning strategy that compels all learners to actively engage in effective collaborative discussions (Kagan, 1992) while increasing their academic scores and behavioral outcomes (Hunter & Haydon, 2013).

NHT cooperative learning strategy has several advantages including: improving learning achievement, curiosity, self-confidence (Karen & Evans, 2012), team work, communication between students and helps students learn to use courtesy and respect (Isjoni & Ismail, 2008).

According to Kagan and Kagan (2007) NHT challenges every member of the group to listen carefully, participate maximally to ensure that all understand and can adequately represent the group. NHT gives priority to group work rather than individual work so that students work in an atmosphere of mutual cooperation and have more opportunities to distribute information and to improve communication skills (Corebima & Nursyamsi, 2016). NHT is supported in group learning and the purpose of the grouping is learners, to be actively involved in the thinking process and the learning activities.

NHT compels the engagement of all learners in the teaching/learning process and discourages the voluntary hand-raising practices that have dominated Uganda's education for a long time (Hunter, 2013). Thus decreases dominance from clever students so that student's equal participation is more apparent (Faryadi 2007 cited in Almuslimi, 2016). Teachers' use of NHT can increase active student engagement, enhance student's motivation to learn and so improve students learning (Kagan & Kagan, 2009). It also encourages peer tutoring from smart students who explain the answers to other (Stigmar, 2016).

However, NHT makes the class atmosphere noisy due to large number of students, it is time consuming, renders some students free-riders in the group, students lack confidence in presentations and students interfere with each other (Harini, Retno & Tri, 2018).

2.3.2 Jigsaw II Cooperative Learning Strategy

According to Gambari& Yusuf (2017), in Jigsaw II cooperative instructional strategy, students are assigned to six member heterogeneous teams to work on academic materials. To begin with, all students are assigned to study and understand the basic concepts of the subject content from a textbook or any other desired source. Later each student receives a segment/section on which to become an expert. Students with the same segment meet in expert groups to discuss their topic, after which they return to the home/original group to teach what they have learnt.

Then students take group or individual quizzes or a group activity that result into a team score (Slavin, 1986) or the teacher collects a written record of each group and creates a master document. The whole process is summarised in figure 3.

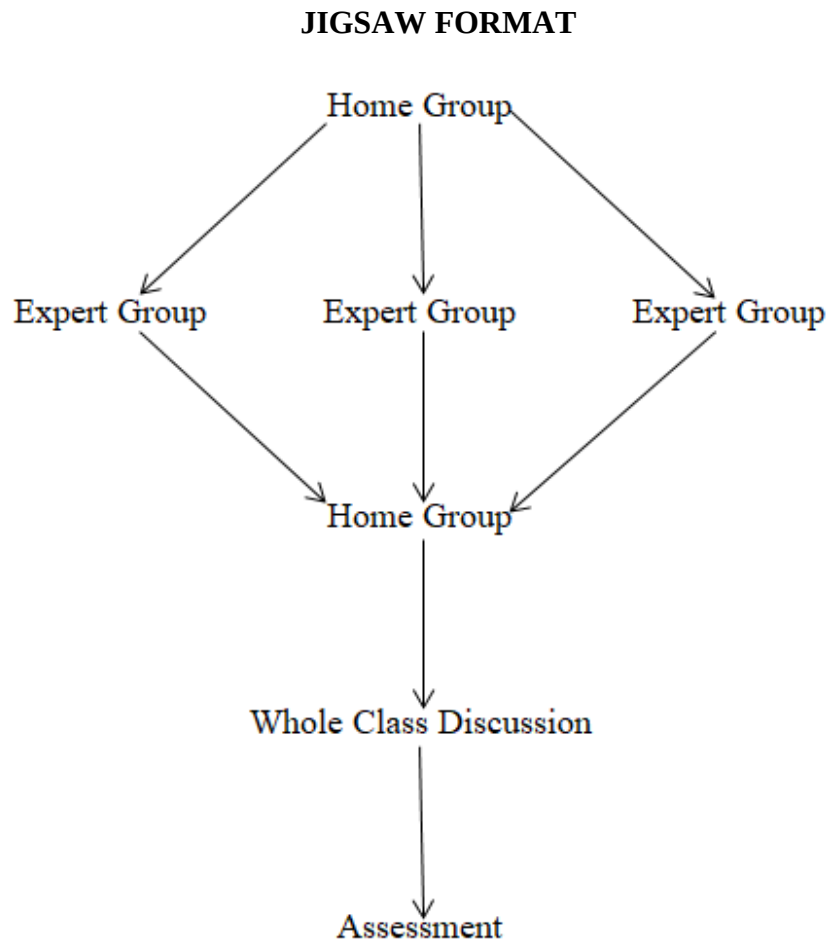


Figure 3: Jigsaw cooperative learning process (Colosi & Zales, 1998)

It is a student-dominated learning process where learners are able to construct their own knowledge with the guidance of the teacher.

Jainal (2021), cited Winslow, (2020) who said that using jigsaw in the classroom has many effects such as improvement of academic performance, higher self-esteem, it is motivating and causes the learner like school more. Dingel and Huq (2013) points out that Jigsaw II provides no room for free riders during group discussions and it is shown to create active learning. This active learning is known to make students meaningfully engaged cognitively and emotionally with other students, thus collaboratively creating knowledge.

Nevertheless, Jigsaw II cooperative strategy is not free from drawbacks. Learners may master their own portions but fail to teach it to their team mates (Slavin, 1995), or an expert group may fail to make meaning out of the given portion because of limited exposure to materials (Wittwer, 2008). This may create gaps in knowledge construction leading to confusion and anxiety in and amongst learners (Fantuzzo et al, 2003). Jigsaw II involves the use of communication skills, as the experts explain the given portions, however some learners have challenges with self-expression. Buchs (2020), supported this when he said that it is problematic whenever partners find it difficult to explain the material due to poor mastery of official language. Buchs continues to identify another challenge of learners failing to understand what their partners are teaching, thus positive interdependence turning to negative interdependence. Susanti & Suberkti (2020), further revealed that the previous learning experiences of passive learning in students haunts the quality of jigsaw strategy. Learners being used to teachers giving all the knowledge makes them lazy to do their personal independent reading.

Not only that, he also reported that jigsaw's success heavily depends on individual student's performance and contribution, which attribute is heavily missing in traditional method cultured learners as stated by Roseth et al (2019) cited by Buchs (Buchs, 2020). Roseth et al emphasized that jigsaw strategy requires cooperative, competitive and individualistic goals of a learner.

2.4 Implementation of cooperative learning.

2.4.1 What is Cooperative Learning?

Cooperative learning is a term used interchangeably with group learning, cooperative learning groups and small group learning. According to Balkcom (1992), cooperative

learning is a successful teaching strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject. Taber (2019) wrote that it is a classroom method of promoting active and effective learning through student interaction in groups of not more than 5-7 students. In my view, it is a method of learning where a student, in a small team, is able to make his/her own meaning (knowledge) from interactions with other students.

Administrate (2013) acknowledged that three types of cooperative group learning exist including informal, formal and cooperative base groups. This study is neither informal since the groups are structured nor cooperate base groups because their existence is to last for a small period (not more than three months). This study attracted formal cooperative group learning which is well organised, assembled for one class and may stay together for at least several weeks working on extended projects.

2.4.2 Relevance of cooperative learning in enhancing students' learning

Traditional methods of teaching which is competitive and individualistic, is when a teacher directs students to learn through memorisation and recitation techniques. These methods do not develop critical thinking, problem solving and decision making skills in a learner (Studybay, 2018). Modern or constructive approach to teaching involves a more interacting student, motivated, with high order thinking and team working skills.

Oloyede, (2012) cited Dowell (1975) who argued that concerning the effectiveness of a competitive and cooperative methods on the comprehension of a cognitive task, the students in the cooperative learning environment perform better than they did in a competitive

environment. Also Adeyemi & Cishe (2016) were of the view that students exposed to cooperative learning strategies performed significantly better in all the skills than their counterparts exposed to competitive and individualistic learning strategies. Adeyemi (2008) however, observed that individualistic setting showed a positive attitude towards learning than both cooperative and competitive setting. Akinsola & Ifamuyiwa (2008) opined that the cooperative arrangement was better for promoting achievement while the competitive learning environment was better for practical skills. In practice, individuals with individualistic and competitive potentials are usually a drop in the sea in a given class. Moges (2019) is a witness to this in his research on “Practices and Challenges of Cooperative Learning in Aires University, Ethiopia”. Student respondents commented that when using the method of traditional lecturing only six to eight students out of 30 may get high marks. However, with cooperative learning method, only 3 to 5 students whose marks are just within average, but the rest of the students have gained high marks. This offers cooperative learning more advantages to its counterpart.

2.4.3 Elements of Group Learning

There is much more to group learning than merely arranging students into groups and its effectiveness has been described with five basic elements of group learning (Rabgay, 2018).

SERC (2020) cited Johnson et al (2006) who said that these five elements of cooperative learning qualifies the approaches with effective learning than when students are simply put into groups to learn. They include positive interdependence, individual accountability, face to face interaction, interpersonal social skills and group processing.

In a school where group learning has never been practiced, the need to expound these elements to the participants is imperative. Positive interdependence is described as the

thinking that each group member's contribution is very important in completing the task. In other words, one group member cannot succeed alone, instilling that ideology of "sink or swim together" in the group members. Individual accountability is each group member's personal responsibility to do his/her part of learning (Child-to-Child-Uganda, 2018).

Accordingly, learners take responsibility of their own learning and contribute to the learning of teammates (Jahanbakhsh & Garman, 2019). Face to face interaction deals with the actual working together. Learners get involved in the process of sharing, helping, supporting and encouraging each other in the group (Johnson & Johnson, 2009). Interpersonal skills have to be taught purposefully and monitored just like the academic skills (Rabgay, 2018). A majority of students have never worked interactively in learning situations and so lack the required skills for doing team work effectively. So teachers must plan to teach teamwork skills through assigning different roles to each group member (Rabgay, 2018). While group processing involves discussion of how well the group is achieving its goals and maintain effective group work relationships (Sutherland, 2019).

No matter what the setting is, prior planning and implementing cooperative learning involves five key steps. These key steps ensures maximum productivity in the students within a teaching/learning process (Laal & Laal, 2012).

Pre-instructional planning: Prior planning establishes the specific cooperative learning structure to be used and lays the foundation for effective group work.

Introduce the Activity to the students: Students need to get their matching orders. Explain the academic task to them and what the criteria are for success. Then structure the cooperate

aspects of their work with special attention to the components of positive interdependence and individual accountability. Set up time limits and allow for clarifying questions.

Monitor and Intervene: This is where you let the groups run while you circulate through the room to collect observation data, see whether they understand the assignment, give immediate feedback and praise for working together. If a group is having problems, you can intervene to help them get on the right track.

Assessment: Some informal assessment is already done while you are monitoring the groups during the exercise. However, once a group finishes their project, work should be assessed by both Instructor and group

Process: Group processing involves asking the group to rate their own performance and set goals for themselves to improve their cooperative work

2.4.4 Group Structuring

Gillies (2014) argued that the teacher has a responsibility of placing learners in heterogeneous groups to allow each student to bring his/her strengths to the group effort. This heterogeneous group is structured basing on ability, strength, experience, gender, ethnicity or some other characteristics (Slavin, 2015; Child-to-Child Uganda, 2018). For instance, if it is a group of four individuals, it should have a strong performing student, two average performing students and one weak performing student based on grades (Baker, 2013). It is a responsibility of the instructor to learn about the students and then form teams according to the plan (Illinois, 2019).

2.4.5 Effective Group Work

Successful group learning does not just happen. It takes extra work by each group member.

For group work to be successful, individual group members need to have clear goals, plans and roles as shown in Table 2.

Table 2: Group roles

Role name	Function
Manager	• Getting group organised • Keeping the group on task • Makes sure everyone has a chance to contribute • Protects members from attack
Spokesman	• Records groups resolution • Checks for consensus among group members • Presents groups work
Checker	• Re-emphasize the main points • Checks understanding • Ensures that every member understands the task
Time keeper	• Ensures meeting start on time • Keeps area clean • Encourages group to stay on task • Announces when time is half way through & when nearly up
Conciliator	• Resolves conflicts • Minimises interpersonal stress • Ensures members feel safe to give opinions
Researcher	• Picks up, distributes, collects, turns in or puts away materials • Is the liaison between groups and between the group and instructor

Source: Cloud (2014)

Cloud (2014) asserted that, groups tend to function better if member roles are defined and assigned during the first meeting. These roles help all members to actively participate in the group process. However, these roles may be rotated amongst group members to ensure that each member experiences all the six functions of the group.

2.4.6 Benefits of Group Learning

Research shows group learning produces the following outputs: Higher academic achievement (Leasa, 2017), increased attention, greater intrinsic motivation, increased understanding of content (Brame & Biel), higher self-esteem, greater social behaviour (Cloud, 2014), more on-task behaviour, better attitude towards teacher, better attitude towards school, communication skills improved (Davies, 2009), students motivated to help one another (Chiriac & Granstrom, 2012), students who explain to others strengthen their own learning, regular and constructive cooperative study groups can assist in mastery of material (Potgieter, 2014) , examination preparation and better performance in examinations (Giuliodori et al, 2008).

2.4.7 Challenges of Group Learning

Moges (2019) in his research on “Practices and challenges on cooperative learning”, isolated instructor challenges from student challenges. Instructors reported that, there were four main challenges thus: the large classes, uncomfortable seating arrangements of students, lack of clear guidance on how to operate cooperative learning and problems of group organisation. In addition to this, Caroline et al (2017) included lack of necessary teaching materials, confrontations from fast learners being held back by slow learners and slow learners being belittled or ignored by fast learners.

Students' challenges occur because group work collects individuals each with their own personalities and experiences. Such challenges may include: lack of awareness of CL, lack of interest in CL, reluctance of students to participate during CL (Pantes, 2010), slow coverage (Bertram, 2021), unwillingness to take on group roles; domination of some students over others during group work, lack of self-expression, shortage of time, poor educational background and reliance of low achievers on higher achievers.

2.4.8 Assessment and Evaluation in Cooperative Learning

Rushby (2016) declared that assessment methods help the instructor answer the questions; “how do I know the required learning has taken place”?

Assessment activities can be categorised as either formative or summative. According to Zook (2021), formative assessments are tests that evaluate how someone is learning material throughout the course while summative assessment are tests that evaluate how much someone has learnt throughout the course. In the classroom, therefore, formative assessments take place during a course while summative assessments are the final evaluations at the course's end.

In research, assessment may take three forms including pre-exercise assessment, assessment during the exercise and post-exercise assessment. Pre-exercise assessment, SERC (2018), documents that it is the kind which takes place before the intervention is implemented. It provides participants with a “ticket” to be part of the study and gives a clue to the researcher about prerequisite knowledge possessed by the learners. During the exercise, formative assessment takes form in group assignments, homework, quizzes, games, essays, reports,

group practical lessons, presentations and experiments as it deems fit by the teacher. SERC continues to say that formative assessment keeps students engaged in class thereby consolidating the manipulated materials into meaning. Post exercise assessment, determines the achievement of each learner in the entire course period.

However, cooperative learning evaluation involves every qualitative measure of determining the success or failure of the intervention. It is usually accomplished through practices like interviews, focus group discussions, questionnaires, field notes, observations, group processing, audio and video recording to mention but a few. Data from interviews, focus group discussions, audio and visual recording is organised into meaningful knowledge through transcription, coding, interpretation and finally theory building (Coxe et al, 2018).

Concerning the subjects responsible for conducting assessment and evaluation in cooperative learning, Lau (2016) confirmed that the teacher has the responsibility of both formative and summative assessment, since he/she is the individual to determine whether learning took place or not in relation with the learner's performance. Assessment also provides students with feedback on the understanding of content, concepts and applications.

Evaluation is also carried out by the teacher, who is the researcher, at the core of the study to see change or improvement in the classroom and community at large. Johnson et al (1998) quoted, "students do not learn from experiences they do not reflect on", 'so as the lesson is ending, the teacher can have students give each other quick feedback. Students can develop a better understanding of their learning process through active reflection on their achievement.

SERC (2018) further asserted that when there is opportunity for peers to assess themselves in their respective groups, this promotes cooperation as students realise their accountability to the group. Again, it allows group to improve its working together as well as eliminating actions that do not contribute positively to group learning (Mentzer et al, 2017).

2.4.9 The teacher's role in cooperative learning

Cooperative learning does not only engage the learner, the teacher is also immensely engaged in the preparation of the classroom practices; in activities like planning, organising, supervising and evaluating the learning process. According to Ozsoy and Yildiz, (2004) as cited in Almuslimi (2016), the role of the teacher in CL is:

- i) To decide on the group size
- ii) To divide the students into heterogeneous groups basing on gender, ethnicity, skills and academic performance.
- iii) To make a proper arrangement of the class (Hertz-Lazorowitz, 2008).
- iv) To give each student a role or to allow them democratically choose roles. .
- v) To explain the process of study to the students.
- vi) To identify learning tasks, fix social and academic objectives for the lesson and pick the relevant CL strategy to achieve the set objectives (Gillies & Boyle, 2010).
- vii) To plan and ensure availability of the materials to be used to facilitate group work for instance apparatus, specimens, reagents and solutions.
- viii) To effectively monitor and supervise the running of the different groups, giving spot guidance where necessary (Gillies, & Boyle, 2010).
- ix) To organise plenary sessions, at completion of group discussions, where different groups share their experience and present the report of the work done.

- x) To provide feedback to the groups or whole class in plenary session and give guidance to further improvement on the quality of their work.
- xi) To evaluate the performance of each student/group to ascertain the extent of improvement in their learning and to decide improvement points, rewards or need for remedial.
- xii) To be aware and able to handle noise, failure to get along, misbehaviour and ineffectiveness in time management in the group (Slavin , 1985).
- xiii) Teacher to provide a secure classroom environment to enable learners ask and answer questions.
- xiv) To discourage competition while encouraging collaboration and sharing of experience among students.
- xv) To consider the students' opinion important whether right or wrong.
- xvi) To provide all support where necessary for learners to give their views without any intimidations.

2.4.10 The student's role in cooperative learning

According to Akpan et al, (2020) the role of the student in CL includes:

- i. Learning to work in groups organised by the teacher for effective cooperative learning (Gillies & Boyle, 2010).
- ii. Developing lesson contents by themselves as they respond to the teacher's prompting in form of questions, assignments, activities, project work and so on
- iii. Becoming authorities in knowledge construction as they share from their previous experiences.
- iv. Taking responsibility to actively participate and collaborate in the process.

- v. Learning to appreciate the opinion of other colleagues in the event of investigating and constructing new ideas.
- vi. Learning to value every experience, learn from them and be able to share with groups.
- vii. Searching for content to share during group discussions

2.4.11 Barriers to implementing cooperative learning

Cooperative learning is a long lived educational teaching practice, since 1930's (Brzuzy et al, 1999), though not many educational systems leave alone schools effectively and efficiently implemented the intervention.

Several sources of setbacks have hindered its implementation, establishment and promotion.

Research has revealed some of the causes thus:

Most teachers have complaints about large classes as hindrances to CL. When groups are working simultaneously, especially in big classes, teachers may not have enough time to monitor each group to ensure that they are working effectively (Diem et al, 2021). So students may take advantage of that gap to fulfill their own interests. However, Johnson & Johnson (1991) and Mulryan (2010) found out that teacher expertise in the determination of student learning was more important than class size.

Secondly, teachers revealed that assessing learners under a cooperative set-up was quite difficult (Buchs et al, 2017). How easy is it for the teacher to determine the understanding of individual group members from group's exercise? It may necessitate more assessment measures to check for any misconceptions in each group member, and that means more assignments given to the students, therefore more work at the teacher's table. CL invites a lot

of teacher engagement such that many teachers have stuck to traditional teaching methods, with minimal burdens.

Thirdly, students have low reasoning capacity which is usually coupled with poor communication skills. The dual, are fruits of traditional teaching methods. Students' failure to express themselves was cited as one of the reasons teachers resist implementing CL in their classrooms. Farivar, Noreen & Webb, (1994) also observed that students who were not able to communicate effectively were less likely to benefit from CL. Due to flaws in language, such students may find it difficult to sustain a discussion, neither could they ask and answer questions nor offer constructive criticism. To effectively overcome such challenges, (Gillies & Boyle, 2010) guided teachers to encourage open communication and so create an environment where every student feels emotionally secure and supported.

Additionally, teachers lack adequate training on CL implementation. This lack or absence of understanding of this type of instruction renders it burdensome for implementation. (Gillies & Boyle, 2008). Therefore, there is a requirement of teacher training in the use and essence of peer learning (Boud et al, 2001).

Students may also be resistant to CL. Some students have had nasty experiences with group work in the past and become irritated when it is proposed (Gillies, & Boyle, 2010). For instance, some students leave group tasks (free-riders) for other group members yet the scores are shared by all group members. And those of them who are fast learners may find CL slow and boring and resort back to individualistic learning. Those students addicted to individualistic learning and/or competitive learning, may fear trying something new.

Using CL format can make it more challenging to cover as much content as can be covered in a pure lecture format, so both teachers and students detest and reject CL.

Again, instructors must be willing to invest time to prepare assignments, learners' activities, appropriate learning strategies, relevant reference books, organise how to monitor progress of students and many more duties. Such enormous responsibilities, discourages teachers from undertaking CL.

2.5 The impact of NHT strategy on the teaching and learning of Biology.

Research has demonstrated that cooperative learning (CL) is an effective instructional tool that has been widely adopted at all levels of education (Johnson, 2009; Schroeder, 2007). Again, research suggested that the use of CL is particularly effective in both science and mathematics (Cascallar et al, 2013).

NHT is one of the learning models that can be used to facilitate students' active participation in the learning process. According to Dieker, Hunter & Whitney (2016), NHT is a cooperative learning strategy that incorporates a unique teacher questioning component to actively involve students within an instructional activity, while increasing their academic scores and behavioral outcomes (Hunter, & Haydon, 2013). NHT is illustrated thus: a class is organised into heterogeneous groups with numbered members. A text is given to read and comprehend by the group members. The teacher poses a question and group members discuss the issue to ensure that everyone understands the material and can ably give the correct answer to represent the group. Then the teacher randomly calls on any number, for the bearer of this number in the various groups to respond to question. The teacher asks if

there are other students who want to refute or add an answer and finally, provides feedback to the answer (Wijayanti & Murwaningsih, 2017). Such a scenario keeps all group members alert, not knowing which number will be called upon. In this way, everyone in the group is compelled to have an answer, and a correct answer to avoid embarrassing the group. Since it is a heterogeneous group, the high achieving students helps the low achieving students to understand the concept in question, thus improving on their cognitive domain. This is supported by Hunter et al, (2016) who said that implementing the NHT strategy, compels all students in the class to respond to the teacher's questions, which has shown to positively affect academic and social outcomes.

Similar studies about NHT strategy and its effect on students' participation and teaching/learning process, have been carried out, and the following are some of the outcomes thereof:

In Indonesia, Girsang (2021) in collaboration with the students during the planning section of the class action research identified the domination of lecture teaching method coupled with significantly less active students during the teaching/learning process. The two parties realised that learning must be designed and implemented in a relevant, engaging, effective and student-centred manner and collectively picked on NHT strategy as a remedy. Data was collected in two cycles, enabling collection of enough data, by observation of students' activities in the learning process of the NHT strategy, assessment and documentation by obtaining photos of the learning process. Findings proved NHT strategy suitable to improve student achievement in Biology subjects in class XI. This was evidenced by the progressive improvement in performance of students during their assessment in the two cycles. The researcher attributed the noted improvement to the students' activeness in participating in

Biology learning, increased attendance in class and more students actively involved in solving problems through group discussions and through teacher to student interactions.

Mustami & Safitri (2018) also conducted an investigation on the effects of numbered heads together in combination with assurance relevance interest assessment satisfaction on students' motivation, in Indonesia. The independent variables were NHT-ARIAS learning strategy and ARIAS direct learning strategy. The dependable variable of the research was students' motivation. Findings had it that the NHT-ARIAS learning strategy was more effective in improving students' motivation compared to the direct ARIAS learning strategy. This is because the integration of NHT learning model into the ARIAS strategy created a more favourable and lively learning environment where students became more active and learning became more student-centred.

Summary of chapter two

In this chapter, the researcher describes the theory that informs her study, teaching methods used in Biology education, the adapted strategies supported in cooperative learning and the impact of NHT strategy on the teaching and learning of Biology. The research was based on the social constructivism theory by Lev Vygotsky which emphasized the role of interactions in knowledge construction through two main principles; the MKO and ZPD. These principles facilitate participation of learners in a group during classroom activities. In these groups, the two learning strategies were implemented included NHT and Jig saw supported in CL. These active learning pedagogies were advocated globally by SDG 4 since 2005, to encourage knowledge construction and skills development in learners. However, teacher centred pedagogies are still evident in the education system especially in third world countries due to

demands to complete the syllabus, an urge to pass national examinations, inadequate instructional materials, negative attitude of students, unavailability of science teachers, shortage of text books to mention but a few. On the other hand, those education systems that embraced learner centred pedagogies such as NHT have their learners rewarded with self-confidence, curiosity, motivation, improved students achievement and soft skills such as team work, communication, problem solving, critical thinking and innovativeness.

CHAPTER THREE: METHODOLOGY

3.0 Overview

The chapter highlights the research design, study population, sampling method, data collection methods, tools and instruments used in action research study.

3.1 Research Design and approach

The research design used in this study is participatory action research with a qualitative approach as explained below.

3.1.1 Participatory Action Research (PAR).

PAR is a qualitative inquiry that permits the researcher and participants to share information as they also learn from one another. According to MacDonald, (2012), PAR is an approach to research where the person being studied participate in all the action research stages including planning, action, observation and reflection. Masters (1995) further asserted that PAR is a step by step inquiry that involves collaboration of participants in data collection which data is later subjected to critical reflection. That is why, after realizing a declining performance in Biology through the successive years of UNEB UCE results, the researcher in collaboration with the administrators, departmental members, students' representatives and a laboratory assistant brainstormed the cause using the work process analysis tool (See section 1.2). Bryman, (2011) emphasized that the action researcher and the client, together diagnose the community problem and brainstorm a solution. In this study, the outcome of the situation analysis was taken to the future workshop, and stakeholders finally identified ‘‘small discussion groups’’ as a plausible remedy. The collaborative efforts of participants to develop a solution qualified PAR as a research design suitable for this study (Comeau &

Watters, 2010). This solution of “small discussion groups” was entrusted to instill the once passive learners in classrooms to active participants in the teaching / learning process.

3.1.2 Qualitative Approach

The research followed a qualitative approach where participant observation, individual interviews, document analysis and focus group discussion methods were used to gather information. Bijayini et al, (2013) shared that qualitative method is used to understand peoples’ belief, experiences, attitudes, behaviours and interactions. The researcher found interviews and focus group discussions more informative because it involved face to face interactions that allowed deeper probing about issues pertaining to active participation in cooperative learning (Barret, 2018). For instance, during the interview discussions some participants revealed free-riders in their groups, an idea the researcher could not observe during classroom activities.

3.2 Study population

The study population comprised members of staff from the department of Biology, students from senior three class (stream East), a laboratory technician and an administrator. These comprise the whole group of stakeholders that were directly and physically involved in the research by virtue of their characteristics.

3.3 Sampling method

The researcher used purposive sampling to select student participants in the study. Purposive sampling technique is the intentional picking of an individual to participate in a research due to his/her desired qualities (Alkassim et al, 2016). The researcher decided to use pre-tested results, to select the high, average and low achieving students. This was because the researcher sought to find out the effect of group learning on low, average and high achieving

student participants (Alkassim et al, 2016). The departmental teachers included subject teachers for senior three classes and the dean for lower secondary who served as an administrator. They were also selected purposively.

3.4 Sample Size

Sample size is the number of participants selected from the overall population to serve as representatives for the real population in that particular study (Omniconvert, 2022). The sample size comprised twenty (20) senior three east students who participated in, in depth interviews, focus group discussions and lesson evaluation. It also included three (3) teachers as well as one (1) laboratory technician that gave feed back in form of structured interviews, and one (1) administrator, the dean for lower school who doubled as a subject teacher. The total sample size comprised 25 individuals, an appropriate number recommended in qualitative research. Dworkin (2012) asserted that the minimum sample size required to reach saturation in qualitative studies that use in-depth interviews is 25-30 participants. He further clarified that it allows thorough scrutiny of issues pertaining to the research questions.

3.5 Methods of data collection.

Several methods were used in collection of data guided by the objectives. For examining the teaching and learning process; interviews, focus group discussions and document analysis were employed to acquire information. For the adapted group learning structures and their implementation, participant observation, evaluation forms, photo and audio video recording were used. Then for evaluation; individual interviews, focus group discussions, photo and

audio video recording were employed. These various methods were employed to complement each other in data collection.

3.5.1 Interviews

The study used interviews as a method of data collection. Most interviews were one to one, face to face with the researcher, to also capture facial expressions during the discussions. Structured open ended interviews were employed, with the students, subject teachers and administrators. The researcher preferred structured interviews because they involved asking each respondent the same question in a similar way. This was to ensure aggregated answers to fit the objectives of the study. Secondly, it provided uniformity in answers to enable comparison of data (Rashidi, 2014).

On the other hand, open ended interviews, often called qualitative interviews, gave the informants freedom to express their own experiences and understanding of events in their own words (Brenner, 2012). The researcher had interviews with each Biology departmental staff in the course of capturing baseline data and evaluating the effect of the intervention in the teaching /learning process. Interviews were also used to capture data from the administrators to back up the process of situation analysis. The researcher also used interviews with students to find out the effect of the intervention in the teaching and learning of Biology. The researcher gave the informants, especially students, liberty to express their views in their local language since some of them had challenges in expressing themselves in the English language.

3.5.2 Focus Group Discussion (FGD)

Focus group discussion is used as a qualitative approach to capture in-depth knowledge about social issues (Derrick et al, 2018). The researcher had focus group discussions with the

students to create an awareness of retardation in Biology performance and therefore a need to address the challenge. Focus group discussion was held with members of the teaching staff at the Biology department to perform a work process analysis producing students and one that produced a working scheme of work for the implementation of the intervention. The researcher also held focus group discussions with all participants as a way of evaluating the effect of the intervention in the teaching/learning process of Biology (See Appendix VI). Wilkinson (2014) asserted that focus group discussion seats the researcher and participants in collective discussions to make meaning out of the intervention.

3.5.3 Future workshop

Future workshop is a data collection method where the researcher tabled the challenges from the situation analysis for discussion, in order to find solutions to the uninterested students in the teaching and learning process of Biology. This was supported by Lauttamaki (2014) who confirmed that future workshop is a good tool for handling tough problems where contrasting ideas from many participants are merged. The findings from the situation analysis were brainstormed by the participants (selected students, Biology departmental teachers, laboratory technicians and two administrators) in a focus group discussion, which came up with a researchable topic. Such cooperative solution findings gave the participants active ownership of the intervention which proceeded into implementation and evaluation.

3.5.4 Participant Observation

Participant observation is a data collection method where the researcher observes and makes meaning of participants' behaviour in their natural normal setting. According to Spradley, (2016), participant observation is a research methodology whereby the researcher becomes

part and parcel of the community under study. The objective is to record participants' conduct in an almost natural setting. It was achieved through an observation checklist filled by the researcher as a participant observer. A camera was also used to capture data about participants in action during classroom activities.

The researcher achieved good rapport with the students to the extent that they were free in highlighting their weak points or challenges encountered inside and/or outside classroom activities. Several of them approached the researcher seeking advice for various issues during which the researcher was able to capture important information about the school culture, their behaviour and attitude towards their studies and the intervention at large. According to McGrath (2019), participant observation seeks for that information that participants may regard unimportant for the study and so do not release it to the researcher, yet such information has great value to the study.

3.5.5 Document analysis

The researcher used document analysis to better understand the trend in performance of Biology in the school from the most recent years. Document analysis is defined as a procedure involving the identification, verification and use of documents related to the subject investigated (Andrade et al, 2018). The documents reviewed for the study included UNEB UCE Biology results, mark sheets of senior three students' performance in the most recent years, mark sheet of the pre and post-test of senior three east students, school time table, Biology departmental teaching syllabus, scheme of work and the school programme. According to Andrade et al (2018), documents in research offer authentic information to base one's judgment or justification in accordance to the subject under investigation.

3.5.6 Photography

Photography is defined as the process of capturing light with a device known as a camera and creating an image (Gallery, 2021). During the implementation period, the researcher or a colleague would capture the necessary event demonstrating participants' engagement. The researcher, with permission from participants, gathered a number of pictures which complimented the other methods used in this study. Gallery (2021) further denoted that photography provides detailed account of actual events, like the environment of operation, the actively engaged students in the class activity and some of the products from the hands-on activities (See Figure 15).

3.5.7 Audio-Video recording

The researcher employed audio video recording during class activities, focus group discussions and interviews. The purpose was to capture scenes involving learners' participation and participants' responses about the intervention. Wiesen (2023) noted that researchers employ audio video recording to record, review and analyses actions in identifiable scenes. In situations where videography was not effective, audiography was applied to add value to the research. This recorded data was then transcribed, coded and then analysed to give authentic feedback about the intervention.

3.6 Tools of data collection

3.6.1 Interview guide

The researcher developed an interview guide (Appendix VII) basing on the study objectives to gather information from the participants. The researcher made appointments with the participant and conducted face to face interactions which usually lasted about thirty minutes.

The interviewee included the subject teachers, laboratory assistant, administrator and student participants.

3.6.2 Observation checklist

The researcher developed an observation checklist (Appendix VIII) for monitoring and evaluation of active participation of students. It comprised twenty-three (23) indicators that spread across five principles (Ong, 2017). The researcher filled the observation checklist at the end of each lesson. The observations were used to triangulate on the information collected from various tools.

3.6.3 Self and Peer assessment form

Self and peer assessment forms also known as self and peer review were used, whereby students evaluated or were evaluated by their peers (Guo et al, 2019). According to Adachi, Dawson & Tai (2017), self-assessment is when a student determines the quality and makes decisions about his/her own work against particular criteria and peer assessment involves students determining the quality and making decisions about the work of their peers against particular criteria. Using the appropriate assessment form, the study participants assessed themselves and any other two group members (Appendix IX). For purposes of triangulation, group assessment was also employed, whereby group managers assessed the activities of the group (Appendix X).

Self and peer assessment are both types of formative assessment. According to Brookhart, (2014) formative assessment is an active and purposeful learning process where the teacher closely follows students' understanding of content through informal and formal assessment. Its purpose is to improve students' achievement. For instance, one group assessment form highlighted the need for more hands-on activities to improve on understanding.

3.6.4 Camera

A camera was used to collect evidence of the research through taking photographs and audio video recordings. The researcher used her smartphone camera to capture the photos, audios and videos during classroom activities, interviews and focus group discussions (Beddall-Hill, Jabbar and Al Shehri, 2011).

Table 3: Summary of methods and tools used in the study

Sn	Methods	Tools
1	Interview	Interview guide, camera
2	Focus Group Discussion	Work process analysis, Focus group guide, camera
3	Document analysis	Camera, Evaluation forms, Assessment guide
4	Observation	Observation checklist, camera
5	Future Workshop	Camera, Focus group guide

Source: Primary source

3.7 Procedures of Data Collection

Introduction letter from the coordinator of MVP program was obtained and delivered to the head teacher seeking permission to conduct the study. In preparation for situation analysis,, appointments for meetings were scheduled and agreed dates confirmed without interfering with the school programme. Interviews were conducted with the relevant administrators, head of Biology department to gather information to form basis for situation analysis. A situation analysis meeting was then conducted to identify the gaps in the teaching/ learning process of Biology in the school. The area of concern was then subjected to future workshop for an in-depth analysis. Stakeholders brainstormed the concerned area and came up with a strategy to the identified gap. An action plan was discussed, specifying who does what, where, when and how. Then the follow up phase monitoring the action plan was done.

3.8 Data analysis

Data collected from the various methods was merged for analysis in interviews and focus group discussions. The audio recorded data from interviews was transcribed, coded according to pre-determined themes including study objectives, analysed and then presented. Analysis involved careful scrutiny of data based on participants' experiences, opinions and feedback in accordance to the intentions of the study. This process finally revealed the outcomes of the intervention.

3.9. Ethical consideration

According to Govil (2013), ethics refers to moral principles of conduct guiding a group of individuals: Participants were guaranteed anonymity and confidentiality in all matters pertaining to their participation and the relationship was built on honesty. The researcher invited participants through a consent letter (Appendix XI) which they signed. This consent letter included among others, permission to allow photo, audio and videography coverage. (Biros et al, 2020) pointed out that the principles of signing a consent letter gives the participants audacity of free expression with the knowledge of whatever eventualities may arise.

3.10 Validity and reliability of data

Validity of data, basically, involves the correct choice and use of data collecting methods and tools in a study. In this study five (5) data collecting methods were utilised which included; interviews, focus group discussions, document analysis, observation, photo and audio video recording. The tools employed included interview guides, focus group guide, observation checklist, camera and lesson evaluation forms. The responses required from participants revolved around activities, products formed from a joint engagement of ideas

from more than one individual. An interview guide and the focus group guide were developed in line with the objectives of the study. Both of these instruments involved face to face interactions which enabled the capturing of in-depth information. The interviews were conducted for at least 30 minutes while the focus group discussions ran for at least one and a half hours (Creswell J. W., 2007). Several methods and tools were used to allow triangulation of data, in the sense that any details left out by one method could be captured by another tool.

There was also repeated inquiry of the same attribute from different sources and levels of participants. The level of consistency of an attribute suggests its validity and reliability (Middleton, 2019). (Pandey & Pandey, 2015) defines reliability as a consistency of data as displayed from the various data collecting methods and tools and validity as the extent at which the chosen tools adequately measure the intended attribute. In this study the attribute measured was active participation of the students, which was judged through observation and interrogation. Observation was aided by research tools including observation checklist and assessment forms while interrogation was aided by the interview and focus group guides (all named tools are included in the appendix). The researcher also sought for consistency in data during transcription and coding. Validity of data is what gives the research its authenticity, such that conclusions made out of the study can be trusted (Osadebe, 2019).

CHAPTER FOUR: PRESENTATION AND INTERPRETATION OF FINDINGS

4.0 Introduction

This chapter presents the findings of the study generated from future workshop, observation, interviews, focus group discussions and document analysis that were employed to explore the use of numbered heads together and jigsaw cooperative strategies to improve active participation of students in the teaching and learning of Biology. The key participants in this study were senior three east students, one laboratory assistant, one administrator who doubled as the head of department and three subject teachers.

Evaluation of implemented interventions was conducted by means of focus group discussions, interviews, use of assessment tools and observation. The summative assessment tool used was a post test, which included two structured questions testing understanding and application of knowledge.

4.1 Teaching and learning methods in the Biology department.

From the future workshop, it was found out that lack of proper balance between theoretical and practical teaching was one of the factors making students uninterested in the teaching and learning of Biology (*see section 1.3*).

Through focus group discussions, the stakeholders highlighted the following teaching /learning methods in the department: Lecture method, demonstration, group learning, practical method and group work.

4.1.1 Lecture Method

All the student participants ably described lecture method as one, where a teacher dictates notes or writes notes on the black board then later explains the notes. Students thought it effective since knowledge was easily and effectively exposed by the teacher. One student

participant further added that it does not waste time. During the focus group discussion, one Biology teacher said,”

“There is limited time to cover the syllabus if I was to conduct all the necessary hands-on activities, so lecture method is an inevitable scape goat”.

The researcher observed that students were mostly taught using lecture method, besides some students kept on confessing their weakness in making personal notes. More still, the researcher witnessed one of the senior three streams being taught using lecture method.

4.1.2 Demonstration method.

This is a method where the teacher shows or displays the experiment before the whole class. Through interviews, one Biology teacher consented to having more demonstration hands-on activities due to inadequate instructional materials. “At least learners are able to watch and learn as the teacher conducted the experiment”, he said.

One student reported that the very few times hands-on activities are conducted was by demonstration. Another student emphasized that a term would go without performing a single practical exercise. This is reason as to why the researcher observed a poor manipulation of apparatus in the learners. For instance, some learners could hardly read a laboratory thermometer, revealing very little or no interaction between the learner and the apparatus.

4.1.3 Group learning

Group learning is the mandatory method used in teaching of the lower secondary school in

Uganda's education system these two consecutive years (that is senior one and senior two). When the researcher visited with one of the senior one classes, she witnessed individualistic learning still being demonstrated among the learners. Some learners separated themselves in two's, one's, four's yet others were discussing in groups of tens', as shown in figures 4 and 5.



Figure 4: Group learning in progress.



Figure 5: Residues of individualistic learning Source: Field data (2022)

One of the senior one teachers confirmed the researcher's observation when he said that, eliminating individualistic learning may require a lot more patience for it seems to be deeply ingrained in the learners. He reported that, it is a normal practice for these students to submit in work done as an individual, since the big quest is for marks acquisition. Otherwise, the learners in groups were observed having active discussions.

4.1.4 Practical Method

In Biology, a practical method is where each student is able to manipulate specimens and apparatus. So there has to be enough provision of instructional materials for all the learners. However, the large class sizes usually compel administrators advised by the teachers to reduce the method to group practical activities. In one of the interviews with a Biology teacher, he said,

“In Luteete secondary school, there is a culture of concentrating practical lessons in senior four, as we prepare the candidates for national examinations”. “This practice is inevitable because the school is constrained with the perpetual provision of instructional materials for all the classes”.

Another teacher clarified that the big classes also contribute to the challenge of providing instructional materials. That is why one of the student participants during the intervention said,

“It is long since we last had a practical lesson like this. If I was to recall well, it may be way back in our senior one”.

Some of the comments passed by learners on practical lessons included:

“We were given chance to touch what we study”, “Experiments were easy to do and to understand”, “More experiments should be done because we understand more when our hands are on the apparatus”.

Indeed, the researcher observed happy, deeply involved learners during practical lessons.

4.1.5 Group work

In a one to one interview, one colleague participant said that in order to check understanding of content in the learners, and given the large classes, he usually gives assignments in groups of ten. Here he expected learners to discuss answers amongst themselves and produce one answer sheet which is easy to mark. He said, he found it a commendable method, because it engaged students in discussions even as they trained in question approach.

4.2 Implementation of the adapted cooperative learning strategies

A cooperative learning strategy is a set of unique procedures designed to ensure active participation of all students, in a heterogeneous group, involved in the process of constructing knowledge. Out of the many cooperative learning strategies, stakeholders picked on only two to make it easy to master one strategy at a time (Kagan, 1990). The implemented strategies were: jigsaw and numbered heads together cooperative strategies.

4.2.1 Numbered Heads Together Cooperative Strategy

In a six-membered group, each student assumed a number from 1 to 6. This was taken as the identity number for that individual, to respond to a question when randomly called upon by the teacher. Students worked as a team to solve a problem and ensured that all understood the solution. For example, the first lesson in the implementation period involved a hands-on activity. So the text books with the well given procedures were distributed to each individual in a group. The researcher and one other individual in the group picked the apparatus, and other items required for the activity. Groups were given time to read through the procedure, familiarizing themselves with the activity. Then later collaboratively, learners carried out the activity. After setting the activity, learners kept on monitoring the experiment. At the end of the experiment, results were recorded by the learners.

Students were active, enthusiastic and excited as they carried out the experiment. The researcher observed division of labour in the course of executing the activity; some learners making inquiries from teachers, making innovative decisions during material and specimen manipulation, improvising for time setting, as they also made consultations amongst themselves.

All such activities were a true reflection of social interaction suggested by Lev Vygotsky, which he said play a fundamental role in the development of cognition.

For harmonization of results, each group's secretary fed in their results in a drawn table on the black board as shown in figure 6.



Figure 6: Group secretaries fed results in the table on blackboard. Source: Field data (2022)

The researcher then posed the numbered question for discussion. Students were observed confidently standing up to submit in the groups' response. This meant, groups had satisfactorily discussed, that every member would ably respond to the teacher's question. In a heterogeneous group, exchange of ideas between the MKO and other group members

actively generated meaning to the material. The learners greatly appreciated these group discussions, to which some responded, saying:

“Discussions generated a number of different ideas, from which we learnt more and therefore improved our understanding”

”In discussions everyone was given chance to participate, thus capturing all our attention to learn”, “because of maximum participation the various ideas were merged into one perfect answer”.

After the plenary discussions with the students, the teacher finally wrapped up, and gave hints to further reading where necessary.

Biology like any other science subject is highly facilitated with practical activities, whose aim is to make the subject understandable, promote intellectual development, promote problem solving and inquiry skills as well as developing manipulation and observational skills in students. As the student conducted the experiment the hands, heart and head were actively engaged. And as the student reflected through the activity, is where Jean Piaget suggested knowledge construction occurs. These were some of the comments learners gave about conducting hands-on practical method:

“We were given chance to touch what we study”, “experiments were easy to do and understand”, “practical lessons increased our participation and attention to other group members’ ideas and to the teacher too”.

This means that hands-on activities stimulated learners’ participation and through the group discussions, understanding of content was quickened.



Figure 7: Students actively engaged in ‘hands on’ activities (see lesson plan in appendix XII).

Source: Field data (2022)

The teacher to student relationship was good to foster freedom of speech. Freedom to ask questions is a good breeding ground to developing critical thinking skills, a pre-requisite to high order levels of understanding. Through the evaluation forms some learners were open to express their weaknesses like,

“I could not make any brief notes”, “I failed to complete homework”, “I had challenges with English language”.

The researcher believes that freedom of expression is one of the indicators that, ‘I need help if you can give it’, and this encourages the MKO to step in with aid and thus promoting the

actual working together implicated in one of the elements of cooperative learning, face to face interaction.

Learners were encouraged to make their personal brief notes during the intervention. Indeed, one could not build up knowledge in the absence of documentation. More so, the need to make one's own notes compelled the learner to actively engage in all the group's deliberations, as he/she sought to make meaning. Several students were observed writing down their ideas, though some confessed failure to make their own notes and others insisted on demanding for notes from the teachers. From the class assessment forms these were some of their responses,

“Stuff in textbooks was not clear”, “Textbooks used hard language”.

These comments revealed little or no involvement of the learner with the text books, demonstrating that little or no learning took place during that the activity.

Another way of engaging learners in the teaching and learning of Biology is through doing class and take-home assignments. Assignments have a way it checks understanding of content, provokes one to consult text books and teachers, and stimulates research. Class assignments were well attended to since each group had to give feedback during plenary discussions or had to respond to a numbered question. However, there was poor response when it came to either group or individual home assignments. All groups did not submit in their first homework assignment on pretext that they had a lot of work to handle. It took some guidance and counseling sessions to expose the need to overcome laziness, and then students started attending to all class activities given to them. By the end of the intervention, the researcher witnessed a much better response of students towards homework assignments.

4.2.2 Jigsaw Cooperative Learning Strategy

With the ten (10) groups in class, each with an average of six students, jigsaw identifies each group as the 'home group'. This home group is further split into three portions, according to the segments into which the material to learn has been split by the teacher. Each portion of the home group is given its particular segment to read. This is the segment to later be discussed in the next step, the 'expert group'. Portions from the home groups sharing the same segment then converge in the expert group to intensively discuss their segment. From the three various expert groups, the learners return to the home group to teach the discussed segments to their home group. When all the segments are discussed in the home group, the group secretary compiles the material into a meaningful, well sequenced Biology. However, depending on the objectives of the lesson plan, plenary discussions may or may not be held. Jigsaw strategy only works with minds-on lesson activities.

In the initial jigsaw lesson held, the researcher observed a number of students fidgeting to locate the texts from which to extract the material in the text books, others called for assistance to clarify whether it was the right text, yet others could hardly make out meaning from the given text. Two expert groups handling the same segment got real stranded, not even putting minds together to make meaning out of the text. One participant called out for help confessing, *"Madam, we can hardly make out the beginning and end of the information to be extracted"* *"we are surely lost"*, they said. The sister expert group had disgruntled students, bored and irritated. *"We cannot see what to read"*, they cried.

However, the other four expert groups were busy discussing their portions and making their brief notes. But because part of the material from the disgruntled expert group was missing, the researcher had to step in to prevent content break down. The researcher decided to call an

impromptu class discussion. The first segment expert group did a commendable job and was so confident in their presentation. Using guided discovery, the whole class was invited to participate in searching for material needed for the second stranded expert group, which was given and written down. The third segment made their presentation, to crown the building of material. The following lesson again employed jigsaw strategy and similar occurrences of misconceptions, confusion, irritated students in a noisy class were observed. Some of the comments in the evaluation forms included;

“It was very hard to find some work in the books”, “it was so tiresome”, “I did not understand the content”, “the work in text book was complicated”, “we did not understand the new teaching style”, “we got disgusted when other groups laughed at our answers”. In the interviews these were some of the reports; “I could not believe my fellow student’s ideas”, “there was no respect for one another in the discussion groups”, “we did not give audience to our fellow friends”, “I failed to understand the model itself”, “Stuff in the text books was not clear”.

The learners’ submissions exposed; inadequate positive interdependence, minimal interpersonal skills, reduced interactions and failure in engagement with the content, all of which interfered with the process of knowledge construction.

One of the purposes of using these strategies in cooperative learning is to encourage peer teaching under a guide (teacher). Accomplishment of the jigsaw learning strategy should be compiled notes from the various expert groups on the material studied. These notes should be compiled by the secretary being guided by the group members from various expert groups. In the two jigsaw lessons implemented, learners were unable to compile their notes on the topic in study, revealing the absence of effective interactions within the group members.

The teacher sabotaging the strategy indicated the back firing into teacher led methodologies which render the learner's passive. Some evaluations from learners cited appreciations for the interdiction of the teacher in the strategy. This implied that learners still desired the old time expository method, where they are passive and only receive ready-made notes from the teacher.

Additionally, there should be respect for each other to afford effective communication of ideas within a group. Evaluation interviews about jigsaw strategy revealed that there was hardly any respect for one another in some groups, meaning that exchange of ideas was impossible. Therefore, effective participation was hindered and so minimal or no learning took place.

Failure to locate relevant texts from reference books gave a sign of very little or no consultation of text books by the learners. Coupled with complaints of complicated language therein, was a signal of lack of active involvement with biology content in text books.

There were two sister expert groups which could hardly engage any discussions within a group. Lack of discussions is lack of cooperation, interaction, interdependence and therefore lack of active participation.

The strategy that exhibited and sustained active participation of learners was more honoured for learning. So, for Luteete secondary school, NHT strategy was more significant in engaging learners than jigsaw.

4.3 Implementation of cooperative learning

4.3.1 Group structuring

The main purpose for heterogeneous groups during group structuring was to facilitate fruitful discussions through the exchange of ideas from individuals with various experiences.

Cooperative learning provides opportunities to work with others from different backgrounds to reach mutual agreement. This process emphasizes that others have many ways of understanding issues and therefore students learn to appreciate the differences. One student said,

“I started to love the way we were grouped because I have somehow improved”. Yet another one commented, “Different ideas come up, then one better answer is formed”.

The researcher witnessed active discussions amongst groups, from which the class would generate new knowledge or obtain better understanding of material. Students also learnt to socialise, bear one another's weaknesses, acquired effective communication and leadership skills. In a nutshell, group work is a breeding ground for soft skills needed in the world of work.

4.3.2 Effective group work

Effective group work is achieved when the group is able to come up with one solution or product from a given task. This means that students must reach an agreement despite the arguments among members. In the course of implementation, students settled in their groups to perform the tasks given. They would always have either a solution to mark or to present for discussions. And it does not follow that they always had the correct answers, but discussions in the plenary or with the teacher would tactfully and beautifully draw them to the right path. The researcher is reminded of one learner who after finishing the practical

lesson with the correct product, did not know what to measure (the product shown in figure 16) to show the diffusion distance of the dye. It took another learner to show him, what, how and where to measure. As a researcher having identified an area of misconception, went ahead to challenge the whole class about what should be measured. And indeed there were other stray students. So, effective group work is informative to the teacher about the likely areas of confusion, disagreement and misconception. There is a way hearts are knit together in group learning that automatically promotes genuine interactions. Some of the learners' comments included:

*“Group learning would work for us because it advocates for improvement”,
 “Group learning should be encouraged even in physics and chemistry”. In
 their assessment forms, where they were asked to identify what they liked most,
 these are some of their responses: “Sharing with my fellow students what we
 had understood”, “participation of group members”; “discussing and reading
 text books with my group member”, “cooperation”.*

In other words, learners were being coached into the proverb that goes; “two heads are better than one”. Learners also enjoyed their leadership roles in groups, the communication, hard work skills and the socialising too.

4.3.3 Benefits of cooperative learning

Through interviews and FGD, learners named their benefits as follows:

*CL enabled group members give different ideas, learners gained confidence as
 leaders, every student had opportunity to participate, it made Biology more*

understandable, improved on communication skills, promoted hard work amongst group members and promoted creativity in learners.

Other benefits from interviews included:

It gave guidance from fellow learners in the group, I obtained first- hand experience with materials and apparatus, it was easier to be taught by a fellow learner, I learnt to make my own notes which is easier to revise, I enjoyed my role in the group, got confidence in discussions, I enjoyed summarizing notes in text books, I acquired responsibility to do my homework.

The learners' comments seemed genuine because of the cultivated freedom of expression between the researcher and learners and amongst the learners themselves. This freedom of expression made learning enjoyable.

4.3.4 Challenges of cooperative learning

Below are the challenges named by learners during the evaluation FGD;

“Passive members in the group, lack of cooperation in the group, laziness, sleeping in class, absenteeism, noisy class, difficulties in summarising notes from text books, failure to agree in discussions, uncompleted work, selfishness in the group, discrimination amongst members, late coming, taking long to settle for CL and undermining others”.

Individual interviews had these reports: CL is slow in coverage, high achievers do not want to share material, failure to explain to each other as students, stuff in text books was not clear, stubborn fellows diverted group from learning, disagreements in the group and teachers could not attend to all learners/groups. These are attributes which derailed active

participation within groups. However, some were expected like disagreements and that is the reason for having a conciliator within the group.

Some passive participants prone to individualistic learning used to dissociate themselves from the groups. When asked how the remaining individuals in the group used to handle such behaviors, one had this to say,

“We would just continue with whoever was willing to participate”

So, cooperative learning fetched a lot of success as reflected in group structuring, group work, improvement in communication and leadership skills, improvement in teacher to student relationship and understanding of material. It also built their individual responsibility towards their studies. All these benefits were achieved through making the learner active in his/her own learning.

4.3.5 Assessment and evaluation in Comparative Learning.

Assessment was handled both informally and formally. The informal way was when the teacher assessed and critiqued the oral answers given by the learners. Such answers would give a clue to whether the learners have understood the concept or not. Then the teacher would quickly decide how to correct the misconception.

Formal assessment was given as pre-tests, post-test and group assignments. Initially the class had challenges with assignment completion then after some guidance and counseling sessions, learners revised their attitude towards homework and were now keen in attempting exercises. The marks obtained in the three group assignments were tabled in appendix XIII.

Evaluation was achieved through students' responses to a few questions after every lesson using group processing forms. Some of the feedback in this section came from these evaluation forms. Individual interviews and FGD were also avenues of evaluating the intervention. Teachers' observation also contributed to the evaluation of the intervention. Part of the evaluation was collected in form of photos, audios and videos.

4.4 Evaluation of the Implemented Strategies.

During the evaluation of the effect of the intervention strategies, interviews, observations, assessment tools, focus discussion meeting and reflections were made on the implemented meeting. The evaluation meeting was held in the senior three east classroom as shown in figure 8.



Figure 8: Evaluation meeting carried out in senior three classroom. Source: Filed data (2022)

The student participants were interviewed to capture in-depth individual experience while evaluation meeting was conducted with the whole class because the strategy targeted improving their participation in classroom, during the intervention. This evaluation meeting amongst others dwelt on what went well, what did not go well and the preferred cooperative learning strategy. Under what went well the researcher targeted getting information on how the strategies benefited the stakeholders, while under what did not go well she targeted

identifying the challenges faced during implementation some of which may be handled in the next cycle. The benefits and challenges of comparative learning in this study were highlighted in section 4.3.3 and 4.3.4 respectively.

The students' preferred cooperative strategy by the majority was Numbered Heads Together (NHT) from both interviews and focus group discussions. The learners opted for NHT because it compelled learners to participate in class, promoted understanding and mastery of content, built self-confidence in learners, freedom to ask questions and challenged learners to be attentive in class. The outcomes of NHT strategy were earmarked using formative assessment, summative assessment, interviews and observations.

4.4.1 Evaluation of NHT strategy

Cooperative working

Active participation of learners was very evident in the groups which was at times demonstrated by division of labour especially during practical lessons. As one learner was making the potato cylinders another one measured the cylinders to the required length, meanwhile someone else measured the solutions to be used. At one other moment they were helping one another to organize the apparatus. During minds-on activities, learners were observed sharing ideas amongst themselves, seeking for final verdict from the teachers, requesting for a variety of text books for consultation in a bid to make meaning.



Figure 9: Students demonstrating cooperative working. Source: Field data (2022)

Making personal notes

Usually after a discussion, learners would take time to make their brief notes. Much as it was a new practice to the class, some confessed that personal made notes were easy to revise, could not be forgotten easily, yet others said it was a hard task to do. One learner confessed that,

“At the beginning I found it hard to develop my notes, but with help from my friends I learnt to make notes and now I am polishing the art every other day”.



Figure 10: Students making their personal notes. Source: Field data (2022)

Improvement of teacher to student relationship

During the future workshop, one of the challenges mentioned was poor teacher-student relationship. In the course of the implementation, especially during discussions and experimentation, learners freely inquired of the teachers. Some needed guidance, clarity of information, affirmation of facts or procedures. Indeed, most often teachers would engage with either a learner or a certain group. In this way active engagement of the teacher and learner was evident, as the gap between the two parties was also dissolving. Figure 11 shows some moments of teacher consultation.



Figure 11: Moments of teacher consultation and support. Source: Field data (2022)

Development of generic skills

Generic skills are sometimes called soft skills; they equip individuals for work and for life. Such skills may manifest in learners through group roles, discussions or during presentation. Sharing roles in the group gave learners a sense of belonging and thus made them active in group activities. Skills like cooperation, communication, presentation, conflict resolution and leadership were displayed. One learner commented that he discovered confidence in himself to stand before the class in discussions, yet several others testified that they enjoyed their roles in their various groups. One learner emphasized,

“I found confidence in exhibiting my role as a checker and I appreciated my group members for trusting and listening to me”, he said.

Out of class consultations:

Some learners who had personal challenges in their studies confided in the researcher. For example, one borrowed leaf from the researcher’s shared experience during the guidance and counselling talks, to inquire how he could achieve his future goal. Another, new entrant in the school also desired to know how to achieve her destiny within her challenging situation. In such conversations, at one moment they were misconceptions, a need for corrections, advice, encouragement and/or guidance. The researcher would take such interactions as individual accountability and responsibility. Much as it was not the obvious active participation in the group, the students were seeking help to boost their level of participation in class.

Plenary Presentations

Those were moments where groups presented their findings from experiments or discussions along with relevant explanations. Plenary discussions consolidate what has been learned, highlights the most important points and stresses what needs to be remembered. Learners would walk into the front not because they knew it all, but because they desired to share their findings. At times a discussion would be generated or there would be need to correct misconceptions. These were moments of active participation and thus active learning.



Figure 12: Students in plenary discussions. Source: Field data (2022)

Group discussions:

Discussions in the group are the means in which learners teach themselves. In a group, learners depended on each other to accomplish the task given, which would result into one solution or one product for the group. They so declared that through these discussions, it was easy to ask questions in case of a misconception, they gained more understanding of the material, gained confidence to express their ideas without fear of being ridiculed, got guidance from fellow learners and it stimulated inquiry from other groups and from the teachers. For the shy fellows, it was easier to ask questions from fellow learners than the teachers yet some found audience to discuss material.

Practical method

It was always a joy whenever the lesson involved practical learning. Hands on activities have a mystery in unfolding the abstract biology, bringing tangible meaning to the material,

stimulating critical thinking, innovation, and problem-solving skills, training learners in observational, data computation and manipulating skills, training in making inferences as well as application of biological principles in the living world. Learners commented that, experiments were easy to understand and made them improve on performance; practical activities compelled all members to participate as they also acquired first-hand experience as well.



Figure 13: Practical session in progress. Source: Field data (2022)

Reading texts

Interaction with content is one of the activities that demonstrate active participation. The learner settles down to read, comprehend and extract material to use in the group discussions. This action demands individual accountability where the learner takes responsibility of gathering information to contribute in the discussions.

The researcher observed a good response of learners to light texts like experimental procedures, already extracted material but a rather poor response to hard copy reading. The following remarks were given when it came to hard copy reading. *“These were complicated old textbooks”, “Things in texts books were not clear”, “ We did not understand this”, “We got lost”, “We could not make out the beginning and the end”.*

The researcher diagnosed a rather poor reading culture in the learners. However, some few appreciated the activity and went ahead to borrow text books to do further reading, yet many were not in the know of a richly endowed library in the school.



Figure 14: Learners interacting with text book content. Source: Field data (2022)

Listening

The English dictionary defines listening as: to pay attention to a speech, to accept advise or obey instructions; to agree, to hear. The English scholar Hamouda, defines listening as the capability to'' identify and understand what others are saying'' (Hamouda, 2013).

In most cases, listening in science involves the ability to follow procedures, assemble apparatus or manipulate specimens, in order to make correct observations.

The researcher witnessed a majority of groups making correct observations, leading to correct conclusions. The conclusions would therefore inspire the right explanations. Figure 15 shows some products from group IV.



Figure 15: Products formed from effective listening. Source: Field data (2022)

Assessment

Assessment is divided into pre assessment, assessment during the intervention and post assessment. The three stages of assessment comprise formative assessment that seeks to establish whether learning has occurred.

Assessment during the Intervention: this included formal and informal methods of assessment. Informal assessment was achieved through the question and answer approach to gauge whether the class is following the discussions or through class discussions to correct misconceptions and stress the main features of the lesson. Informal assessment is rarely awarded marks (as it deems fit for the teacher). Feedback from informal assessment of class activities was usually oral through discussions except and a few times when books were marked. There is always need for the teacher to check learners' books, and confirm whether learners are making notes, what quality and quantity, are the notes systematically written, legible, are diagrams drawn, and are they correct diagrams and so on. Since it was their first time to make their own notes, many note books were found wanting. Many had at least one item missing like table of observations, conclusion, diagrams, definitions and the like. So in

the feedback, they were cautioned to be more vigilant in notes making and to follow instructions given by the teacher.

Formal assessment was given to them as group assignments for take home. As earlier on mentioned, all groups did not submit in the first assignment. All they had were lame excuses. The researcher then reprimanded the class through some wise talks, which redeemed a good number of participants. Three group assignments were given during the intervention and they were awarded marks (See appendix XII).

The assignments given included questions requiring understanding and application of material. The groups were organized in such a way that the cream of the class were in the first groups. It was not intentional, but after arranging pre-test results chronologically, it would follow that always the better performer would be dropped in the first groups. Interpretation of results through the three group assignments had the first groups with the better grades, but as the lessons continued, the middle groups took in the lead, eventually having a mix of both middle and last groups in the lead.

Post assessment

It is so amazing, from the results of the post test that a learner among the low achievers took the first position in the post test. The post-test results showed a majority of the so known low achievers improving a lot in their grades and the high achievers either maintaining or deteriorating.

Results from formal assessment of group assignments and post- test showed great improvement among the low and average achievers and maintenance or deterioration in high achievers. The researcher thinks that the deterioration or maintenance of high achievers could

be due to the altered learning style, from knowledge based to competence based. From the researcher's observation especially during discussions and presentation, there was a struggle within the learners to shift from memorization to understanding content. Indeed, at times the researcher had to intercept a discussion in order to explain the underlying biological meaning behind a concept. This is a reminder of when learners had to write the pre-test and their teacher proposed a week of revising before they could sit for the paper. Indeed, the quality of answering questions in the pre-test, suggested rote memorization of material.

CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This chapter discusses the outcomes of the interventions that targeted improving participation of students in class through NHT and jigsaw strategies supported in cooperative learning, as they were presented in chapter four of this report. This discussion of the results depended on the interpretation and description of the processes based on the researcher's experience, observation and reflection upon the situation as it unfolded in the process of research and also on the perceptions and views from the participants of this research. The researcher also incorporated related views, theories and concepts from various scholars where it deemed necessary, to back up the analysis of results.

Discussion of results were presented per objectives, which was followed by the conclusion and recommendations that revealed the way forward of this research study.

5.1 Teaching and learning methods in the biology department

Findings from chapter four (4) identified lecture method, demonstration, practical method and group learning as the most employed teaching/learning methods in the department. The majority of pedagogies employed in the department namely lecture method, demonstration and practical method were traditional transmissive methods. The researcher's findings are in agreement with (Chen Xie, 2018) who reported poor performance in learners of grades 1-12 taught with traditional transmissive models in comparison with constructivist and improved transmission models. More so, according to Mjelde ((2013), vocational education must engage the learner with the task to evoke understanding of material and construction of knowledge. This is in line with (UNESCO, 2016) that advocates for transformative teaching

methodologies which put the learner at the centre of learning experience through the Sustainable Development Goal (SDG) 4. Learners are therefore able to acquire specific practical skills which they can use in the world of work. At the back of this goal 4 is the notion that even a senior two drop out would have acquired some skills to fend for himself or herself in the world of work. So this policy condemns traditional teaching methods, like lecture method, because it denies the learner interaction with the task thus robbing him/her of developing new ideas, skills and values. Some of the reasons for teachers sticking to traditional methods of teaching are an examination orientated educational system (Bakaira, et al, 2013) and a push by administrators to complete syllabus (Njiru, 2012). Unfortunately, both of the named challenges haunted the Biology curriculum in Luteete secondary school, leaving the system heavily influenced by traditional teaching methods.

Additionally, baseline data revealed that at times a term would go without any practical lesson or at least one conducted (Ahmad, 2014) and the major cause identified was lack of instructional materials (Paulo & Tilya, 2014). Paulo decried inadequate laboratory supplies as one of the reasons for failure of the CBC in Tanzania. On the other hand, practical lessons are good stimulants in the understanding of Biology though may lose meaning if not conducted alongside theory. The school culture of conducting practical lessons in candidate classes therefore becomes a traditional method of teaching too, for learners will be performing practical lessons to pass examinations (Bakaira et als, 2013) and not to learn, for memorisation (Chinwe, 2012) and not to understand the Biology. Also, demonstration hands-on activities are usually carried out by the teacher as the learners are observing. So, learning is by watching, which is better than having no practical at all. But (Mjelde, 2013) defied it as a vocational practice since the learner has not interacted with the material. For it is the direct interaction with material that breeds tangible knowledge and skills.

However, group learning in the lower secondary classes involved active participation practices such as learners collecting live specimens (leaves) themselves for a hands-on activity, learners holding discussions and presenting their findings to the whole class. (Kagan and Kagan, 2009) commended NHT for actively engaging students in activities like collecting specimens, plenary discussions and thus learners becoming motivated. Through discussions, (Stigmar, 2016) asserted that smart students explain answers to the others, to encourage better understanding of content..

5.2 The Active Participation Cooperative Strategy Adopted

According to objective two (ii) of this study, NHT cooperative strategy satisfactorily enhanced the participation of learners in the teaching/learning process of Biology. A number of occurrences mentioned in chapter four (4) showed evidence of active participation of the learners in the learning experience while using NHT strategy, such as: confidence in manipulation of apparatus, the readiness to give answers, confidence during discussions, the evidence of products formed the quality of answering questions and the freedom of expression. (Kagan, 2007) said, NHT indirectly trains students to share information, listen carefully, and speak with caution so that students become more productive. (Isjoni and Ismail, 2008) affirmed Kagan by commending NHT for improving learning achievement, self -confidence, team work and communication skills. (Kagan, 2009) wrapped up by advocating NHT strategy for increasing active participation, enhancing motivation and so improving students learning.

Jigsaw strategy on the other hand, exposed the learners' poor skills in personal reading and communication. The strategy eventually failed to sustain learners' engagement in the classroom activities, especially in one of the segments of the material. Through the lesson

evaluation forms, learners revealed their failure to understand material, how hard it was to extract notes from textbooks and how complicated work was in textbooks. (Wittwer, 2008) reported that while using jigsaw strategy, learners may fail to make meaning out of the portion, demonstrating that learners have failed to interact with content. The researcher also observed poor mastery of English language in the learners as a hurdle to jigsaw strategy. The school had a culture of vernacular use in their casual and classroom communications, which greatly derailed eloquence in self-expression in the official language. Since jigsaw demanded learners to explain their findings to home group members, lack of expression by some learners affected exchange of material within the group, besides Biology could not be easily explained in vernacular either. That is why (Buchs, 2020) asserted that it is real havoc if learners fail to explain themselves during jigsaw learning strategy. Some individuals' failure to express themselves blocked the assembling of a unit material to be learnt that day.

5.3 Group Learning

Objective three of the study was highly recommended by learners to awesomely engage them in classroom activities. Many confessed it was a first time experience yet worth the venture. Because learners were placed in heterogeneous groups (Baker, 2013), the interactions between the MKO and low achieving students improved their understanding which was evidenced with improved scores. This was supported by (Sutherland, 2019) who revealed that high academic achievement is a benefit of CL. The collaborative practical activities interested the learners so much, more so when they produced tangible results which were discussed to bring meaning to the theory learnt. (Cloud, 2014) confirmed this when he highlighted greater intrinsic motivation a wonderful gain in CL. Exchange of ideas from different sources and individuals, during discussions, had the magic of unfolding hidden meaning thus bringing about better understanding (Brame & Biel, 2015). Making their own notes and reading texts became a wonderful challenge as some of them made good

discoveries out of the two activities. Such attitude towards new innovations displayed commendable individual accountability which led to self-discoveries, resulting into self-improvement.

Group learning increased individual scores especially of the low and average achievers. That is why (Leasa, 2017) maintained that active participation of learners in classroom activities breeds marked academic proficiency. Learning cannot be assured without assessment. Formal and non-formal assessment revealed the fruits of active participation. Groups showed a progressive improvement in scores as attributed by (Girsang, 2021).

However, free-riders as reported by some learners during interviews, affected quality cooperative learning. (El Massah, 2018) acknowledged that the free riding behavior threatens the success of teamwork, where one or more members in a group choose to benefit from the sweat of other members with little effort of their own.

5.4 Evaluation of the effect of Numbered Heads Together Strategy

Objective four sought to evaluate the effect of NHT Strategy on the teaching and learning process. Evaluation is an important stage in any study as it yields feedback on the effect of the study on the community. NHT strategy was able to instill motivation in students (active participation) to the extent of improving their scores, especially the low and average achievers. This is in support with what (Abigial et al, 2022) concluded from her study in Nigeria that NHT fosters interest in learning biology, and (Girsang, 2021) who proved that NHT improves students' progressive performance. Girsang attributed the noted improvement to the students' activeness in participating in Biology learning. More benefits of NHT strategy in cooperative learning included: unfolding generic skills of learners like leadership, presentation, self-confidence, improving relationship between teacher and student to mention

but a few. That is why (Isjoni and Ismail, 2008) said that NHT improves teamwork, communication skills and helps students learn to respect each other. (Karen, 2012) also hailed NHT strategy for building confidence in learners.

Nevertheless, some hardworking, high achievers reported laziness by some group members especially with take-home assignments. These lazy members used to dodge, give excuses or escape from group discussing assignments. (Susanti and Subekti, 2020) revealed that some individuals take long to orient into new interventions. Learners being used at receiving all knowledge from teachers in the old traditional method find it cumbersome to shift into self-driven pedagogies. That is why poor individual scores were still evident on classroom mark sheets of the post-test assessment.

5.5 Complexities and contradictions of the study

The school timetable had only two double lessons for Biology learning, to teach both theory and practical lessons. These periods are too few to cover the enormous Biology syllabus effectively. For a practical lesson may involve; introduction of rationale for subtopic, giving out apparatus because there is no Biology laboratory in the school for the technicians to prepare in advance, starting off the learners ,time for experiment to be set and run, reading observations, making conclusions and explanations or discussions for application in daily life. Before long, the period would have run out. The researcher suggested administrators to at least secure another double lesson to the class. Otherwise, during the study, the class had to create more time in order to obtain and record experimental results.

There was a challenge of inadequate instructional material, where the teachers had to either improvise or get into their pockets. In case the teacher was hard up, the lesson would be taught the traditional way. If it were possible learners would be given chance to cost share for

the provision of some few affordable instructional materials. At least one thousand shilling per student per term could be collected.

The study was interrupted with change of time table by administrators, such that the researcher had to be shifted to another stream to reduce on clashes with her original school time table. Therefore, there was little time to orient the new set of learners into the new learning strategies. So some learners perceived the intervention as a lure into the new lower secondary group learning and so resented the intervention. The researcher had to explain the difference between the two pedagogical approaches to settle their grievances.

There was a contradiction of the school having a well- stocked library with a time table for every class for library use and novice learners in text book use. The learners were ignorant in location of texts to read, use of table of contents and index and had challenges in understanding text book language. How I wish an individual on staff be nominated to ensure good library use by all students in the school.

There was this complexity of noise making during class activities which became a concern to all of the students. The learners themselves confessed being distracted by their noise yet could hardly keep their voices low in discussions. The administration would organise workshops to sensitise learners about the drawbacks of being noisy and also engage some stringent measures to curb the distraction.

Time management was also a complexity. Ordinarily, the class arrangement was in rows and columns which had to be transformed into group learning arrangement in Biology lessons. Learners were rather slow in organising the class into groups. Again time was consumed in distributing textbooks, apparatus and specimens, which activities are rare during traditional

teaching methods. This could be one reason learners and teachers complain that CL is slow in coverage. Due to poor time management, sometimes the next lesson was probed into, which used to make some learners grumble. And, much as learners were eager to give their contributions, some had challenges with self-expression. The class had to be patient, supportive and understanding to such individuals by giving them ample time to give their responses.

5.6 Conclusion

In conclusion, teacher-led pedagogies dominated the teaching/ learning process in the department rendering learners passive in classroom. This learner was passive both in knowledge creation and skills development. There is need for teachers to realise that we are training learners for the world of work, which demands tangible skills for the welfare of that individual and the society at large. These skills are better acquired through the learner centred approaches which also train social skills in learners. So teachers ought to incorporate learner centred pedagogies for use in classrooms at all possible costs.

NHT strategy was found more significant in engaging students in classroom activities than jigsaw strategy. It was evidenced that NHT was more applicable, adaptable and sustainable in engaging learners. Therefore, a teacher should endeavor to identify an appropriate cooperative strategy to employ for a particular class, stream, lesson or part of lesson, to maximize learners' participation. Additionally, cooperative learning through formation of heterogeneous groups encouraged learners to engage in effective discussions in the classroom. The learners were able to teach themselves through the phenomenon of MKO which resulted into better understanding of content, later leading to improved individual scores.

NHT strategy proved to sustain active participation in learners throughout the teaching/ learning process, motivated learners, increased students' understanding of Biology, improved teacher- student relationship, improved learners' soft skills such as communication, teamwork, cooperation, interaction, leadership, presentation, self-confidence and several others. These are skills most craved in the world of work that learners acquire through cooperative learning.

These commendable fruits of cooperative learning, offer awesome rewards to the curriculum (Agirreazluenaga, 2020), such as individuals who are job creators other than job seekers, competent to harness and manipulate issues in the world of work, can fend for themselves and also contribute to the development of society and the nation at large.

5.7 Recommendations

In light of the study findings pertaining to improving participation of learners in the classroom using NHT strategy supported in cooperative learning, the following recommendations were suggested:

5.7.1 Recommendations to students

For a student to optimally benefit in cooperative learning, he/she should actively participate in all group activities as guided by the teacher.

Students should seek for a more knowledgeable person (fellow student, teacher, elder in the community, parent) to share ideas about a given task to foster understanding of knowledge..

5.7.2 Recommendations to teachers

Teachers should give students opportunity to build their own knowledge by using learner-centred pedagogies such as NHT strategy supported in cooperative learning, making learners interact with the content and amongst them.

Teachers should do adequate supervision to ensure that all students are participating; groups are on course and against any other eventualities.

Teachers should purposefully form heterogeneous groups to foster effective discussions between the more knowledgeable learner and the low achieving learner.

Teachers should be life-long learners always ready to learn new learner-centred approaches to sharpen one another in the career.

5.7.3 Recommendations to the administration in the school

To encourage the adoption of cooperative learning incorporated with NHT strategy in the teaching /learning process of Biology classrooms.

To consider hosting sensitization workshops for teachers on the importance, effectiveness and implementation of cooperative learning.

To ensure implementation of the strategy through supervision at classroom level.

5.7.4 Recommendation to MoES

To consider institutionalizing Continuous Professional Development (CPD) courses for all secondary school teachers so as to foster understanding of active participation approaches.

To put up stringent supervisory measures of ensuring establishment of active participation approaches at classroom level.

Teacher training institutions to consider integrating cooperative learning/ strategies in the pre-service curricular of science teachers in order to give them exposure to active participation learner approaches.

5.7.5 Recommendation to the government of Uganda

To finance the following interventions: establishment of CPD courses for secondary school teachers, supervisory measures for implementing learner-centred approaches, building of school laboratories and provision of some basic instructional materials to schools.

5.8 Suggested fields of further research

- i) To investigate the progressive improvement of each individual member in a group.
- ii) To investigate the use of NHT cooperative strategy in other science subjects.
- iii) To investigate other cooperative learning strategies that improves participation of learners in Biology classrooms.

5.9 Dissemination of research findings

The researcher intends to

- i) Collaborate with her supervisors to publish an article in a recognized journal.
- ii) Request for permission to conduct teachers' sensitization workshops especially in Luteete SSS, Ndejje SSS and SESEMAT (Luwero Region).

iii) Continuously implement findings in the researcher's classes that contribute to effective learning of Biology in secondary education.

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APPENDICES

Appendix I. Introductory letter

APPENDICES

Appendix 1. Introductory letter


KYAMBOGO UNIVERSITY
 P. O. Box 1 Kyambogo, Phone: 041-285001/2 Fax: 041-220464
 www.kyambogo.ac.ug
 FACULTY OF VOCATIONAL STUDIES
 DEPARTMENT OF ART & INDUSTRIAL DESIGN
MASTERS IN VOCATIONAL PEDAGOGY PROGRAMME

15th September, 2018

The Headteacher
 Lukete S.S.S.

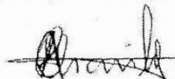
RE: INTRODUCTION OF NJOGEDDE JULIET.

This comes to introduce to you NJOGEDDE Juliet a student of Masters in Vocational Pedagogy (MVP) Programme at Kyambogo University. This student bears registration 17/U/17434/GMVP/PE and in her final year. As a requirement for graduation, this student is expected to carry out Action Research through a collaborative process with World of Work.

Any support rendered to her is highly appreciated.

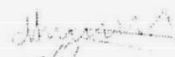
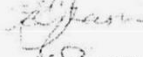
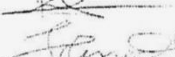
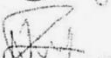
Looking forward to your usual support.

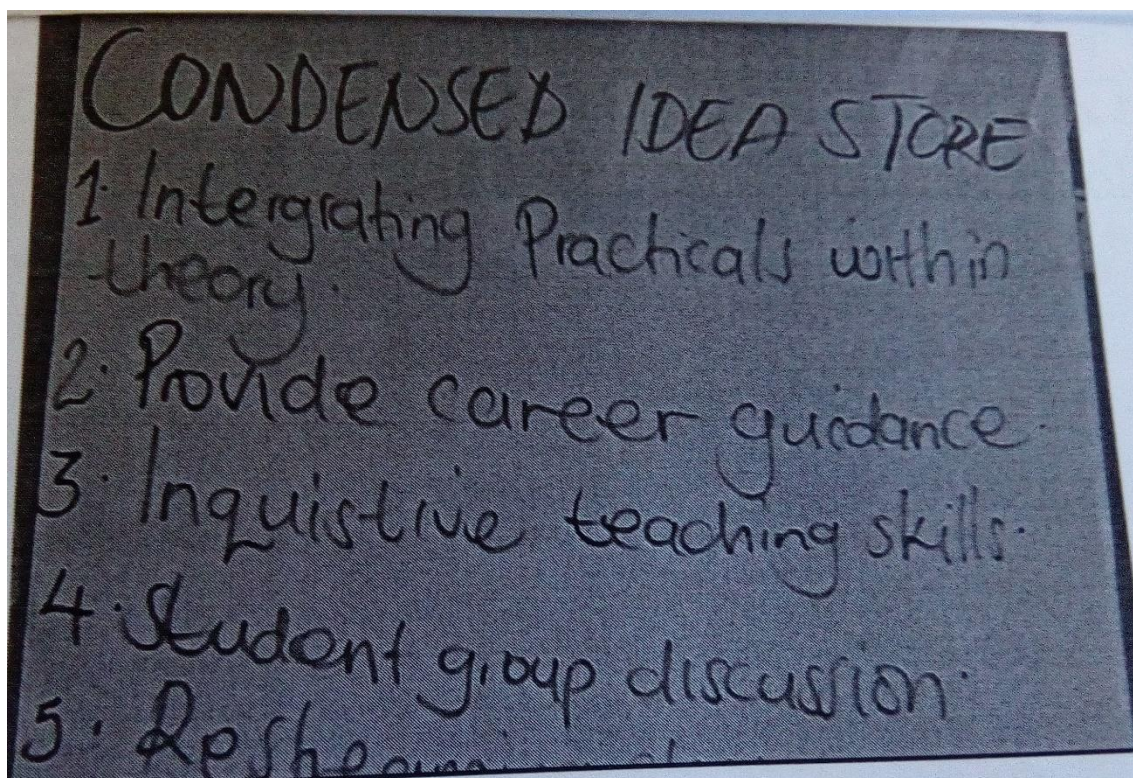
Yours Sincerely,



Chris Serwaniko
 Project Coordinator, NORHED MVP Project
 Masters in Vocational Pedagogy Program

Appendix II: Attendance list of Stakeholders in the Future Workshop

ATTENDANCE LIST OF THE FUTURE WORKSHOP ON 18 TH FEBRUARY 2019 IN LUTEETE SECONDARY SCHOOL STAFF ROOM		
NAME	DESIGNATION	SIGNATURE
1- ODONGO JACKSON	TEACHER	
2- ALI KASSIM	TEACHER	
3- KATENDE RIMUEL	STUDENT	
4- OMODO DANIEL	STUDENT	
5- OTILA ANIKROSE	STUDENT	
6- NAKIBINGE RONALD	STUDENT	
7- NDAGIRE SARAH	STUDENT	
8- SSEROLIMA BIAH REAGAN	STUDENT	
9- KWAGHAKWIE AMOS	STUDENT	
10- OTOK WALTER	STUDENT	
11- MPALIRE PAVIN	STUDENT	
12- LUSWATA EDWARD	STUDENT	
13- KAKOZA GABRIEL	STUDENT	
14- KAMOGA SHANITAH	STUDENT	
15- NAZIWA CLARYS	STUDENT	
16- NAMUKASA PROSS	STUDENT	
17- ALAKASYITI STELLAH	STUDENT	
18- KATEREKKA ARAFUTA	STUDENT	
19- SEMWAGIRE EDWARD	TEACHER	
20- AARON JOHN BAPTIST MATEKA	SUPERVISOR	

Appendix: III. Idea store

Appendix IV: Pairwise matrix

	1	2	3	4	5	Tally	Rank
1		1	1	4	5	//	2
2			2	4	5	/	4
3				4	3	/	4
4					4	////	1
5						//	2

KEY

Where,

1 = Integrating Practical with Theory

2 = Provide Career Guidance

3 = Inquisitive Teaching Skills

4 = Student Group Discussions

5 = Re- streaming Classes

Appendix V: Action Production Plan

ACTIVITY	KEY PEOPLE	INDICATORS	TIME FRAME
Preparation for Cooperative learning	-Administrators -Teachers -Student participants -Lead researcher	Meeting	16 th -20 th May 2022
Cooperative learning Implementation Pre test	-Teachers -Students -Lead researcher	-Question Paper -Answer Sheets	23 rd May-29 th June 2022
Cooperative learning using NHT & Jigsaw Strategies	-Lead researcher -Teachers -Students - Laboratory technician -Lead researcher	-Attendance Lists -Observation check list -Assessment Forms -Photographs	
Monitoring	-Teachers -Administrator -Lead researcher -Teachers -Students	-Observation checklist -Assessment Forms -Group assignments - Students' Note Books	
Assessment			
Cooperative learning Evaluation Post test	-Lead researcher -Teachers -Students	-Question Paper -Answer Sheets	30 th June-6 th July 2022
Evaluating Process	-Lead researcher -Administrator -Teachers - Laboratory technician - Students	-Attendance List -Focus Group guide	

Appendix VI: Evaluation focus group discussion guide

NHT AND JIGSAW STRATEGIES TO ENHANCE PARTICIPATION OF LEARNERS DURING GROUP LEARNING AT LUTEETE SECONDARY SCHOOL.

EVALUATION FOCUS GROUP DISCUSSION GUIDE

- What are the current teaching/learning methods employed in the Biology department?
- From your experience what is group learning/teaching method?
- What is the role of the teacher in GL?
- What is the role of the teacher in other traditional teaching/learning methods?
- What were the strengths (advantages) of GL compared to other traditional teaching /learning methods?
- What were the weaknesses (disadvantages) of GL compared to other traditional teaching/learning methods?
- What were the two group learning models adapted in this research/ study?
- Were the models effective in enhancing active participation of students in the lessons?
Give your reasons.
- As an individual, which was your preference (model) and why?
- In your opinion, how did active participation during lessons improve on your understanding of content?
- Would you desire to have more GL in your teaching/learning process?
- What are your general comments about GL?

Appendix VII: Students Evaluation Interview Guide

NHT AND JIGSAW STRATEGIES TO ENHANCE PARTICIPATION OF LEARNERS DURING GROUP LEARNING AT LUTEETE SECONDARY SCHOOL.

STUDENTS EVALUATION INTERVIEW GUIDE

- What are the teaching/learning methods most used in your Biology lessons?
- From your experience, what is group learning?
- What were your positive areas and strengths during GL?
- What were your negatives and/or weaknesses during GL?
- How did you rate your level of participation in GL compared to the normal teaching/learning methods?
- In your opinion, did you level of participation in class improve your understanding in Biology? Give reasons.
- What was/were your preference(s) model(s)? Give reasons.
- Would you desire to have more GL lessons? Give reasons.
- What are your general comments about GL?

Appendix: VIII: Observation checklist

NHT AND JIGSAW STRATEGIES TO ENHANCE PARTICIPATION OF LEARNERS DURING GROUP LEARNING AT LUTEETE SECONDARY SCHOOL.

OBSERVATION CHECKLIST

Class observed:

Date

Time

Topic/subtopic

Cooperative strategy:

Observer

No.	Items	Indicators	Comments
1	Attendance	-Number of students.	
		-Number of girls.	
		-Number of boys.	
2	Type of content delivery	-Theory:	
		-hands-on	
		i) Type :	
		ii) Availability of materials. Adequate/Inadequate	
		iii) Equipment functionality Good condition/Needs maintenance/Needs replacement	
		iv) Readiness of technician Active/Passive	
		v) Health & safety precautions	
		vi) Improvisation. Needed/Not needed	

3	Participation Indicator	Group Participation i) Group on task Yes/No ii) Interaction within group Active/Passive	
		iii) Assignment completion Completed/Not completed	
		iv) Interaction with textbooks Active/Passive	
		Individual Participation i) Interaction with content Active/Passive	
		ii) Homework completion. Completed/ Incomplete	
		iii) Writing notes. Active/ Passive	
		iv) Questions asked. Stimulating/Not stimulating/No question asked	
		v) Listening. Active/ Passive	
		vi) Confidence in presentations. Confident/ Not confident	
		vii) Facial expression. Excited/Bored	
4	Teacher/Student Interaction	Active/Passive	
5	Lesson conclusion	Type of formative assessment	

Brief Comments

.....

.....

Appendix IX: Self and group assessment form

NHT AND JIGSAW STRATEGIES TO ENHANCE PARTICIPATION OF LEARNERS DURING GROUP LEARNING AT LUTEETE SECONDARY SCHOOL.

SELF AND GROUP ASSESSMENT FORM

Student's name:

Group number:

Date:

Evaluate your performance in this lesson by ticking the most appropriate response.

Statement	Well done	Fairy done	Least done
Contributed ideas to the group			
Listened to and respected my group members			
Came to class prepared to work			
Found appropriate materials for the lesson			
Cooperated with my group members			
Concentration while reading text			
Homework completion			
Asked relevant/searching questions			
Made my brief notes			
Paid attention to instructions			

i) What task did you perform for the group?

.....

.....

.ii) What do you think was your greatest strength from the list above?

.....

.....

iii) What do you think was your weakness that you should work on in your next lesson?

.....

.....

Evaluate each group member's performance:

Group Member's Name.....

Statement	Well done	Fairy done	Least done
Contributed ideas to the group			
Listened to and respected my group members			
Came to class prepared to work			
Found appropriate materials for the lesson			
Cooperated with my group members			

i) What task did she/he perform for the group?

.....

.....

ii) What do you think was her/his greatest strength from the list above?

.....

.....

iii) What do you think was her/his weakness that should be improved in next lesson?

.....

.....

Appendix X: Group assessment form

NHT AND JIGSAW STRATEGIES TO ENHANCE PARTICIPATION OF LEARNERS DURING GROUP LEARNING AT LUTEETE SECONDARY SCHOOL.

GROUP ASSESSMENT FORM

Group number:

Group leader:

Date:

Topic:

i) What did you like most in the lesson?

.....

Reason

.....

ii) What did you dislike in the lesson?

.....

Reason

.....

iii) Have you completed the assignment? Yes/No

If no, what could be the reason?

.....

.....

iv) How do you rate the group in terms of group members' participation?

A Excellent B Very good C Good D Fair E Poor

vi) Any other comments.

.....

.....

Appendix XI: Consent Form for study participants

Date.....

Dear

I am Njogedde Juliet, a masters of vocational pedagogy (MVP) student at Kyambogo University.

I am pleased to invite you to participate in a research study on the use of group learning strategies to enhance participation of students in the Biology classrooms in Luteete Secondary School.

You are specifically invited to participate in this study because I believe as a stakeholder; you have, in one way or the other, a part to play in improving the teaching and learning of Biology in Luteete Secondary School.

Background Information of the study.

The purpose of this study is to improve students learning of Biology through active participation based in group learning.

By the end of the study, we seek to have:

- i) Established the current teaching/ learning methods of Biology in Luteete Secondary School.
- ii) Established and utilized the adapted group learning strategies in group learning as an alternative teaching/learning method in Biology.
- iii) Evaluated the effect of the adapted group learning strategies in the group learning method.

Procedure

If you agree to be in this study, you will be asked to:

- Participate in the preparation meeting for implementation of group learning method in the teaching/learning of Biology.
- Participate in classroom activities as the adapted group learning structures are implemented
- Participate in availing laboratory materials and apparatus for hands-on activities through timely requisitions, purchases and improvisations where applicable.
- Participate in acquisition of scholastic materials to effect the implementation of group learning in the teaching/ learning of Biology.
- Participate in Focus Group Discussion (FGD) to evaluate the effect of the adapted group learning strategies.
- Give permission to have your audio and video responses- taped and transcribed.
- Give permission for your photos to be taken during the study, and to be used in the report of the study.
- Take part in the follow up of the interventions.
- Exercise your rights to withdraw from participation in the research if need arises.
- Participate voluntarily since no incentives are available for participants.
- If you require any information about this study, or would like to speak to the researcher, please call Njogedde Juliet at +256772654882 or contact office of Directorate of training and graduate research at Kyambogo University at +256414285037.
- I have read the above information regarding this research study and consent to participate.
- Participant.....Date.....
- Researcher.....Date.....

Appendix XII: NHT Cooperative Strategy Lesson Plan

Subject: Biology	
Topic: Movement Into and Out Of Cells	
Sub-topic: Osmosis-Demonstration of osmosis using non-living things (visking tube)	
Name of teacher: Ms Juliet Njogedde	
Name of School: Luteete Secondary School	
Class: S 3 East	Number of learners: 58
Date: 8 th June 2022	Duration: 80 minutes

RATIONALE

Content: Demonstration of osmosis using non-living things.

Social objectives (Life skills and Values): Interaction, communication, presentation, reasoning.

Strategy: NHT Strategy supported in cooperative learning, Brainstorming, question and answer

Position: .3/36

Academic objectives (Subject competences): To set experiment following procedures, make correct observations and inferences, identify the hypotonic solution with reasons, and identify the hypertonic solution with reasons, to state the direction of water molecule movement.

Prerequisite Skills: Manipulation, Observation, Recording, Comprehension, making inference

Prerequisite Knowledge: Definition of osmosis and terms used in osmosis; hypotonic, hypertonic and isotonic solution.

Teaching/learning materials/resources: Two 10 cm visking tubings (VT), two 10cm long threads, distilled water, 50% sucrose solution, 2 test tubes, test tube rack, stop clock for each group.

References: Jones, G., Jones, M (1987), BIOLOGY, GCSE Edition, New York, Cambridge Press

Lubega,E., Bagonza,E., Asiimwe,A.,and Kanyomoza,I.(2021), New Lower Secondary School Curriculum, Biology Senior 2, Learners' Book2,Kampala, Baroque.

Lesson Flow

Step (Time)	Teaching/learning activities	Learning Points	Remarks
Introduction 7:40-7:45am	Initial Question: What is hypertonic and hypotonic solutions?	Hypertonic solution is one which is more concentrated than the surrounding solution. Hypotonic solution is one which is less concentrated than surrounding solution.	
Development 7:45-7:55am	Introduction of new lesson by membrane to be used in activity and giving objectives of the lesson. displaying the visking tube as a non-living semi-permeable	Visking tube is a transparent polythene-like membrane that is used to demonstrate osmosis in non- living things.	
7:55-8:00am	Collection of materials, apparatus and learners' text books.	Picking of materials, apparatus and learners' books.	
8:00-8:40am	Experiment is set, observations are recorded, and questions are discussed.	Setting experiment, recording results, discussing questions in various groups.	
8:40-8:50am	Plenary discussions guided by NHT strategy of questioning.	Volume of contents in VT at end of expt., VT a semi-permeable membrane, which is the cell membrane in animal cells.	

Conclusion 8:50-8:55am	Teacher wraps up lesson with summarizing the discussion and giving an assignment for further investigations.	Distilled water (hypotonic), Sugar solution (hypertonic), correct direction of water molecule movement.	
8:55-9:00am	Self and group evaluation	Reports on what went on well, or failed in lesson& how to improve.	
Assignment: i) What is active transport? ii) Give three significance of active transport in living things. iii) Compare diffusion, osmosis and active transport. (Assignment to be discussed in groups, and to be graded)			

Self-Evaluation

Strength(s).....

.....

.....

Area to Improve.....

.....

Way Forward.....

Appendix XIII: Results of Group Assignments

SN	Group Number	Assignment 1/10	Assignment 2/15	Assignment 3/15
1	1	05	05	06
2	2	08	06	09
3	3	04	09	12
4	4	03	06	07
5	5	05	10	12
6	6	05	08	06
7	7	06	10	11
8	8	04	08	09
9	9	04	10	11
10	10	03	08	09