Addis Ababa University

College of Natural and Computational Sciences

Department of Zoological Sciences

Effects of student-centered methods on achievements of students in learning biology: the case of Meskerem Secondary School

By

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A MSC Thesis

Submitted to the Department of Zoological Sciences in partial fulfillment for the requirement of the Degree of Masters of Sciences in Biology

Advisor: Dr. Sutuma Edessa

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This is to certify that the Thesis prepared by **Tamiru Shumi** entitled**: "**Effects of student-centered methods on achievements of students in learning biology: the case of Meskerem Secondary School**"** and submitted to the Department of Zoological Sciences in partial fulfillment for the requirements of the Degree of Masters of Sciences in Biology complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

By Tamiru Shumi_____

Signed by the Examining Committee:

Examiner _____Signature _____Date _____

Advisor _____Signature _____Date _____

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Head of the Department or Coordinator

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Acronyms used in this text

AD Average difference

D Difference mean

H_0 Null hypothesis

H_a Alternative hypothesis

NTL National training Laboratories

PBL Project-Based Learning and Problem-Based Learning

S standard deviations

SC Student-Centered Teaching Methods

SCI Student-centered instruction

SCL Student-centered learning

SCT Student-centered teaching

SD Difference of standard deviations

SSD Square of score difference

TCL Teacher-Centered Teaching Methods

Abstract

The purpose of this study was to improve the Biology Achievement of Students through Student-Centered Teaching Methods in Biology Classes. The student-centered teaching method of teaching prepares the students to solve problems, makes them creative, and uses information from their environment and other sources to make a better life for themselves and society. The rank of students' biology achievement in Biology class was very poor as observed the students' scores. The sample includes respondents selected by using a simple random sampling technique from the randomly selected two classes of Meskerem Secondary School grade 10 students and biology teachers selected by using purposive technique. Grade 10 students and biology teachers of the schools were the source of the data. Data was collected by using students' tests and teachers' interviews. The collected data was analyzed and interpreted statistical by using tables, graphs, percentages and t-test. The study also revealed that biology teachers were habituated to implement teacher-centered teaching methods of teaching. The students' biology achievement that learned through student-centered teaching method was improved than the teacher-centered teaching method in grade ten biology classes. In general, the Student-centered teaching method was an approach to learning which focus mainly on the interests of the students and transfer the focus of activity from the teachers to the learners. It increases learner autonomy and independence by putting responsibility for the students by imparting to their skills and the basis on how to learn a biology subject.

Key words: Academic achievement, Effect, Student-centered, Teacher-centered and Methods

Chapter one

1. Introduction

1.1. Background of the study

The main purpose of teaching at any grade level is to bring a behavioral change in the learner. These behavioral changes maybe including the change of academic skills, solving problems, increase desirable attitudes and values. Teachers must implement different teaching methods to help students to get knowledge, skill, experience, and retain knowledge for long life. The students who get knowledge, skill, experience, and retain knowledge can improve their academic achievement when they solve different problems, illustrate concepts and principles, demonstrate procedures, and clarify points of likely confusion by their own through reading. Ganyaupfu, (2013) states, that teaching is a procedure that includes bringing approximately perfect modifications in students with a view to acquire precise outcomes. In order for the approach used for teaching to be effective, keeps that instructors want to be conversant with sever teaching(Adunola, 2011).

To improve students' biology achievement, the teachers must use effective teaching methods that increase learner participation in the teaching and learning process (Muraya, D. N., & Kimamo, G. 2011). To gain the intention of teaching, the teacher needs to undertake powerful teaching strategies in education. He/she has many alternatives to select from one of a kind teaching strategies designed especially for teaching and getting to know. Powerful teaching is regularly characterized via way of means of the active involvement of students and an emphasis on instructional achievement. The position of the teacher is visible as a facilitator of learning as opposed to a supply of know-how to teach (Sturtridge, G. 2014).

Effective use of learning methods can greatly improve students' academic achievement. Poor academic achievement has been blamed on poor teaching methods. Learning method has been considered as important factors in improving students' academic achievement. Research experiences show that the student-centered teaching method of instruction is more effective than traditional learning (Emaliana, I. 2017).

A compatible learning style with the teaching style of a course instructor enables the students to retain the information much longer, apply it more efficiently and effectively, and have more positive post-course attitudes toward the subject than their counter parts who experience learning/teaching styles mismatches. In other words, since there are individual differences in learning style, adapting academic materials to these differences will facilitate learning and thus help increase learning

benefits “especially for low and moderate achieving students” (JilardiDamavandi, Mahyuddin. 2011). Therefore understanding students’ learning styles and their impact on their academic achievement is important for teachers for it is the first step in ensuring students’ achievement.

There are many variables that can impact successful student achievement, but the most critical are classroom instruction and learning disabilities. It is important to remember that all students do not learn the same way or at the same rate(Jenson, Petri et al. 2011). Students are like leaves on a tree; there are no two exactly the same. Just as a leaf comes in unique colors, shapes and sizes, each student has their own unique learning style. The teachers must use a variety of teaching methods and understand the background and individual needs of each student (Narmaditya, Winarning et al. 2017).

Academic achievement describes academic outcomes that indicate the extent to which a student has achieved their learning goals. Academic achievement may refer to completing educational benchmarks such as a diploma, bachelor’s degree and masters. Academic achievement is often measured through examinations or continuous assessments.

Academic achievement is the extent to which a student or institution has achieved either short or long-term educational goals. Achievement may be measured through students’ grade point average, whereas for institutions, achievement may be measured through graduation rates and tests. Effective use of learning methods can greatly improve students’ academic achievement. Poor academic achievement has been blamed on poor teaching methods. Learning method has been considered as important factors in improving students’ academic achievement. Research experiences shows that the best designed learning method of instruction is more effective than traditional learning (teacher centered method of instruction) (Kang’ahi, Indoshi et al. 2012).

Furthermore, there are inconclusive results over which individual factors successfully predict academic performance, elements such as test anxiety, environment, motivation, and emotions require consideration when developing models of school achievement.

There are two basic teaching approaches. Those are: teacher-centered teaching approaches and student-centered teaching approaches.

Teacher-centered approaches are more traditional in nature, focusing on the teacher as instructor. They are sometimes referred to as direct instruction, deductive teaching or expository teaching, and are typified by the lecture type presentation. Direct instruction is a term often used to describe a variety of whole class expository teaching techniques. It is sometimes referred to as ‘chalk and talk’.

It is a teacher-centered approach in which the teacher delivers the academic content in a highly structured format, directing the activities of students and maintaining a focus on academic achievement. Common forms of direct instruction include lectures and demonstrations. Direct instruction is not always appropriate, since it is not always the most effective way to help students learn. Teacher-Centered learning (TCL) is considered as an approach using instruction to transfer knowledge to students (UTAMI, 2020). In these methods of teaching, the teacher controls what is to be taught and how students are presented with the information that they are to learn. A teacher-centered approach is a kind of approach which focuses on teaching than learning (Yousif, 2020). The shortcomings of teacher-centered have led to bring about changes for the new learner-centered or active learning method. The new method paves the way for the learner's active participation under the guidance of the teacher or in a personal initiative forms. These approach adheres to the strong assumptions of the learner to be active than passive (Norman, 2003).

Student-centered approaches learning, also known as learner-centered education broadly encompasses methods of teaching that shift the focus of instruction from the teacher to the student. In original usage, student-centered learning (SCL) aims to develop learner autonomy and independence (Lee and Hannafin ,2016) by putting responsibility for the learning path in the hands of students.

Student-centered instruction (SCI) is an instructional approach in which students influence the content, activities, materials, and pace of learning. This learning model places the student in the center of the learning process. The instructor provides students with opportunities to learn independently and from one another and coaches the students in the skills they need to do so effectively. The SCI approach includes such techniques as substituting active learning experiences for lectures, assigning open-ended problems and problems requiring critical or creative thinking that cannot be solved by following text examples, involving students in simulations and role plays, and using self-paced and/or cooperative(team-based) learning. Properly implemented SCI can lead to increased motivation to learn, greater retention of knowledge, deeper understanding, and more positive attitudes towards the subject being taught (Jony, 2016).

According to (Jony, 2016)Student-centered instruction is an approach to learning which focus mainly on the interests of the students, rather than teachers and administrators and transfer the focus of activity from the teachers to the learners. These methods include active learning, in which students solve problems, answer questions, formulate questions of their own, discuss, explain,

debate, or brainstorm during class; cooperative learning, in which students work in teams on problems and projects under conditions that assure both positive interdependence and individual accountability; and inductive teaching and learning, in which students are first presented with challenges and learn the course material in the context of addressing the challenges. Inductive methods include inquiry-based learning, case-based instruction, problem-based learning, project-based learning, discovery learning, and just-in-time teaching(Prince and Felder, 2006).

Biology is the study of living things. In general, biologists look at the structure, function, growth, origin, evolution and distribution of dwelling organisms. (Gambari, Yaki et al. 2014).It helps learners to have insight on natural and environmental concepts, principles, theories, and laws. Among others, the objectives of teaching biology at secondary school level involve the ability of the learners to develop an awareness of the environment, to have meaningful and relevant knowledge in biology necessary for successful living in a scientific and technological world and to make room for technological development. Additionally, knowledge of biology is a requirement for many fields of study that have a vast contribution to the technological growth of the nation (Athman and Monroe, 2001).These are medicine, laboratory sciences, pharmacy, nursing, physiotherapy, and agriculture among others(Annan, Adarkwah, 2019). Hence, the introduction of Biology to secondary school students is a crucial step towards grooming them for a successful promotion from class to class and career with good grade(Annan, Adarkwah 2019).

The problems of student's under achievement in biology have been observed by many researchers and viewed in different angles due to its diversity. Sharan, (1980)put it that "directly or indirectly classroom interactions are controlled by the teacher for it is he who promotes particular learning situation through his choice of objective, organization of experience, selection of materials and methods in order to facilitates the students' academic performance. Ali, A.R.,Toriman, M.E. and Gasim, M.B. (2014).attached the problem with inadequate supply of teaching and learning resources such as chemicals, charts, apparatus, models, local specimens, laboratories, textbooks, and libraries led to poor performance in Biology. They added that irregularities related to the teacher of Biology such as irregularity in administration of practical, class discussion, teachers not allowing students to ask questions, teachers not giving prompt feedback on assignments or exams, by not making the Biology subject interesting and teachers not conducting demonstration during practical.

Student-centered learning (SCL) needs a more consistent and solid identity and teachers need a generally agreed model of SCL that is better defined, based on a combination of theory, practice and evidence, utilizes technologies to their best advantage and is underpinned by effective assessment strategies. Teachers need a deep understanding of what constitutes the successful practice of SCL and what the best outcomes for students "look like". It is only then that we can hope to see the kind of seismic shift required in teachers' attitude, approach and practice to make SCL a genuinely beneficial mode of education and only then that we can hope to empower teachers in using student-centered learning methods improving the Academic Achievement of Students (Attard, Di Iorio et al. 2010).

To implement the student-centered learning (SCL) method, it needs a more consistent and solid identity of teachers and needs a generally agreed model of SCL that is better defined, based on a combination of theory, practice, and evidence utilizes technologies to their best advantage and is underpinned by effective assessment strategies. To use this method to improve students' achievement systematically shift required in teachers' attitude, approach and practice to make SCL a genuinely beneficial mode of education, and only then that we can hope to empower teachers in using student-centered learning methods to improve the Academic Achievement of Students. This is the reason why the researcher was initiated to does research on "improving the academic achievement of students through student-centered teaching methods in biology classes.

1.2. Statement of the problem

The student's academic achievement has become a hot topic in education today, especially for the teacher has a responsibility to improve students' biology achievement (Pooja, 2017). The ultimate goal for any teacher is to improve the ability level and prepare students for educational maturity. Defining students' academic achievement and factors that impact progress is critical to becoming a successful teacher. Each grade level has learning goals and prepared teaching methods to achieve the learning goal. Students' biology achievement will increase when a quality teaching method is used in class (Stronge, Ward, 2007).

The successful teaching method is good results in improving students' biology achievement. However, knowing the 'what' and the 'how' is just the first step to improve students' biology achievement. Understanding the factors that can impact a student's ability or style to learn is very important.

Robin, B. (2006, March). Put, a good teacher will use different teaching methods such as discussion methods, stories, videos, to gain student attention and to support the learning process. The teacher should constantly be thinking of ways to make learning fun and appropriate. Based on these it has been observed that poor academic achievement in the biology class is caused by using ineffective teaching methods by teachers and lack of suitable adequate science equipment.

In general, the researcher (teacher) was observed many problems that cause poor students' biology achievement in biology class during his working experience in the school. Those problems were: The teachers focus on teaching processes to cover the subject portion but not focus on learning styles of students how they understand the subject matter. The interest of teachers to use student-centered teaching methods was very low because of the shortage of time. Most teachers used teacher-centered teaching methods because; their objective was portion coverage rather than subject matter understanding of students. The students' have no interest to discuss in a group and to present what they discuss in their group, and they copy the given assignment from other students. In addition, there were no sufficient laboratory materials that support students to participate in laboratory practice. From those problems, the researcher focus on the effects of student-centered teaching methods on students' biology achievement in biology class in Meskerem Secondary School.

The following table1 shows grade 9 students first semester biology analyzed marks in 2013/2020 academic calendars in Meskerem Secondary School. The analyzed were done for 102 male and 130 female total 232 grade 9 students, 95 male and 151 female total 246 grade 10 students and 14 male and 30 female total 44 grade 11 students.

Table 1 Grade 9-11 students' biology analyzed mark

Grade	Above 50				Blow 50				From 50-74				From 75-84				From 85-100			
	M	F	Tot	%	M	F	Tot	%	M	F	Tot	%	M	F	Tot	%	M	F	Tot	%
9	61	94	155	66.8	42	35	77	33.2	47	82	129	55.6	3	8	11	4.7	1	3	4	1.7
10	81	121	202	82.1	15	30	45	18.3	65	85	150	61.0	2	23	25	10.1	12	14	26	10.6
11	11	27	38	86.4	3	3	6	13.6	9	19	28	63.6	1	6	7	15.9	1	2	3	6.8

Source: Meskerem Secondary School (2013/2021)

1.3. Objectives of the study

1.3.1. General objective

The general objective of this thesis is to study the effect of student-centered teaching methods to improving the biology achievement of students in biology classes.

1.3.2. Specific objectives of the study

The specific objectives of the study are to:

1. Improve the biology achievement of grade 10 students in biology classes
2. Employ both teacher-centered and student-centered teaching methods.
3. Compare and contrast the biology achievement of students in both methods
4. Investigate the challenges of using student-centered teaching methods in biology classes?

1.4. Research question

1. What methods can improve the biology achievements of students in biology classes?
2. Can student-centered methods of teaching improve the academic achievement of students?
3. How can compare and contrast the biology achievement of students in biology classes?
4. What are the challenges of using student-centered teaching methods in biology classes?

1.5. Significance of the study

It is proved that the student-centered teaching method of teaching prepares the students to solve problems, makes them creative, and uses information from their environment and other sources to make a better life for themselves and society(Brush and Saye 2000). Based on this notion, the researcher was implementing the student-centered teaching method to improve the academic achievement of students.

Therefore, the result of this study has the following significance:-

1. It may help planners, educational officials, and policymakers to be aware of the problem of implementation of student-centered **t**eaching methods and thereby to seek solutions.

2. It will enable the teachers to gain valuable information on the actual status of the teaching-learning process and the implementation of student-centered teaching methods to improving the academic achievement of students.

3. It may encourage other interested bodies to be involved in strengthening the implementation of the active learning method to practical conditions to improving the academic achievement of **s**tudents.

4. It increase classrooms foster community and collaboration among students and encourage students to take responsibility for their own learning.

1.6. Limitation of the study

The researcher strongly agrees that the inclusion of all the Addis Ababa city schools and population size in the study can help to get more relevant and broader information. However, because of time, financial, and other resources constraints the researcher cannot able to conduct the study in depth. The researcher also believes the importance of including content analysis in the study is more reliable and stronger in its evidence but due to time and other resources constraints, the study data has been limited on students test and teachers interviews.

1.7. Delimitation of the study

This study is delimited to Addis Ababa city, Arada sub-city, Meskerem Secondary Schools. It only focuses on improving the academic achievement of grade 10 students' through student-centered teaching methods in biology classes.

1.8. Organization of the study

This particular study was well organized made into five chapters. The first chapter offers the opening introductory portion of the study that contains a background of the study, statement of the problem, key research questions, general objectives of the study, specific objectives of the study, significance of the study, limitation or delimitation of the study, and organization of the study.

The second chapter involves a review of related literature and conceptual framework that argues the idea of student-centered teaching methods.

Chapter three, issued with the research design and methodology of the study. Chapter four consists of analysis, results and discussions and chapter five consisted of summary, conclusions and recommendations. At the end there were reference and appendix.

Definition of terms used in the text

Academic achievement: It is the extent to which a student, teacher or institution has attained their short or long-term educational goals. Completion of educational benchmarks such as secondary school diplomas and bachelor's degrees represent academic achievement.

Active learning: It refers to active involvement of the learners on different learning tasks within and out of the classroom. It includes group work, role-playing, discussion, etc.

Implementation: It is how teaching – learning activity put into practice in or out of the classroom by teachers or students in schools.

Learning strategies: It refers to a set of skills that students use to understand different tasks. This way, they are able to choose and effectively employ the appropriate technique to accomplish tasks or meet specific learning goals.

Learning styles: A learning style refers to an individual's method of making sense of new material, commonly done through sight, touch and sound. The four key learning styles are: visual, auditory, tactile and kinesthetic.

Student-centered learning: The term student-centered learning refers to a wide variety of educational programs, learning experiences, instructional approaches, and academic-support strategies that are intended to address the distinct learning needs, interests, aspirations, or cultural backgrounds of individual students and groups of students.

Teacher-centered learning: It is more traditional or conventional approach, which the teacher functions in the familiar role of classroom lecturer, presenting information to the students, who are expected to passively receive the knowledge being presented.

Teaching method: It refers to the general principles, pedagogy and management strategies used for classroom instruction.

Chapter two

2. Review of related literatures

This chapter focuses on review of related literature, theoretical analysis and analyzing their research findings which are considered to be relevant to the study.

2.1. Literature review

According to Ganyaupfu (2013), teaching is a non-stop technique that entails bringing approximately suited adjustments in students through use of powerful teaching techniques. Teaching method is the way of teachers delivers the subject matters to students by using different methods corresponding to the learning styles of students that were encountered. Each student has different learning styles from the very fast, moderate and low able to receive lessons quickly. Therefore, a teacher must be able to apply the various learning method in accordance with the learning styles of students. Unless the students whose moderate and low ability will be left behind in the understanding of the material that is presented. And it will be cause the students mentioned are not interested and lazy to learn because cause they have felt unable to do. Teaching method helps to determine the success or failure of learning and teaching activity and it is a unity in teaching system. The more effective method that is used by teachers in teaching is expected to improve the achievement of learning goal (Riqi, Chaniago, 2021).

According to Djamarah (2010) the effective method of teaching is teaching strategy that achieves expected goals subject matter. By using a good method, the teacher will achieve the goal of teaching and learning smoothly. When the goals are formulated in order to students have certain skills, so that the methods that are used must be adapted to goals. Thus teachers should use methods that can support teaching and learning activities, so it can be used as an effective tool to achieve the goal of teaching. Thus basically learning methods are learning methods that are used by teacher to achieve the goals in teaching and learning activity. The effective methods that are used in teaching and learning process to the student are increasing the opportunity to improve their academic achievement in biology subject.

In teacher centered teaching approach, students simply obtain information from the teacher without participation and building their engagement level with the subject being taught (Boud and Feletti, 1999). This approach is low practical, more theoretical and based on memorizing the knowledge (Ganyaupfu, 2013). It does not apply activity based learning to encourage students to learn real

world problems based on applied knowledge. Again in this method the teacher controls the transmission and sharing of knowledge, the lecturer may try to maximize the delivery of information while minimizing time and effort. Because of this, interest and understanding of students may get decrease. To solve such problems, (Fatuma, 2015)specified that teaching should not merely focus on dispensing rules, definitions and procedures for students to memorize, but should also actively offer students as primary participants.

Student-Centered Method with the appearance of the idea of discovery learning, many pupils nowadays broadly be given to apply student-centered techniques to decorate energetic learning (Weiland, 2012). Most teachers today apply the student-centered methods to promote interest, critical thinking and enjoyment among students (Rao, 2016). The student centered teaching method is regarded more effective since it does not centralize the flow of knowledge from the lecturer to the student (Ganyaupfu, 2013).This approach also motivates goal-orientated behavior among students, hence the method is very effective in improving student academic achievement (Zulfiquar and Zamir, 2015).

Student-centered techniques of teaching inspire students assemble their personal knowledge of the content material and broaden a private feeling approximately the learnt concepts (Hynes, 2018). This manner that students focused technique places plenty recognition on enquiry and problem-primarily based totally getting to know there by making students because the middle factor of getting to know. The techniques in Learner centered procedures encompass question, answer, organization work, demonstration, guided getting to know, position play/drama, and assignment primarily based totally getting to know.

Weimer, (2002) defines teacher centered techniques as lecture-primarily based totally teaching in which in students are “passive recipients of knowledge”. She characterizes learner-centered teaching as “teaching focused on learning what the students are doing is the central concern of the teacher”. She describes five ways in which learner-centered teaching departs from the traditional instructional paradigm. First, in learner-centered teaching, the students are the ones who must do the work, the thinking, and the problem-solving in class. Second, educators must demonstrate to students how to do this activity. They must help students develop learning skills, not just content knowledge. Third, students must present not only on what they are learning, but also on how they are learning it (i.e., their experience of learning). Faculty should help students move beyond focusing on grades so they can begin monitoring and assessing their own progress. Fourth, in a learner-centered classroom,

faculty share power (to at least some degree) with students, thereby giving students some choice and control in the learning experience. Finally, learner-centered classrooms foster community and collaboration among students and encourage students to take responsibility for their own learning (Weimer, 2002). There is significant evidence that student centered learning pedagogies are more effective than teacher centered or lecture methods. According to a meta-analysis by Freeman, Eddy (2014) blue right-pointing triangle, classes that incorporate student centered strategies have significantly greater gains in student academic achievement compared with traditional lectures and significantly lower failure rates. The effect of student centered learning pedagogies was so pronounced that Freeman and his colleagues suggested moving onto second-generation studies that focus on comparing student centered learning techniques to determine which practices are most effective and the best way to implement them, and how much student centered learning needs to be implemented to improve academic achievement. Furthermore, many of these methods depend on interactions between students and teachers, and there is mounting evidence that students work in collaborative groups' increases student achievement.(Carey and Evans, 1989)state that, when students work in groups, they have higher understanding knowledge and better motivation toward learning science, and these results applied to all types of students.

Learner-centered teaching often includes active learning, but it goes beyond active learning, as evidenced by Weimer's attention to sharing power and to the importance of promoting metacognition. In the learner-centered teaching method, the students are an empowered, active agent in their own learning (Weimer, 2002).They have the ability to make decision and influence aspects of their learning, such as topics, means of demonstrating their knowledge or skills, deadlines, and class policies. Additionally, both students and teachers in learner-centered methods recognize the importance of metacognition. (Svinicki, 2004) defines metacognition as "the procedure of marshaling a learner's cognitive sources in carrier of learning". Metacognition involves reflecting on the inputs, processes, strategies, preferences, goals, and products of one's own thinking and learning. When faculty integrate activities that promote metacognition, such as goal-setting, reflective writing, and self-assessments, students have the opportunity to increase their self-efficacy and to be more invested in their learning experiences. In short, attending to metacognition fosters deeper learning and greater academic achievement (Svinicki 2004, Young and Fry 2008).

Student-center methods such as cooperative learning open ended assignments, critical-thinking exercises, simulation, and problem-solving activities increase the learners' motivation (Felder and

Brent 1996) Students' responsibility and independence help to develop characteristics of lifelong learners- motivation, self-evaluation, time management and skills to access information. Cooperative learning is an instructional paradigm in which group of students work on structural actives (e.g., assignments, homework, laboratory experiments, reading assignment and projects) under conditions that meet five criteria: positive interdependence, individual accountability, face-to-face interaction, appropriate use of collaborative skills, and regular self-assessment of group functioning(Kaufman, Felder et al. 2000)Many studies have shown that when teachers implemented correctly, student centered learning methods improves information gaining and retention, higher-level thinking skills, interpersonal and communication skills, and self-confidence (Johnson, Johnson et al. 1998) Cooperative learning is learning methods that students work in group. A key difference between cooperative learning and traditional method group work is in the latter, students are asked to work in groups without attention to group functioning, whereas in cooperative learning, group work is wisely prepared, planned, and monitored by leader of group (Jacobs, Lee et al. 1997)Positive interactions do not always occur naturally, and social skills instruction must precede and concur with the cooperative learning strategies. Social skills encompass communicating, building and maintaining trust, providing leadership, and managing conflicts (Goodwin and Jasper 1999).

(Johnson, Johnson et al. 1989)state Co-operative learning experiences, compared to competitive and individualistic ones, promote higher achievement, greater motivation, more positive interpersonal relations among students, more positive attitudes toward the subject area and teacher, greater self-esteem and psychological health, more accurate perspective taking, and greater social skills (p. 8-9). In addition, (Slavin, 1987)show that two conditions must be recognized if cooperative learning is to fulfill its claim of increasing student academic achievement significantly. He believes that "students must be working in active toward a common goal and success at achieving the goal must depend on the individual learning of all group members of students". Though, the student-centered learning method is attracting international researchers in education, very few studies could be found in the previous research which literature relating to the subject of Biology class, especially in Ethiopia. It is, therefore, important to examine the effects of student-centered methods in improving the Academic Achievement of Students in Biology class.

2.2. Conceptual framework

For decades, the student-centered teaching approach, with its conceptual framework based on the constructivism theory (Krahenbuhl, 2016), has been popular among many educators. A conceptual

framework is an analytical tool with several variations and contexts (Ibarra, H. 1993). It can be applied in different categories of work where an overall picture is needed. It is used to make conceptual distinctions and organize ideas. Strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply.

Teachers at various grade levels have been applying the student-centered teaching approach for a deferent reasons: to increase student participation in education (Kelly, 1985), to develop confidence of students (Dandoulakis 1986), to foster the intellectual development of students (Lohman and Finkelstein 2000), to enable students to build multiple historical perspectives (Ogawa, 2001), to improve students' understandings of historical ideas and concepts (Stout, 2004), to shift the learning responsibility to students (Passman, 2000), and so forth. However, little is known on how the student-centered teaching approach has been defined by deferent educators, on the impact of this teaching method upon students' learning and other aspects of their behavior. A study of the research literature seems to be a reasonable way to develop a clear understanding of the active learning or student-centered teaching approach.

The implementation of student centered learning models have positive effects on students' academic achievements and their attitudes to science courses (Odom and Bell 2015), while implementation of student centered learning and group investigation encourages students to think critically through planning, arguing, stating questions and problems, and providing solutions to environmental problems (Jeronen, Palmberg et al. 2017).

Academic achievement is overall performance results that suggest the volume to which a students has completed precise goals that are the focus of activities in instructional environments, specifically in school, college and university (Mimrot, 2016). (Bendixen and Hartley, 2003)define that academic achievement is a multidimensional concept referring to conceptual, factual, procedural and meta-cognitive knowledge achievement.

Academic achievement is measured with the aid of using non-stop checks and checks however there may be no preferred settlement on how it is best evaluated or which aspect are most important procedural knowledge such as skills or declarative knowledge such as facts. (Ward and Stoker, 1996), Furthermore, there are inconclusive results over which individual factors successfully predict academic performance, parts such as test anxiety, environment, test anxiety, motivation and emotions require consideration when developing models of school academic achievement. Now, same schools are receiving money based on its students' academic achievements. A school with

more academic achievements would receive more money than a school with less achievement (Zeidner and Hadar, 2013).

2.3. Benefits of a Student-Centered Approach

A student-centered method is different from teacher-centered instructional model. In a student-centered methods to learning, classrooms move from direct instruction to a more community-driven environment, one which supports student empowerment, critical thinking skills, conversations, independence, and problem-solving techniques. In student-centered instruction, the change begins with the teachers' ability to implement it. These strategies do require and involve students in the overall planning process, implementation, and assessments. It moves the students from passive receivers of information to active participants in their own discovery process.

Benefits of using a student-centered approach to teaching include:

- Improvements in students' communication and collaboration skills
- Advances in students' ability to think and work independently
- Increased student interest in school activities and education in general
- Stronger relationships between students and teachers through shared experiences

2.4. Student-centered teaching strategies

As educators continue to refine and hone their instructional practices, there are several student-centered teaching strategies for implementing a student-centered in classroom:

2.4.1. Choice Boards

This approach allow students to select activities they will complete to practice a skill or demonstrate understanding. In this method of learning, students are given ownership and empowerment opportunities while teachers plan differentiate their instruction. It can be utilized not just for assessment purposes, but also to introduce new material, for supplemental practice, or as a combination of multiple elements of a lesson or unit.

2.4.2. Inquiry-Based Learning

In this learning strategy, student ideas, questions and analysis are highlighted and focusing on the student perspective regarding a particular open question or problem to solve it. This strategy is mainly used for initial student engagement, leading students to move beyond basic knowledge to a deeper understanding of evidence-based reasoning, critical thinking and creative problem solving.

Within this learning strategy, different elements of a lesson can include like group projects, case studies and research projects among others that students solve by their own and provide opportunities for students to hone skills that are highly valuable in the world in which we now live.

2.4.3. Project-Based Learning and Problem-Based Learning

In this studying approach, students work on longer responsibilities or works that finish in form of an authentic product or presentation. This studying approach relies upon closely on student team work, communication and creativity, with the trainer serving as a facilitator student activities and progress.

This learning approach includes shorter projects that examine a current problem, and through definition, research, and causes of the problem, students evaluate solutions together to the chosen problem, solve the problem and report the potential solutions.

2.4.4. Flipped Classrooms

Teachers all ways try to find methods to maximize instructional time in the classroom. A learning style that takes this into account is the use of a flipped classroom. In this learning plan, new content or introduction is delivered to students outside of the classroom. The Learning material can contain videos include readings, pre-recorded presentations or direct instruction and research assignments.

In this method, lecture room time is utilized by the teacher to facilitate getting to know and assist students benefit exercise making use of expertise found out of doors of the lecture room. Instead of the typical "go out price tag or entrance tickets" wherein students hand in a price tag displaying addition questions on understanding, students use "front tickets," wherein they input the lecture room with a finished assignment, written response, quiz, or weblog put up serving as their "price tag or entrance tickets." Ultimately, the flipped lecture room version can include more than one student-centered getting to know strategies, making it very famous in faculties today.

Student-centered gaining knowledge of techniques offer empowerment possibilities that permit a deep dive into extra than simply mandated exams or canned, standards-primarily based totally curriculum. Utilizing the techniques mentioned can set you on a route to generating college students geared up to make a distinction in an ever-changing, worldwide society.

In addition, this study was conceptually framed using active learning to differentiate the treatment from the control.

2.5. Five learning styles

Active learning is a teaching methods to participate students by using 5 strategies or learning styles: (1) visual, (2) verbal, (3) kinesthetic, (4) Social learner's and (5) using real-time feedback (Knobloch-Westerwick and Meng 2009).

1. **Visual learners:** Visual learners retain information more effectively when visual aids are used, such as, pictures, images, film clips, colors and diagrams. They are also good at understanding visual data presented in maps, charts and graphs.

2.5.1. Strategies for teaching visible rookies:

• Use visible aids - maximum different rookies will advantage from visible factors as well.

• Provide visible analogies and metaphors to assist with visible imagery.

• Substitute phrases for shades and pictures.

• Ask the students to take notes due to the fact this includes searching at your presentation or visualizing what you're presenting.

• Color or emphasizes key factors in text.

• Avoid the use of huge blocks of text.

• Include sporting events wherein the students create thoughts maps.

• Get students to visualize the use of phrases, such as, "Picture this", and "Let's see what you'll do."

2. **Verbal learners**: Verbal learners favor using words and linguistic skills - in speech and in writing, such as, reading, writing, listening or speaking. They like word games, puns and rhymes etc. and are often strong public speakers.

2.5.2. Strategies for teaching verbal learners:

- Use verbal teaching and writing activities.
- Ask them to discuss or present.
- Use acronyms or mnemonic devices.
- Get the class to read aloud.
- Ask them to teach members of the class certain material.
- Suggest they reread and rewrite their notes, including summaries.
- Incorporate quizzes into your lessons.
- Show them or provide them with lists of key words.

- Providing these learners with a combination of information in a variety of verbal ways can assist their learning, for example, they may initially read about a concept, afterwards they listen to an audio to support what has been read, then they write notes and finally they partner up with someone and discuss the topic.

3. **Kinesthetic**: kinesthetic learners need to experience knowledge through actions either by "doing" or getting personally involved with the learning process. Sometimes these learners prefer a faster paced learning experience with instructors that keep things moving at a fast pace within the classroom. Hands-on activities are very beneficial to these students along with a lab setting where physically active learning is done. Class demonstrations and field work outside of the classroom are also components to successful learning. Practical learners process information effectively when they use their bodies and when they are actually doing something. They put their learning into practice.

2.5.3. Strategies for teaching physical and tactile learners:

- Use physical exercises and provide hands-on experiences.
- Exercises where they are standing and walking are very effective.
- Include activities where they use a pen and paper to map out their thoughts and problem-solve because writing is a physical exercise.
- Find a venue that provides these learners with large spaces so they can write and draw.
- Encourage them to draw diagrams, graphs and maps.
- Get them to interact with physical objects or solve puzzles.
- Role-playing.
- Suggest reviewing their notes whilst they engage in physical activity.
- Ask them to teach other class members some of the lesson content.
- When you are asking them to visualize, explain the sensations that would be felt, such as, "The wind was forcibly hitting against the left side of my body."

4. **Social learner**: Social learner's process information by interacting with and relating to others. They enjoy working with others and are often strong leaders.

2.5.4. Strategies for teaching social learners:

- Be inquisitive and ask them what they think about a concept/topic/idea.
- Ask them to bounce ideas off of each other and compare their ideas with others'.

- Allow them to discuss and share stories.
- Include group work.
- Engage in a role-play.

5. **Using Real-time feedback:** Are Dialogic processes and activities which can support and inform the student on the current task, whilst also developing the ability to self-regulate performance on future tasks. Following from this concept, once pencils are down and answer sheets are handed in, there is no harm in reviewing the answers on the question paper or detailing what exactly was the heard in the cardiovascular station. Doing so could even lead to an open forum where, if students felt that certain questions were badly worded or certain signs were hard to detect, they could subsequently express their opinion on the matter. After all, many of today's exams are written by senior experts in the field and could easily be misaligned with what is clinically relevant today, with what is implied by a particular question, or, more important, with what is expected of today's students. This process would surely be of benefit not only for the student but also for the teacher. Real-time feedback in class can make your courses more personalized, enjoyable and effective in developing students' knowledge and skills. Here you will find 18 ideas and techniques on how to give effective learning feedback that will leave your students with the feeling they can conquer the world.

2.5.5. Strategies for teaching using Real-time feedback:

- **Feedback should be educative in nature: -** Providing feedback means giving students an explanation of what they are doing correctly and incorrectly.
- **Feedback should be given in a timely manner: -**When feedback is given immediately after showing proof of learning, the student responds positively and remembers the experience about what is being learned in a confident manner.
- **Be sensitive to the individual needs of the student**: -It is vital that we take into consideration each student individually when giving feedback.
- **Ask the 4 questions**: -Providing answers to the following four questions on a regular basis will help provide quality feedback. These four questions are also helpful when providing feedback to parents: 1. what can the student do? 2. What can't the student do? 3. How does the student's work compare with that of others? And 4. How can the student do better?

- **Feedback should reference a skill or specific knowledge**: - This is when rubrics become a useful tool (single-point rubrics, for example). A rubric is an instrument to communicate expectations for an assignment and a useful way to provide effective feedback for learning.
- **Give feedback to keep students 'on target' for achievement**: -Regular 'check-ins' with students let them know where they stand in the classroom and with you. Utilize the '4 questions' to guide your feedback.
- **Host a one-on-one conference**:-Providing a one-on-one meeting with a student is one of the most effective means of providing feedback.
- **Feedback can be given verbally, non-verbally, or in written form**: -Be sure to keep your frowns in check. It is imperative that we examine our non-verbal cues. Facial expressions and gestures are also means of delivering feedback.
- **Concentrate on one ability or skill: -** It makes a far greater impact on the student when only one skill is critiqued versus the entire paper being the focus of everything that is wrong.
- **Alternate due dates for your students/classes**: -Utilize this strategy when grading papers or tests to provide effective feedback for learning. This strategy allows you the necessary time to provide quality, written feedback.
- Educate students on how to give feedback to each other:-Model for students what appropriate feedback looks like and sounds like. As a Secondary School teacher, we call this 'peer conferencing
- **Have the student take notes: -**During a conference over a test, papers, or a general 'check-in,' have the students do the writing while you do the talking. The student can use a notebook to jot down notes as you provide verbal feedback.
- **Use a notebook to keep track of student progress**:-Keep a section of a notebook for each student. Write daily or weekly, dated comments about each student as necessary. Keep track of good questions the student asks, behavior issues, areas for improvement, test scores, etc.
- **Return tests, papers, or comment cards at the beginning of class**:-Returning papers and tests at the beginning of class, rather than at the end, allows students to ask necessary questions and to hold a relevant discussion.
- **Use Post-It notes**:-Sometimes seeing a comment written out is more effective than just hearing it aloud. During independent work time, try writing feedback comments on a post-it note.

- **Give genuine praise**: - Students are quick to figure out which teachers use meaningless praise to win approval. If you are constantly telling your students 'Good Job' or 'Nice Work' then, over time, these words become meaningless. Make a big deal out of a student's A+ on that vocabulary test.
- **"I noticed…"-** Make an effort to notice a student's behavior or effort at a task. For example; "I noticed when you regrouped correctly in the hundreds column, you got the problem right." "I noticed you arrived on time to class this entire week." Acknowledging a student and the efforts they are making goes a long way to positively influence academic performance.
- **Provide a model. For example:** - Communicate with your students the purpose of an assessment and/or feedback. Demonstrate to students what you are looking for by giving them an example of what an A+ paper looks like. Provide a contrast of what a C- paper looks like. This is especially important at the upper learning levels.

2.6. The Learning Pyramid model

As The Learning Pyramid model suggests that some methods of study are more effective than others and that varying methods will lead to deeper learning and longer-term retention(Letrud 2012). So the teachers must select the most effective methods of learning that encourages students to take what they learn and put it into practice where by promoting deeper understanding and moving information from short-term to long-term memory. More effective methods are student-centered methods. Therefore the teachers can improve biology achievement of students' through student-centered methods if used properly in biology class. See figure 1 the following The Learning Pyramid model.

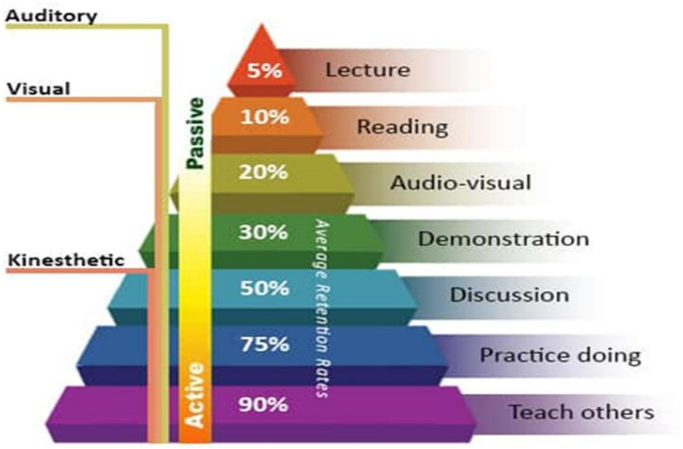

Figure 1 Learning Pyramid model

Source: Edgar Gale (1962)

While some have criticized the learning pyramid, the idea behind it remains in line with research that demonstrates that students can retain information more effectively if they do something rather than just hear it.

1. lecture

A lecture is a passive way of learning, and is among the most ineffective ways to learn and retain new information. Now, this can vary a bit from person to person. Trying to comprehend new material through lectures is difficult for many people; however, students who are auditory learners are better at learning through this teaching method than those who are visual or kinesthetic learners.

2. Reading

When compared to listening to a lecture, reading is marginally more effective when it comes to the likelihood that students will retain the information. The advantage that reading has over listening to a lecture is that it provides students with reference material that they can go back to later to help you recall the material.

3. Audio-Visual

The Learning Pyramid indicates that learning through audio-visual methods will typically help student retain 20% of the information offered. This method of learning may integrate learning aids such as: Pictures, Handouts, Videos, Flip charts, Whiteboards, Slide shows, Audiotapes, Projectors, Multimedia, 3D objects and more.

Audio-visual learning may include a lecture in addition to a series of visual aids, or as an individual instructional video. As time progresses and technology has evolved, innovative forms of audio-visual presentations have made it easier for students to retain new knowledge.

4. Demonstration

Learning by demonstration involves observing a teacher showing students how to do something by walking them through a step-by-step process. As the teacher shows how to do the task, he or she simultaneously tells the students what they're doing.

Demonstration is the first method of learning on The Learning Pyramid is considered to be "active". Because demonstration often provides information in a clearer manner than passive study methods, it leads to a greater understanding–especially when information is vague or confusing.

5. Discussion

Discussions offer an active, cooperative learning environment that leads to a greater retention of information. This is the first form of kinesthetic learning on the Learning Pyramid. Discussions don't

always look the same; they can take on a variety of forms. However, they always involve a collaborative, open-ended exchange of ideas to help:

- Prompt learning
- Develop new ideas
- Engage in problem solving
- Gain a better sense of understanding

Those participating in a discussion offer a variety of points of view, respond to others' ideas, and engage in self-reflection to further their understanding or interpretation of a given subject. A discussion may occur between two people, a small group, or a large group with a teacher or student leader. A discussion can focus on any subjective topic or issue that is based on a text, something in the media, a social justice issue, a societal norm, etc.

6. Practice Doing

Gaining "hands-on" experience is one of the most effective ways to learn. This method of learning allows you to apply what you've learned to everyday practice, which helps you be able to recall the information in the long-term. When you practice doing something, it makes the information more meaningful, which also leads to a deeper understanding of it and a higher retention rate.

One way that technological advances have furthered opportunities to "practice doing" is through simulation. Simulated learning allows people to safely manipulate systems and then observe the impact of the change, which lets them receive immediate intrinsic feedback. Cognitive tools such as these offer practical hands-on training to help learners practice and gain experience that they can then easily translate into real-world scenarios.

7. Teach Others

The most effective way to master a subject is to teach it to others. If students can teach other people about a subject correctly, it means that they understand the concepts, they have a high retention for the information, and they are able to easily recall it.

2.7. Five principles of learner-centered teaching

(Weimer 2002)delineates five principles of learner-centered teaching, which are 1) to engage students in their learning, 2) to motivate and empower students by providing them some control over their own learning, 3) to encourage collaboration and foster a learning community, 4) to guide

students to present on what and how they learn, and 5) to explicitly teach students skills on how to of note, various terms are used in the literature to refer to strategies that are related to learner-centered teaching.

These five are principles of learner-centered teaching:

1. **To engage students in their learning**: - Student-centered learning shifts the balance of classroom power from teacher to student thus fostering active learning and engagement among peers.
2. **To motivate and empower students by providing them some control over their own learning**: -Student-centered learning enables critical thinking and to develop knowledge rather than a collection of facts by building upon and challenging prior learning.
3. **To encourage collaboration and foster a learning community**: -Student-centered learning situates the teacher as facilitator and contributor rather than authoritarian and director of knowledge.
4. **To guide students to reflect on what and how they learn**:-.Student-centered studying returns the duty for studying to the students, so students are capable of find out their strengths and weaknesses and participate in directing their very own information gain..
5. **To explicitly teach students skills on how to learn: -**Student-centered learning employs effective assessment to promote learning and inform future practice. Explicit guidance is a manner to train abilities or ideas to students the use of direct, established guidance. It facilitates make classes clean through modeling for students the way to begin and be triumphant on undertaking and giving them sufficient time to practice. It is a manner to supply direct, established guidance to students from kindergartners to high-schools. Or you can use it to pre-teach or re-teach a skill to one student or a group of students.

Generally there are a huge variety of options for the time period lively gaining knowledge of, such as: gaining knowledge of thru play, technology-primarily based totally gaining knowledge of, activity-primarily based totally gaining knowledge of, institution paintings, undertaking method etc. The not unusual place elements in those are a few extensive characteristics and traits of lively gaining knowledge of. Active gaining knowledge of is the alternative of passive gaining knowledge of; it's far learner-centered, now no longer teacher-centered, and calls for greater than simply listening; the lively participation of each pupil is important component in lively gaining knowledge of. Students should be doing matters and concurrently reflect on consideration on the paintings

achieved and the cause at the back of it so they can beautify their better order questioning capabilities.

2.8. Advantages and Disadvantages of Student Centered Learning

2.8.1. Advantage

• Students broaden getting to know and different talents and advantage significant understanding as a way to assist them during life.

• It can assist to construct pupil talents and self-esteem.

• And additionally they advantage extra emotional and cognitive aid from their peers.

• Students find out that getting to know is exciting and fun.

• Students are extra attentive and inclined to take part within the classes.

• The scholar has extra of an energetic function to play of their getting to know.

• Students can adapt the manner they learn, to make their research extra effective.

• Students paintings on tasks or troubles in groups with each private and crew duty for conceptual understanding.

• Students are actively supporting and motivating spirit to be successful collectively.

• Active function as peer tutors to similarly beautify the organization's success.

In addition to those benefits of cooperative getting to know additionally have short coming and it along with the following:

2.8.2. Disadvantage

• It calls for an extended time for students so it's miles tough to attain curriculum targets.

• Take a long term for instructors in order that instructors in popular do now no longer need to apply cooperative learning.

• It calls for unique competencies of instructors in order that now no longer all instructors can do or use of cooperative learning.

• Specific nature of student demand, which includes the character, loves to learn together.

Chapter three

3. Research Methodology

3.1. Study site

The study was conducted in Meskerem Secondary School grade 10 biology classes found in Arada sub-city, Addis Ababa.

3.2. Research design

As mentioned in the introduction, the aim of this study was to assess the effects of student-centered methods on achievements of students in learning biology in the Meskerem Secondary School. To analyze this study descriptive survey design was employed. A descriptive survey research is an approach of descriptive research that blends quantitative and qualitative data to provide relevant and accurate information Munjuri, M. G. (2011).

3.3. Research Method

In this study, descriptive method was employed because, it helps to explain educational phenomena in terms of the condition that exist, opinions that are held by students, teachers and instructor, possesses that are going on, effects that are evident, or trends that are developing Springer, K. (2009). At times descriptive survey is the means through which opinions, attitudes, suggestions for educational practices can be obtained.

The general method of this study was mixed method. That means quantitative supported by qualitative approach. Mixed methods design is useful when the strength of both quantitative and qualitative can provide the best understanding for research problem Almalki, S., (2016) also indicated that mixed method approach is more than simply collecting and analyzing both kinds of data; it also involves the use of both approaches in the same way, so that the overall strength of a study was greater than either qualitative or quantitative research. Hence, interpretation of qualitative data collected through interview was support and quantitative data collected from students' tests. Based on this the researcher has used the following steps. First, the researcher asks the concerned body to get permission from each sample. After that, the researcher collects the data through tests and interviews. Test and Interview are conducted on Meskerem Secondary School students and teachers respectively. Finally, in the sample Schools, the researcher describe the study, invite the

students and teachers to participate, gave instructions for completing the tests and interview and assure confidentiality, and identify the respondents who will be responsible for answering the tests and interviews. The data gathered through tests and interviews were interpreted and analyzed by using quantitative qualitative and respectively.

3.4. Research population

As we know that, subject or population of the study is very important. It helps to obtain reliable data about the study in a minimum cost, time, energy, and limit of accuracy. Population or subject is to mean the source and concern of the research and the researcher. The Meskerem Secondary schools has 199 grade 9 students, 230 grade 10 students, 249 grade 11 students and 127 grade 12 students totally 805 students and 79 teachers population in 2013/2021 academic calendar year.

So that, this study will primarily, involve 230 populations of grade 10^{th} students and biology teachers of Meskerem secondary school.

3.4.1. Data sampling techniques

This study was designed to assess the academic performances of learners by student-centered and teacher-centered teaching methods and investigate teaching strategies enhance to improve the biology achievement of students learning grade 10 biology subject.

The researcher used simple random sampling and purposive sampling that are the most widely used in selecting study population.

As study population, 2 sections of 11sections grade 10 biology students of Meskerem Secondary School of the 2013/2021academic calendar year were selected using simple random sampling.

Due to COVID-19, the number of students in one section of the class was minimized to contain 20to 25 so that the researcher simply employed both section (grade 10A= 21 and 10B =20) totally 41students selected through situational sampling.

Student population was used as practitioners learning biology through teacher-centeredness and student-centeredness and conduct required performances as students of grade 10 biology classes.

The researcher (teacher) taught both sections (10A &10B) using teacher-centered methods two sub-topics and assessed the performances of leaner's through continuous assessment tests on those sub-topics and recorded the results. In contrast, the researcher (teacher) taught the same sections using student-centeredness methods other two sub-topics and conducted continuous assessment on the other two sub-topics, recorded and compared the biology achievement of students learnt using both

methods and gained result in all four tests. For interview questions, the researcher purposely selected 8biology teachers among 79 teachers.

3.4.2. The Sample Size

The study involved both teachers and students. From the target 230 grade 10th students the researcher used Simple Random Sampling in order to take 41 students or 2 sections(grade 10A= 21 and 10B =20) from 11 sections. In additional to this, 5 grade 10biology teachers were used in the study by using Purposive sampling from a total 79 Teachers of the school.

Table 2Sampling size

Students	**Gender**		**Teachers**	
Sections	M	F	M	F
10A	9	12	6	2
10B	11	9		
Total	20	21	6	2
	41		8	

3.5. Data collection tools

The main data gathering instruments were tests for student samples and interview questions for teacher samples.

3.5.1. Tests

A test is an educational assessment that is used to measure students' knowledge, understanding of some topic during the teaching/learning process, skill and aptitudes.

The researcher used teacher-centered teaching methods (lecture methods), to taught biology lessons in both sections of grade 10A and 10B and conducted continuous assessment tests in both learning activities and recorded the results of both tests.

Contrary, the researcher taught the same biology students of the same sections through student-centered methods (group discussion, presentations of group work, asking question and answering and individual activity), conducted tests continuously in both methods and recorded achieved academic results.

The researcher selected two learning units and four sub-topics from grade 10 text book (unit 3 *Endocrine glands* page 93 and *Reproductive health* page 108 and, Unit 4 *Photosynthesis* page 141

and *Transport* page 158,) to implement both methods in grade 10 biology classes. The researcher (teacher) taught both sections through teacher-centered method (*Endocrine glands and Photosynthesis*) and through student-centered method (*Reproductive health* and *Transport*) to implement both methods in grade 10 biology classes then the students were take tests.

The results of students' tests were recorded in a table and analyzed quantitatively by finding mean, standard deviation and a t-test to decide hypostasis. The following criteria were used to select these four topics. The topics are meaningful, that is important for the grade 10^{th} students as well as interested to implement teacher-centered teaching methods (lecture methods) and student-centered methods (group discussion, presentations of group work, asking question and answering and individual activity) methods. The methods were implemented in two sections of grade 10^{th} students, because to gather the relevant data that explain or discuss the effect of student-centered teaching methods to improve students' biology achievements.

Multiple-choice tests are taken in order to measure the simple understandings and the difficult concepts' of the student. These tests are specially designed to measure the ability of a student in correct answering of a specific question. Since all of the achievable solutions are given, it does now no longer take lots time calculating and devising a brand new answer. The researcher used multiple-choice tests to measure achievements of students because it does not take much time and it can assess the complex concepts as well as the simple understandings of the student. The researcher was prepared ten (10) multiple-choice test items.

3.5.2. Interview

Interviews were made with 5 grade 10 biology teachers on the applicability and comparative advantages of both teacher-centered and student-centered teaching methods in biology classes. From 8 biology teachers 3 of them were not participate on interview because of different cases.

3.6. Data Analysis methods

In this particular study the raw data which were gathered from both open-ended and closed-ended interview questions and student test were analyzed. Quantitative and qualitative data analyzing strategy was applied.

The data gathered from students' tests items, were interpreted quantitatively, but the data gathered from teachers' interview items were interpreted qualitatively. In addition to this the data obtained from students' tests were analyzed by *t-test.*

A t-test is a statistical test that is used to compare the means of two groups. It is often used in hypothesis testing to determine whether a process or treatment actually has an effect on the population of interest, or whether two groups are different from one another.

3.7. Ethical consideration

The participants of the study would be fully informed that the study is for academic purpose and they do not need to write names and addresses. Their participation would be fully based on their willingness and interest of the participants. No information about the personal detail of the respondents should be exposed in any of the records, reports or to other individual without respondents' permission.

Chapter four

4. Results and discussion

In this chapter, the analysis and interpretation of data as well as major findings of the study could be presented. This could be done through; tests and interview are presented using tables. The chapter is divided in to three sections. Characteristics of the respondents (subjects), analysis of the main data and discussion of the major results are presented, respectively.

4.1. Data display

Table 3 Profile of sample Students

Sex	Students		Age							
			15-16		17-18		19-20		Above 20	
	No	%	No	%	No	%	No	%	No	%
M	20	48.8	13	31.7	5	12.2	1	2.4	1	2.4
F	21	51.2	9	22	9	22	3	7.3	0	0
Total	41	100	22	53.7	14	34.2	4	9.7	1	2.4

As it is represented in table 3 about the students profile from the total 41grade 10^{th} student samples 48.8% and 51.2% of the students are male and female, respectively.

Concerning to their age level 31.7% male and 22% female of the students is found in the age of 15-16 and 12.2% male and 22%female from 41 students found in the age of 17-18.

In addition 2.4% male and 7.3% female of the students is found in the age of 19-20. Finally, only 2.4% male student is above 20 in age level.

Table 4 Profile of sample Teachers

Sex	No	%	Age	No	%	Experience	No	%	E-level	No	%
M	6	75	20-25	-	-	1-5	1	13	Degree	4	50
			26-30	4	50	6-10	2	25	Masters	2	25
			31-35	2	25	11-15	3	38	-	-	-
			36-40	-	-	16-20	-	-	-	-	-
			41-45	-	-	Above 20	-	-	-	-	-
F	2	25	20-25	1	12.5	1-5	-	-	Degree	1	12.5
			26-30	1	12.5	6-10	1	12.5	Masters	1	12.5
			31-35	-	-	11-15	1	12.5	-	-	-
			36-40	-	-	16-20	-	-	-	-	-
Total	8	100		8	100		8	100	-	8	100

The above teachers‟ profile shows that 75% of them were male and 25% of them were female teachers. Regarding to their age 12.5% of them were 20-25, 62.5% of them were 26-30, 25% of them were 31-35. Also concerning their experience in the current school is 12.5% of them were 1-5, 38% of them were 6-10, 50% of them were 11-15.

Their educational levels are, 62.5% of the teachers were degree and 37.5% of them were master degree holders.

The following table 5 shows data collected using tests of grade 10A biology class students learnt through teacher-centered teaching methods.

Table 5 Result of tests achieved by grade 10A students

Tests	T1	T2	Average	100%
Total mark	113	106	109.5	1095
Mean(X)	5.38	5.05	5.214	52.14

Key: T1= test one, T2= test two, TC= Teacher-centered teaching methods, 10A= grade 10A students

As indicated in table 5, the mean and average mean of two tests that learned by TC was 5.38, 5.05 and 5.21 of T1 andT2 respectively. The average of two tests was 5.214 or 52.14%.

The following table 6 shows data using tests of grade 10A biology class students learnt through student-centered teaching methods.

Table 6Result of tests achieved by grade 10A students

Tests	T1	T2	Average	100%
Total mark	165	166	165.5	1655
Mean(X)	7.857	7.905	7.881	78.81

Key: T1= test one, T2= test two, SC= Student-centered methods, 10A= grade 10A students

As indicated in table 6, the mean and average mean of two tests that learned by SC was 7.857, 7.905 and 7.881 of T1, T2 and average respectively. In addition, students achieved 78.81% through student-centered teaching method. As table 2 and 3 show, the average difference of student-centered teaching methods and teacher-centered teaching method result was 2.667 (7.881-5.214=2.667).

Therefore, student-centered teaching method achieved 2.667 or 26.67% than teacher-centered teaching method.

The following table 7 shows data collected using tests of grade 10B biology class students learnt through teacher-centered teaching methods.

Table 7 Result of tests achieved by grade 10B students

Tests	T1	T2	Average	100%
Total mark	113	84	98.5	985
Mean(X)	5.65	4.2	4.925	49.25

Key: *T1= test one, T2= test two, TC= Teacher-centered teaching methods and 10B= grade 10B students.*

As indicated in table 7 mean and Average mean of two tests that learned by TC was 5.65, 4.2 and 4.925 of T1, T2 and average respectively.

In addition students achieved 49.25% through teacher-centered teaching method.

The following table 8 shows data using tests of grade 10B biology class students learnt through student-centered teaching methods.

Table 8Result of tests achieved by grade 10B students

Tests	T1	T2	Average	100%
Total mark	129	173	151	1510
Mean(X)	6.45	8.65	7.55	75.5

Key*: T1= test one, T2= test two, SC= student-centered teaching methods, 10B= grade 10B students*

As indicated in table 8mean and Average mean of two tests that learned by SC was 6.45, 8.65 and 7.55 of T1, T2 and average respectively. In addition students achieved 75.5% through SC method. As table 7 and 8 show, the average difference of student-centered teaching methods and teacher-centered teaching method result was 2.625 (8.65-6.45=2.625).

Therefore student-centered teaching method achieved 2.625 or 26.25% than teacher-centered teaching method.

The following table 9 shows the total result, mean and present of data collected using tests to analysis and evaluate achievement differences result of biology class students of grade 10A and 10B learnt using student-centered and teacher-centered teaching methods.

Table 9 Total results and mean of tests achieved by grade 10A and 10B students

Section	No	SCL result			TCL result			Difference		
		Total	Mean	100%	Total	Mean	100%	Total	Mean	100%
10A	21	165.5	7.881	78.81	109.5	5.214	52.14	56	2.667	26.67
10B	20	151	7.550	75.5	98.5	4.925	49.25	52.5	2.625	26.25
Total	41	316.5	15.431	154.31	208	10.139	101.39	108.5	5.292	52.92
Mean(X)	-	7.72	7.72	77.2	5.07	5.07	50.7	2.646	2.646	26.46

Key: SC= student-centered teaching methods, TC= Teacher-centered teaching methods, 10A =grade 10A students and 10B= grade 10B students.

As it is shown in table 9 the mean score of students taught with SCL 7.72 was higher than that of the mean of TC 5.07. In percent SCL was 77.2% achieve while TCL was 50.7% achieved.

The difference between student-centered teaching method and teacher-centered teaching method was 2.646 or 26.46%.

This shows that the student-centered teaching method was more effective to improved students' academic achievement in biology class than teacher-centered teaching method. In general, the difference result was found based on the teaching methods used in class during teaching grade 10 biology lesson.

4.2. Data analysis

The data gathered from students' test were analysis by t-test quantitatively. A t-test is a statistical test that is used to compare and contrast the means of two samples groups in the research. It is often used in hypothesis testing to determine whether a process actually has an effect on the population of samples. It is a test in statistics that is used for testing hypotheses when the standard deviation of the population is not known.

- Basically, the t-test allows the comparison of the mean of two sets of data and determines if the two sets are taken from the same population.
- After the null and alternative hypotheses are known, t-test formulas are used to calculate values that are then compared with standard values.
- Based on the comparison, the null hypothesis is either rejected or accepted.

- The t-test is usually performed in cases where the sample size is small ($n \leq 30$) (De Winter, Joost CF. 2013).

4.2.1. Analysis of the achievements of students by *t-tests*

The researcher claims that students will improve their academic achievement if they learnt through student-centered teaching methods than learnt through teacher-centered teaching methods.

The following table 10 shows score difference and standard deviation of average data collected using tests to analysis and evaluate the difference achievements of students of grade 10A biology classes learnt using student-centered teaching methods and teacher-centered teaching methods.

At $\alpha=0.05$, is there enough evidence to conclude that the students' academic achievement was better if they learn through student-centered teaching methods than teacher-centered teaching methods?

Hypotheses:

H_0. There is no significant difference between the contribution of teacher-centered teaching and student-centered teaching methods on improving students' academic achievements.

H_a. There is a significant difference between the contribution of teacher-centered teaching and student-centered teaching methods on improving students' academic achievements.

Table 10Resultsand Score difference of tests achieved by grade 10A students

Results	SCL result	TCL result	Score difference	SSd	100%
Total mark	165.5	109.5	56	187	1870
Mean	7.881	5.214	2.667	8.905	89.05
St. Dev.	0.921	1.538	1.317	1.37235	137.235

Key: *T1= test one, T2= test two, SCL= student-centered teaching methods, TCL= Teacher-centered teaching methods, 10A= grade 10A students, SSd= Square of score difference*

From the sample data, it is found that the corresponding sample means are:

$$\bar{X}_1 = 7.881$$

$$\bar{X}_2 = 5.214$$

Also, the provided sample standard deviations are:

$$s_1 = 0.921$$

$$s_2 = 1.538$$

And the sample size is n = 21, Degrees of freedom (d. f) =21-1=20. For the score differences we have

$$\bar{D} = 2.667$$

$$s_D = 1.317$$

1) Null and Alternative Hypotheses

The following null and alternative hypotheses need to be tested:

$$H_0 : \mu_D \leq 0$$

$$H_a : \mu_D > 0$$

This corresponds to a right-tailed test, for which a t-test for two paired samples be used.

2) Rejection Region

Based on the information provided, the significance level is alpha = 0.05 or α=0.05, and the critical value for a right-tailed test is *tc*=1.725 from t-table.

The rejection region for this right-tailed test is R= {*t*:*t*>1.725}

3) Test Statistics

The t-statistic is computed as follows:

$$t = \frac{\bar{D}}{s_D/\sqrt{n}}$$

$$= \frac{2.667}{1.317/\sqrt{21}}$$

$$= 9.282$$

4) Decision about the null hypothesis

Since it is observed that *t=9.282>tc=1.725*, it is then concluded that *the null hypothesis is rejected.*

Using the P-value approach: The p-value is *p = 0*, and since *p = 0 < 0.05*, it is concluded that the null hypothesis is rejected.

5) Conclusion

It is concluded that the null hypothesis Ho is rejected. Therefore, there is not enough evidence to claim that the population mean difference $\mu D=\mu 1-\mu 2$is greater than 0, at the alpha = 0.05 or α=0.05 significance level.

Confidence Interval

The 95% confidence interval is 2.067 <μD<3.266.

Graph 1

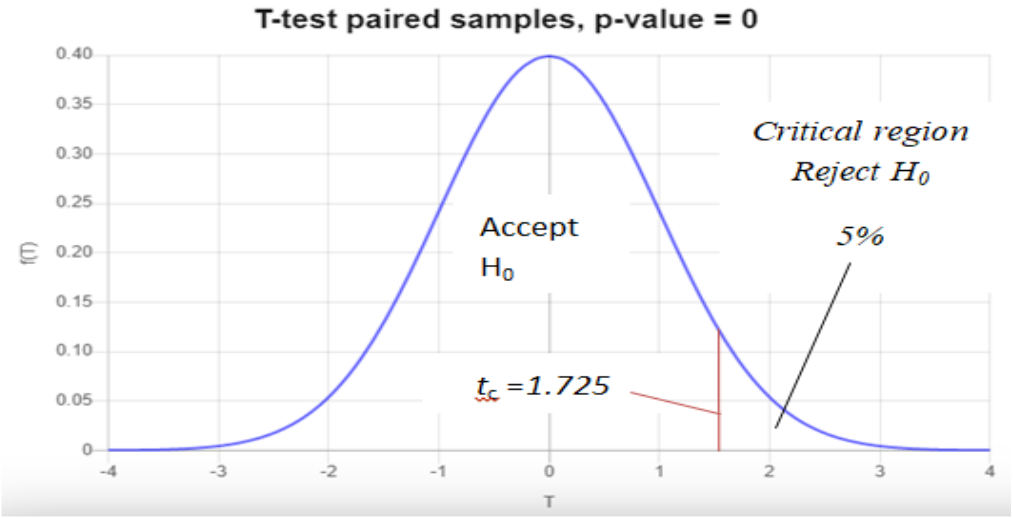

Figure 2 *t-test* 10A

This value lies in the hat H_0 is rejected. So there is enough evidence at the 5% level to support the claim that the students' academic achievement learnt using student-centered teaching methods is better than teacher-centered teaching methods. In addition, there was evidence at a 5% level of significance to suggest that student-centered teaching method was well-encouraging students to improve their academic achievements in biology class.

In general, at $\alpha = 0.05$ level of significance, there was enough evidence to conclude that the students' academic achievement that learnt using student-centered teaching method is better than learnt using teacher-centered teaching methods in grade 10A biology class.

The following table 11 shows score difference and standard deviation of average data collected using tests to analysis and evaluate the difference achievements of students of grade 10B biology classes learnt using student-centered teaching methods and teacher-centered teaching methods.

Table 11Results and Score difference of tests achieved by grade 10B students

Results	SCL result	TCL result	Score difference	S Score difference	100%
Total mark	151	98.5	52.5	182.75	18275
Mean(X)	7.55	4.925	2.625	9.1375	913.75
St. Dev.	0.759	1.444	1.538	1.5379	153.79

Key: *T1= test one, T2= test two, SCL= student-centered teaching methods, TCL= Teacher-centered teaching methods, 10B= grade 10B students, SSd= Square score difference*

From the sample data in table 11, it is found that the corresponding sample means of SC and TC averages are:

$$\bar{X}_1 = 7.55$$

$$\bar{X}_2 = 4.925$$

Also, the provided sample standard deviations of SC and TC averages are:

$$s_1 = 0.759$$

$$s_2 = 1.444$$

And the sample size is n = 20, Degrees of freedom (d. f) =20-1=19. For the score differences we have

$$\bar{D} = 2.625$$

$$s_D = 1.538$$

1) Null and Alternative Hypotheses

The following null and alternative hypotheses need to be tested:

$$H_0 : \mu_D \leq 0$$

$$H_a : \mu_D > 0$$

This corresponds to a right-tailed test, for which a t-test for two paired samples be used.

2) Rejection Region

Based on the information provided, the significance level is α=0.05, and the critical value for a right-tailed test is *tc*=1.729.

The rejection region for this right-tailed test is R = {t: t > 1.729}

3) Test Statistics

The t-statistic is computed as follows:

$$t = \frac{\bar{D}}{s_D/\sqrt{n}}$$

$$= \frac{2.625}{1.538/\sqrt{20}}$$

$$= 7.633$$

4) Decision about the null hypothesis

Since it is observed that $t = 7.633 > tc = 1.729$, it is then concluded that *the null hypothesis is rejected.*

Using the P-value approach: The p-value is $p=0$, and since $p=0<0.05$, it is concluded that the null hypothesis is rejected.

5) Conclusion

It is concluded that the null hypothesis Ho *is rejected.* Therefore, there is not enough evidence to claim that the population mean difference $\mu D=\mu 1-\mu 2$is greater than 0, at $\alpha=0.05$ significance level.

Confidence Interval

The 95% confidence interval is $1.905<\mu D<3.345$.

Graph 2

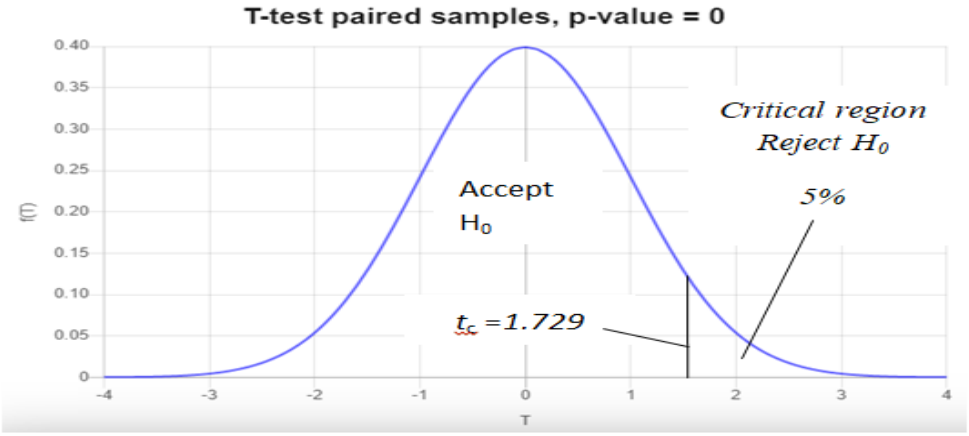

Figure 3 *t-test* 10B

This value (t=7.633.) lies in the critical value or region that H_0 is rejected. So there is enough evidence at the 5% level to support the claim that the students' academic achievement learnt using

student-centered teaching is better than teacher-centered teaching methods. In addition, there is evidence at a 5% level of significance to suggest that student-centered teaching is well-encouraging students to improve their academic achievements in biology class.

In general, at $\alpha = 0.05$ level of significance, there is enough evidence to conclude that the students' academic achievement that learnt through student-centered teaching method is better than learnt through the teacher-centered teaching method in grade 10B biology class.

4.2.2. Analysis of average difference by t-tests of 10 A and 10 B

The researcher claims that students will improve their academic achievement if they learned through SC methods than learning through TC methods. The blow table 9 shows the comparison average of two scored tests that were learned through both methods.

The average means of tests that learnt through SC 7.7155 was higher than that of the mean of tests that learnt through TC 5.0695. The difference 2.646 was found between the two groups based on the methods. Based on this the SC method is the best method to improve students' academic achievement if the teachers used properly in the biology class.

At α=0.05, is there enough evidence to conclude that the students' academic achievement is better if they learn through SCL methods than TCL methods?

The following table 12 shows total score, average mean and square of score difference of data collected using tests to analysis and evaluate the difference achievements of students of grade 10A and 10B biology classes learnt using student-centered teaching methods and teacher-centered teaching methods.

Table 12Average mean and score difference of tests achieved by grade 10A and10B students

Section	**No**	**SCL result**		**TCL result**		**Difference**		
		A mean	**100%**	**A mean**	**100%**	**Sd**	**SSd**	**100%**
10A	21	7.881	78.81	5.214	52.14	2.667	7.113	26.67
10B	20	7.550	75.5	4.925	49.25	2.625	6.891	26.25
Total	41	15.431	154.31	10.139	101.39	5.292	14.004	52.92
Mean(X)	-	7.7155	77.155	5.0695	50.695	2.646	7.002	26.46
St. Dev.	-	0.852	8.52	1.481	14.81	1.411	2.646	14.11

Key: *SC= student-centered teaching methods, TCL= Teacher-centered teaching methods,A= Average, 10B= grade 10B students, Sd=score difference, SSd= Square of score difference.*

From the sample data, it is found that the corresponding sample means are:

$$\bar{X}_1 = 7.72$$

$$\bar{X}_2 = 5.073$$

Also, the provided sample standard deviations are:

$$s_1 = 0.852$$

$$s_2 = 1.481$$

And the sample size is n = 41. For the score differences we have

$$\bar{D} = 2.646$$

$$s_D = 1.411$$

1) Null and Alternative Hypotheses

The following null and alternative hypotheses need to be tested:

$$H_0 : \mu_D \leq 0$$

$$H_a : \mu_D > 0$$

This corresponds to a right-tailed test, for which a t-test for two paired samples be used.

2) Rejection Region

Based on the information provided, the significance level is alpha = 0.05 or α=0.05, and the critical value for a right-tailed test is *tc*=1.684.

The rejection region for this right-tailed test is R={t:t>1.684}

3) Test Statistics

The t-statistic is computed as follows:

$$t = \frac{\bar{D}}{s_D/\sqrt{n}}$$

$$= \frac{2.646}{1.411/\sqrt{41}}$$

$$= 12.01$$

4) Decision about the null hypothesis

Since it is observed that t=12.01>tc=1.684, it is then concluded that *the null hypothesis is rejected.*

Using the P-value approach: The p-value is p=0, and since p=0<0.05, it is concluded that the null hypothesis is rejected.

5) Conclusion

It is concluded that the null hypothesis Ho *is rejected.* Therefore, there is not enough evidence to claim that the population mean difference $\mu D=\mu 1-\mu 2$is greater than 0, at the alpha = 0.05 or α=0.05 significance level

Confidence Interval

The 95% confidence interval is 2.201<μD<3.092.

Graph 3

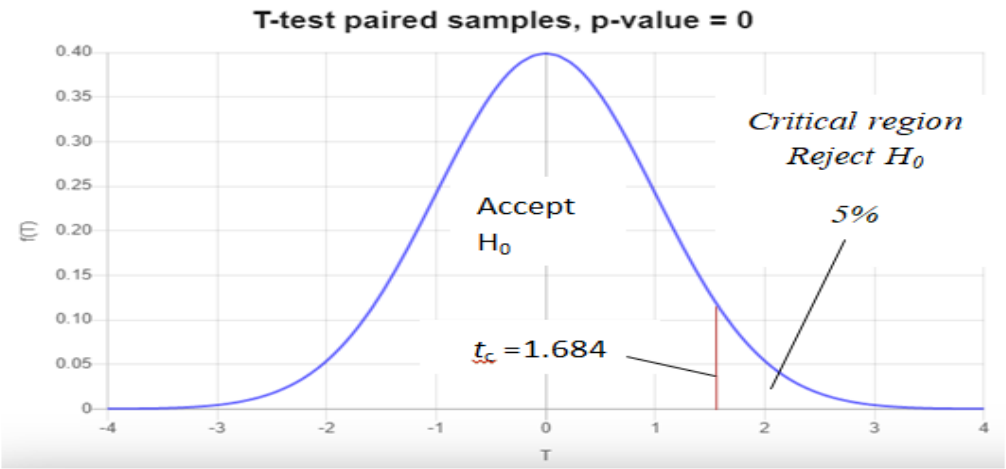

Figure 4 *t-test* AD

This value (t=12.01) lies in the critical value or region that H0 is rejected. So there is enough evidence at the 5% level to support that the student's academic achievement learned by SC methods is better than teacher-centered teaching methods. In addition, there is evidence at a 5% level of significance to suggest that SC is well-encouraging students to improve their academic achievements in Biology class.

The blow table 13 shows the difference mean of two scored tests that were learned through both methods. The average means of tests that learnt through TC 5.0695was lower than that of the mean of tests that learnt through SC 7.7155. The difference -2.646 was found between the two groups

based on the methods. Based on this the teacher-centered teaching method is not the best method to improve students' academic achievement in the biology class.

Table 13 Average mean and score difference of tests achieved by grade 10A and10B students

Section	No	TCL		SCL		Difference	
		A mean	100%	A mean	100%	Sd	SSd
10A	21	5.214	52.14	7.881	78.81	-2.667	7.113
10B	20	4.925	49.25	7.550	75.5	-2.625	6.891
Total	41	10.139	101.39	15.431	154.31	-5.292	14.004
Mean(X)	-	5.0695	50.695	7.7155	77.155	-2.646	7.002
St. Dev.	-	1.481	14.81	0.852	8.52	1.411	-

Key: *SCL= student-centered teaching methods, TCL= Teacher-centered teaching methods, A= Average, 10B= grade 10B students, Sd= score difference, SSd= Square of score difference*

From the sample data, it is found that the corresponding sample means are:

$$\bar{X}_1 = 5.073$$

$$\bar{X}_2 = 7.72$$

Also, the provided sample standard deviations are:

$$s_1 = 1.481$$

$$s_2 = 0.852$$

And the sample size is n = 41. For the score differences we have

$$\bar{D} = -2.646$$

$$s_D = 1.411$$

1) Null and Alternative Hypotheses

The following null and alternative hypotheses need to be tested:

$$H_0 : \mu_D \geq 0$$

$$H_a : \mu_D < 0$$

This corresponds to a left-tailed test, for which a t-test for two paired samples be used.

2) Rejection Region

Based on the information provided, the significance level is alpha = 0.05 or α=0.05, and the critical value for a left-tailed test is tc=−1.684.

The rejection region for this left-tailed test is R= {t:t<−1.684}

3) Test Statistics

The t-statistic is computed as follows:

$$t = \frac{\bar{D}}{s_D/\sqrt{n}}$$

$$= \frac{-2.646}{1.411/\sqrt{41}}$$

$$= -12.01$$

4) Decision about the null hypothesis

Since it is observed that t=−12.01<tc=−1.684, it is then concluded that *the null hypothesis is rejected.*

Using the P-value approach: The p-value is p=0, and since p=0<0.05, it is concluded that the null hypothesis is rejected.

5) Conclusion

It is concluded that the null hypothesis Ho *is rejected.* Therefore, there is not enough evidence to claim that the population mean difference μD=μ1−μ2is less than 0, at the alpha = 0.05 orα=0.05 significance level.

Confidence Interval

The 95% confidence interval is −3.092<μD<−2.201.

Graph 4

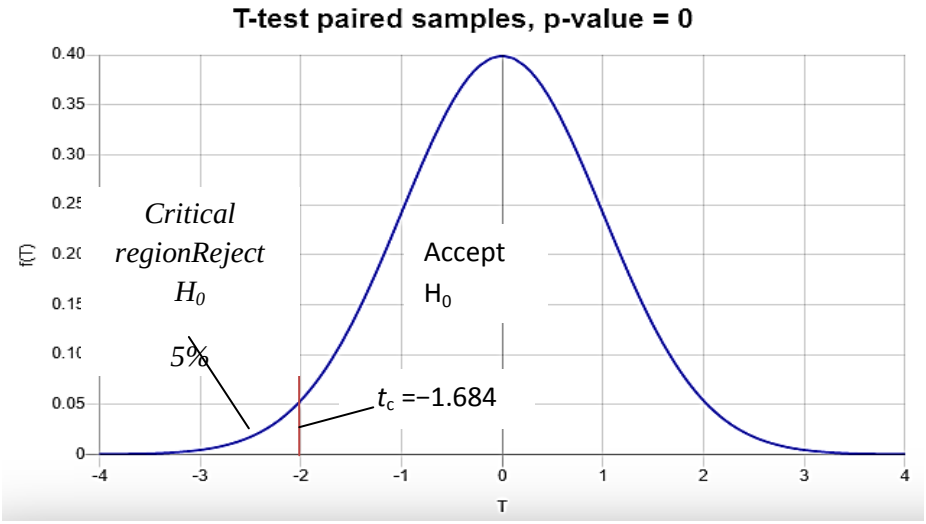

Figure 5 *t-test* AD

This value (t=-12.01 lies in the critical value or region that H0 is rejected. So there is not enough evidence at the 5% level to support that the student's academic achievement learned by teacher-centered teaching methods is better than SC methods. In addition, there is no evidence at a 5% level of significance to suggest that teacher-centered teaching is well-encouraging students to improve their academic achievements in biology class.

4.2.3. Analysis of data collected from teachers interview

In this topic, the researcher has attempted to gather data from teachers about their opinions and practice on student-centered teaching methods in biology classes by using interviews. The teachers' responses were analysis and evaluation as the following by using the passage and finally analyzed qualitatively.

Researcher: Q1. Whatmethods could improve the academic achievement of students?

Teacher 1: Student-centered teaching methods, such as student demonstration to peer, project, case study, discussion in group, brainstorming etc. can improve students' academic achievement.

Teacher 2: The student-centered teaching method is more successful than the other methods.

Teacher 3:Student-centered teaching method can improve students' academic achievement, because it make student active in class but teacher-centered teaching method make students passive.

Teacher 4: The active learning (student-centered teaching) method like group discussion, field trip, assignment, problem based and others.

Teacher 5: Group discussion method which the teacher used to improve students' academic achievement in biology class.

Researcher: Q2what types of teaching aids support student-centered methods of teaching in biology?

Teacher 1: There are different teaching aids that support student-centered teaching methods based on the topic lesson. For example laboratory instruments such as microscope, centrifuge, prepared slides, and real objects like plant leaf and animals models.

Teacher 2: Using technology such as video to visuals the lesson and charts, graphs, models, etc.

Teacher 3: The teaching aid that used to teaching biology is charts, audio, video, plant parts and different organ models.

Teacher 4: There are many teaching aids that support student-centered teaching methods based on the topic of lesson. For example, in class the teacher can use charts, models, parts of plants, microscope, hand lens and different chemicals in laboratory.

Teacher 5: All types of teaching aids that related to biology subject are used to support student-centered teaching methods to improve achievements.

Researcher: Q3 Can continuous assessment support in achieving better in biology class?

Teacher 1: Yes, because it can tests the level of students' knowledge development constructively and to distinguish who are long memory to short memory.

Teacher 2: Yes, it can support in achieving better result in biology class.

Teacher 3: Continuous assessment is the part of active learning that supports students to score better result in biology subject.

Teacher 4: Yes, it can support to achieve better result in biology subjects. Because the assessment used to identify understands of students during the lesson and after the lesson of the subject.

Teacher 5: Yes, it can.

Researcher: Q4. What are the greatest problems or challenges of using student-centers teaching methods in biology classes?

Teacher 1: The great problem or challenges during teaching and learning biology in student-centered techniques the students discuss other ideas out of the topics, side talk, and lack of interest.

Teacher 2: The challenges that we face when we apply the student-centered teaching methods is class will be disturbed, most of the students are dominated by active students only and it takes more time.

Teacher 3: The greatest problem or challenges to implement student-center teaching methods is insufficient time, quantity, and quality of teachers in facilitating student-centered learning, overloaded curriculum, and a lot of paperwork and limitation of standardized testing.

Teacher 4: There are many problems or challenges that hinder the implementation of student-centered methods. The main problems are student background, English language, students' interest, and teachers' interest to use this method, shortage of time, and teaching aid and curriculum.

Teacher 5: There are a lot of problems that hinder the implementation of student-centered methods. Most of the students instead of discussing the main point of the lesson they discuss anther points. For example, they laugh with each other, they talk about themselves that do not have any relation with the education, less potential and they discuss social life, love, politics, sport, etc.

In the above interview question the teachers responded that the students discuss other ideas out of the topics, side talk and lack of interest of students and teachers, insufficient time, domination of few students over others and they talk about themselves that do not have any relation with the educations were the major factors towards the implementation of student-centered teaching methods. Here, the researcher thought that the implementation of student-centered teaching methods needs the commitment of teachers and students to improve their achievements.

Researcher: Q5. Do you think that can student-centered teaching method is used to improving students' academic achievement in biology class?

Teacher 1: I have no doubt on the advantage of student-centered teaching methods because it creates better participation, discussion and the students' peer teaching and idea sharing. So the students' achieve more than that of teacher-centered methods.

Teacher 2: Of course, rather than the talk and chock method applying student-centered teaching methods improves the academic achievement of students. If teachers use student-centered teaching methods, most of students will actively participate in teaching learning processes in class.

Teacher 3: Yes, it is important to the achievement of students' because it is personalized learning, the subject is interactive and improves knowledge retention, and also encourages further learning.

Teacher 4: Yes, it can improve.

Teacher 5: Yes, if the students and teachers take responsibility to use student-centered teaching methods in the class, it is very important to improve the academic achievement of students.

In the above interview question, the teachers responded that a student-centered teaching method was important to improve the academic achievement of students. Here, the researcher believed that student-centered teaching methods were used to improve student's academic achievement in biology class.

Researcher: Q6.What is the main reasons that hinder the implementation of student-center teaching methods?

Teacher 1: The reason that hinders the use of student-centered methods in biology class is students' attitude on the advantage of the methods, lack of self-confidence when they participate in the class, and lack of equipment to support students learning by themselves.

Teacher 2: There are so many factors that could be obstacles to implement student-centered methods. Some of them are class size, shortage of time, and shortage of teaching aid.

Teacher 3: There are many factors that hinder the implementation of student-centered teaching methods in biology class. Those are lack of interest and confidence of students and teachers, class size, students feel discomfort when they work with others, family issues and instability, teaching methods, and learning environment.

Teacher 4: The challenges are lack of teachers and students interest and confidence, class size; students feel discomfort when they work with others.

Large class size and excessive workload had been found to be the main factors that hinder the implementation of SCL.

Teacher 5: The main reason hinders it is, less potential of students in the academic status and they do not take responsibility. Most of them do not give attention to education and do not worry about knowledge; simply they want the certificate only. In addition, they do not ask themselves, is it my grade level is equal with my knowledge and why they come to the school.

Researcher: Q7.In what ways do you think your students are benefited from the implementation of student-centers teaching methods in Biology classes?

Teacher 1: Using student-centered teaching methods have many advantages for the teacher and learners: Such as it creates a good understanding of the lesson, improves the self-confidence of the learners, and increases their ability to do something to know more about practical things.

Teacher 2: The student-center method has benefits for the students. Some of its benefits are it improving their result because they have got better knowledge and they improve doing co-operatively with a classmate. In addition, by doing different activities practically in a lab they develop their doing skill in day-to-day activities.

Teacher 3: If we use this method in the teaching-learning process in class, we can see many changes in students. They can solve problems or they can develop problem-solving abilities and critical thinking. In addition, it enables them to apply information and integrate knowledge, active and collaborative engagement in learning, to develop their autonomy as a learner and enable lifelong learning.

Teacher 4: It can improve students' communication and collaboration skills. Advances in students' ability to think and work independently. In addition, it increases student interest in school activities and education.

Teacher 5: There are many ways that students benefited from the implementation of these methods. These are, give individual work to read and give the chance to talk what understand from the reading. In group discussion also each member of the group was given chance to present what he/she understand from the discussion.

Researcher: Q8**.**What is the reason that students score low achievement in biology subjects?

Teacher 1: The reason for low achievement in biology class is students' background, their lifestyle, lack of support out of the school system, peer pressure that takes lots of time that used for reading, and lack of interest to learn biology.

Teacher 2: Some of the reasons that students score low achievements are the methods of teaching, lack of interest, they don't determine the science in the lab, and unavailability of facilities in the school.

Teacher 3: There are many reasons. From those improper timetable, inadequate study time, lack of study materials, family economic and other problems, discouragement, lack of interest to learn, medical problems and disability, and poor socio-cultural home environment.

Teacher 4: The main season is teaching method is based on theoretical; there is no practice because of the shortage of time and teaching aid in the school.

Teacher 5: Students think that most the educated people lead good life economically (educated people have low income). So they want short cut the ways of getting income instead of passing through education. For example, the male wants certificates for car licenses and females for an Arabic country. So they do not believe that there is change by education.

The interviewees‟ in the above question showed that the implementation of student-centered technique would be attractive if the teachers and students give more focus to use in the teaching-learning process. In addition to this, they also added that the implementation would be more interesting if there is sufficient time and facility needed to implement it.

The information that was found from the interview helped the researcher further understanding teachers‟ perception towards the implementation of student-centered teaching methods in biology classes to improve students' academic achievement. Although most of the teachers had good perceptions of the implementation of student-centered teaching methods, some constraints in their school had left obstacles towards the implementation of student-centered teaching methods. As the respondents answered the obstacle to implementing this method were insufficient time, students' background, students' and teachers' interest, shortage of teaching aids, curriculum, and others.

4.3. Discussion

The result of the analysis of hypothesis one which stated that there is significant different between student-centered teaching methods and teacher-centered methods to improve students' biology achievement that H0 is rejected. So there is enough evidence that the student's biology achievement learned by student-centered teaching methods is better than teacher-centered teaching methods. In addition, that student-centered teaching methods is well-encouraging students to improve their academic achievements in biology class. This shows that student-centered teaching methods brought about better achievement in biology. The finding is supported by (Zulfiquar and Zamir 2015).This approach also motivates goal-orientated behavior among students; hence the method is very effective in improving student academic achievement. Also, (Ganyaupfu 2013) states that the student-centered teaching method is regarded more effective since it does not centralize the flow of knowledge from the lecturer to the student.

According to the key informant obtained from students' tests score results and interviewees, student-centered teaching method was more effective methods to improve student's academic achievement when it compared with teacher-centered teaching methods. According to (Felder and Brent 1996)the student-centered teaching method enables the students to apply information and integrate knowledge, active and collaborative engagement in learning, to develop their autonomy as a learner and enable lifelong learning. In addition, this method was well-encouraging students to improve their academic achievements than the teacher-centered teaching method in biology class.

Finally, based on the students' test result and teachers' interview answers the student-centered teaching method was the effective to improve students' academic achievement than teacher-centered teaching method in biology class.

Chapter five

5. Summary, Conclusions and Recommendations

5.1. Summary

The study was conducted to improve the biology achievement of Students by Student-centered teaching methods in biology classes. It was to improve the academic achievement of students by using different student-centered teaching methods in biology class.

According to the key informant obtained from students' tests score results and interviewees, student-centered teaching method was more effective methods to improve student's biology achievement when it compared with teacher centered teaching methods.

The student-centered teaching method enables the students to apply information and integrate knowledge, active and collaborative engagement in learning, to develop their autonomy as a learner and enable lifelong learning.

The students that taught with SCL were 7.72 higher than that of the mean of TCL 5.07. In percent SCL were 77.2% achieve while TCL were 50.7% achieved. The difference between student-centered teaching method and teacher-centered teaching method were 2.646 or 26.46%. This shows that the student-centered teaching method was more effective to improved students' academic achievement in biology class than teacher-centered teaching method. In general, the difference result was found based on the teaching methods used in class during teaching grade 10 biology lesson.

At the value (t=7.633.) the critical value or region $H_0$was rejected. So there was enough evidence at the 5% level to support the claim that the students' biology achievement learnt using student-centered teaching is better than teacher-centered teaching methods.

As the researcher understands teachers' interview answers, the student-centered teaching was effective method to improve students' academic achievement. But there were some obstacle to implement it in the class. Those obstacles were insufficient time, students' background, teaching aid, teachers' commitment and others.

5.2. Conclusions

In general, Student-centered instruction is an approach to learning which focus mainly on the interests of the students, rather than teachers and administrators and transfer the focus of activity from the teachers to the learners. It increases learner autonomy and independence by putting

responsibility for the students by imparting to their skills and the basis on how to learn a biology subject.

(SCI) is an educational technique wherein e students affect the content, activities, substances, and tempo of gaining knowledge. This gaining knowledge of version locations the scholar within the middle of the gaining knowledge of the process. The teacher gives students with possibilities to analyze independently and from each other and teaches the students the abilities they want to achieve effectively.

Properly carried out of SCI can cause growth motivation to learn, more retention of knowledge, deeper understanding, and extra nice attitudes toward the issue being taught. Student-centered instruction is an approach to learning which focuses mainly on the interests of the students, rather than teachers and administrators. These methods transfer the focus of activity from the teachers to the learners.

Student-centered learning changes the learning process from teacher to student thus increasing active learning and engagement among students. It enables critical thinking and to develop knowledge rather than a collection of facts by building upon and challenging prior learning.

In student-centered learning, the teacher is a facilitator and contributor rather than a transfer and director of knowledge. It returns the responsibility for learning to the students, so students are able to understand their strengths and weaknesses and take part in directing their own knowledge gain.

5.3. Recommendations

Based on the findings of this study the following recommendations were made. Teachers need the training to understand what constitutes the successful practice of SCL and the best outcomes for students. Training shift required in teachers' attitude, approach, and practice to make SCL a genuinely beneficial mode of education and empower teachers in using student-centered learning methods to improving the Academic Achievement of Students. Therefore, assessing the implementation of the active learning approach is found to be crucial.

The energetic participation of every student is a vital issue in student-centered teaching methods. Students need to be doing matters and concurrently consider the works performed and the reason at the back of it a good way to beautify their better order wondering capabilities.

Poor academic achievement of students is essentially connected to the utility of useless teaching techniques through instructors to affect expertise to learners. Therefore to enhance educational

fulfillment the academics should use powerful coaching techniques in Biology elegance and in different classes.

It is critical to don't forget that every student does no longer study or learn in an identical manner or at an identical rate. Students are like leaves on a tree; there aren't any precisely identical. Just as a leaf is available in precise colors, shapes, and sizes, every student has their own precise getting-to-know style. Therefore teachers should use student-centered teaching methods to achieve the different learning style of students and to improve their academic achievement.

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APPENDIXI

Addis Ababa University

College of Natural and Computational Sciences

APPENDIX I. Tests answered by Students

Dear, Respondents

This test is prepared for the purpose of conducting a study on '*Improving the Academic Achievement of Students through Student-Centered Teaching Methods in Biology Classes in Meskerem Secondary School of Addis Ababa'*. To achieve the purpose, your cooperation in completing this test is highly appreciated. The success of this study depends on your honest and sincere responses to the tests. The data you provide will be kept confidential and will not be disclosed to any third party. You are, therefore, kindly requested to provide the required information.

Thank you in advance for your cooperation

I. Meskerem secondary school Biology Grade 10 **Test1** in 2013 on Endocrine for 10A

Choose the correct answer from the given alternative and write the letter on the give space.

1. Which of the following is an example of **ductless** gland?
   A. Sweat glands C. Pituitary glands
   B. Salivary glands D. Mammary glands
2. Which glands are secreted hormones directly into the blood stream?
   A. Tear glands C. Sweat glands
   B. Digestive glands D. Thyroid glands
3. The glands that control the other endocrine glands are:
   C. Pituitary glands C. Parathyroid glands
   D. Pineal glands D. Thyroid glands
4. The common reason for not making enough thyroxin hormone is:
   A. Lack of insulin in the body C. Lack of glucagon fluid
   B. Lack of Iodine in the diet D. Lack of glucose in blood
5. Which of the following pairs of hormones are produced in the pancreas?
   A. Thyroxin &Glucagon C. Glucose & Insulin
   B. Insulin & Glucagon D. Insulin & Testosterone

6. Which of the following serves both as an endocrine and exocrine glands?

   A. Overs B. Pancreas C. Testes D. Adrenal

7. Which hormone prepares the body for action?

   A. Adrenalin B. Insulin C. Glucagon D. Parathyroid

8. Growth hormones are produced by _____glands.

   A. Thyroid gland C. Adrenal gland

   B. Pituitary gland D. Pancreas gland

9. Which hormones are produced by **gonads endocrine glands?**

   A. Testes in girls C. Ovaries in boys

   B. Ovaries in girls D. Adrenaline in boys

10. Which hormone controls the development of male secondary sexual characteristics?

   A. Progesterone C. Adrenaline

   B. Estrogen D. Testosterone

II. Meskerem Secondary school 2013 Grade 10 Biology **Test2** on Photosynthesis 10A

Choose the correct answer from the given alternative and write the letter on the give space.

1. Which flowering plant organ use light energy, carbon dioxide and water to make food by photosynthesis?

   A. Root B. Steam C. Leaf D. Flowers

2. Which inorganic molecules used to produce the organic molecule glucose in photosynthesis?

   A. Carbon dioxide C. Oxygen

   B. Water D. A and B

3. The main photosynthetic tissue of the plant leaves are:

   A. Waxy cuticle C. Palisade mesophyll

   B. Spongy mesophyll D. Lower epidermis

4. Which tissue controls the entry of carbon dioxide into the leaf and loss of water by transpiration?

   A. Stomata B. Guard cells C. Cuticle D. Epidermis

5. Which dead tissue brings water from the soil to the cells of the leaves?

   A. Xylem B. Phloem C. Cuticle D. Stomata

6. Gases move in and out of a plant through:

   A. The cuticle B. The epidermis C. The stomata D. The roots

7. What is the function of light in photosynthesis process?

A. To split water molecules into hydrogen and oxygen. D.A and B
B. To produce Adenosine triphosphate (ATP).
C. To convert carbon dioxide into glucose.

8. What is the source of hydrogen?
   A. Carbon dioxide C. Glucose
   B. Water D. Sugar
9. What is the light-dependent reaction product?
   A. Hydrogen B. Water C. Glucose D. Carbon
10. Which of the following is not needed for photosynthesis to take place?
    A. Carbon dioxide B. Oxygen C. Chlorophyll D. Light

III. Meskerem secondary school Biology Grade 10 **Test1** in 2013 on Reproductive 10B

Choose the correct answer from the given alternative and write the letter on the give space.

1. The method of directly injecting a sperm into ovum in Assisted Reproductive Technology is called:
   a. GIFT c. ICSI
   b. ZIFT d.ET
2. Increased IMR and decreased MMR in a population will:
   a. Cause rapid increase in growth rate
   b. Result in decline in growth rate
   c. Not cause significant change in growth rate
   d. Result in an explosive population
3. Intensely lactating mothers do not generally conceive due to the:
   a. Suppression of gonadotropins
   b. Hyper secretion of gonadotropins
   c. Suppression of gametic transport
   d. Suppression of fertilization
4. Sterilization techniques are generally fool proof methods of contraception with least side effects. Yet, this is the last option for the couples because:
   i. It is almost irreversible
   ii. Of the misconception that it will reduce sexual urge
   iii. It is a surgical procedure

iv. Of lack of sufficient facilities in many parts of the country

Choose the correct option:

(a) i and iii (b) ii and iii (c) ii and iv (d) i, ii, iii and iv

5. A national level approach to build up a reproductively healthy society was taken up in our country in:

   a. 1950s c. 1980s

   b. 1960s d. 1990s

6. Emergency contraceptives are effective if used within:

   a. 72 hrs of coitus c. 72 hrs of menstruation

   b. 72 hrs of ovulation d. 72 hrs of implantation

7. Choose the right one among the statements given below:

   a. IUDs are generally inserted by the user herself

   b. IUDs increase phagocytosis reaction in the uterus

   c. IUDs suppress gametogenesis

   d. IUDs once inserted need not be replaced

8. Following statements are given regarding MTP. Choose the correct options given below:

   i. MTPs are generally advised during first trimester

   ii. MTPs are used as a contraceptive method

   iii. MTPs are always surgical

   iv. MTPs require the assistance of qualified medical personnel

   (a) ii and iii (b) ii and iii (c) i and iv (d) i and ii

9. From the sexually transmitted diseases mentioned below, identify the one which does not specifically affect the sex organs:

   a. Syphilis c. Gonorrhea

   b. AIDS d. Genital warts

10. Condoms are one of the most popular contraceptives because of the following reasons:

    a. These are effective barriers for insemination

    b. They do not interfere with coital act

    c. These help in reducing the risk of STDs

    d. All of the above

IV. Meskerem secondary school Biology Grade 10 **Test2** in 2013 on Transport in plants 10B
Choose the correct answer from the given alternative and write the letter on the give space.

1. The rate of transpiration will _____ if the atmospheric pressure is low
   a. Increase c. Stay unchanged
   b. Decrease d. Can't be determined
2. The main function of guard cells is to help with _____
   a. Transpiration c. Transcription
   b. Guttation d. None of the above
3. Transpiration is regulated by the movements of _____
   a. Parenchyma cells c. Epithelial cells
   b. Guard cells d. None of the above
4. The steroid hormones easily pass through the plasma membrane through simple diffusion because they are _____
   a. Gaseous c. Water Soluble
   b. Carbon-based d. Lipid Soluble
5. Living cells placed in an isotonic solution tend to retain their shape and size. This is based on the principle of
   a. Diffusion c. Osmosis
   b. Transpiration d. None of the above
6. Girdling around the trunk of a tree can cause it to _____ if it cannot regrow to bridge the wound
   a. Stop absorbing water c. Die
   b. Stop growing d. None of the above
7. Transport of food materials in higher plants occurs through
   a. Flowers c. Tracheids
   b. Companion cells d. Sieve elements
8. Nearly 90% of the flowering plants have _____
   a. Spores c. Naked seeds
   b. Mycorrhizae d. None of the above
9. The movement of materials from the leaves to other tissues of the plant is called _____
   a. Tropic movement c. Transpiration
   b. Guttation d. Translocation
10. The exudation of xylem sap drops on the edges of leaves is called
   a. Transpiration c. Condensation
   b. Guttation d. None of the above

APPENDIXII

College of Natural and Computational Sciences

Improving the Academic Achievement of Students through Student-Centered Teaching Methods in Biology Classes: The Case of Grade 10 and 11 Meskerem Secondary School

APPENDIX II. Interviews questions answered by Teachers

Dear, respondents

The purpose of this interview is used to collect data on the **Improving the Academic Achievement of Students through Student-Centered Teaching Methods** in Meskerem Secondary school of Arada sub-city, in Addis Ababa. Please make available responses based on the instructions of each section.

Note that there is no need of writing your name.

Thank you for your cooperation.

V. Interviews question answered by Teachers

1. What methods could improve the academic achievements of students?
2. What types of teaching aids support student-centered methods of teaching in biology
3. Can continuous assessments support in achieving better results in biology class?
4. What the greatest problems or challenges of using student-centers teaching methods in biology classes?
5. Do you think that can student-centered teaching method is used to improving students' academic achievement in biology class?
6. What are the main reasons that hinder to implement student-center teaching methods?
7. In what ways do you think your students are benefited from the implementation of student-centers teaching methods in Biology classes?
8. What is the reason that students score low achievement in Biology subject?

APPENDIX III

APPENDIX III. Daily lesson plan

Meskerem Secondary School

Daily lesson plan (TC)

Teacher Name TamiruShume Grade: 10, Subject Biology: Topic Unit 3: Human biology and health sub-topic: Endocrine glands Page 93.

Content	**Specific Objective**: By the end of the lesson student will be able to:	Teacher's Activities				Student Activities	
		Introduction Time 5'	Presentation Methods Time 20'	Stabilization Time 10'	Evaluation Time 10'	Experimental Student activity	Control Student activity
3.3 The endocrine glands	-Define glands as structures that produce hormones or other secretions and distinguish between exocrine and endocrine glands. -list the main endocrine glands and describe their functions. -Explain the location of endocrine glands. -Explain the cause and treatment of goiter. - State the cause and treatment of diabetes mellitus.	Revising the previous and introducing the new one.	By lecture.	Summarizing the given lesson in short and précised way.	Class work, homework, Assignment, Group work and test.	Recalling the pervious lesson and listening attentively.	Recalling the pervious lesson, listening attentively and taking note.

Meskerem Secondary School

Daily lesson plan (SC)

Teacher Name Tamiru Shume Grade: 10, Subject Biology: Topic Unit 3: Human biology and health Sub-topic: Reproductive health Page 108.

Content	**Specific Objective**: By the end of the lesson student will be able to:	Teacher's Activities				Student Activities	
		Introduction Time 5'	Presentation Methods Time 20'	Stabilization Time 10'	Evaluation Time 10'	Experimental Student activity	Control Student activity
3.3 The endocrine glands	-Define glands as structures that produce hormones or other secretions and distinguish between exocrine and endocrine glands. -list the main endocrine glands and describe their functions. -Explain the location of endocrine glands. -Explain the cause and treatment of goiter. - State the cause and treatment of diabetes mellitus.	Revising the previous and introducing the new one.	By group discussion, asking and answering question, group work, and individual activity, of Student-centered method.	Summarizing the given lesson in short and précised way.	Class work, homework, Assignment, Group work and test.	Recalling the pervious lesson, listening attentively, taking note, asking question, answering question, and working in group, Use the STAD method, learner work in	Recalling the pervious lesson, listening attentively, taking note, asking question, answering question, and working individually.

Meskerem Secondary School

Daily lesson plan (TC)

Teacher Name TamiruShume Grade: 10, Subject Biology: Topic Unit 4: Food making and growth in plants Sup-Topic: Photosynthesis Page 141.

Content	**Specific Objective**: By the end of the lesson student will be able to:	Teacher's Activities				Student Activities	
		Introduction Time 5'	Presentation Time 20'	Stabilization Time 10'	Evaluation Time 10'	Experimental Student activity	Control Student activity
4.1 The leaf	-Label the internal structures of leave -Explain the functions of the internal structures of leave	Revising the previous and introducing the new one.	By lecture.	Summarizing the given lesson in short and précised way.	Class work, homework, Assignment, Group work and test.	Recalling the pervious lesson and listening attentively.	Recalling the pervious lesson, listening attentively and taking note.
4.2 photosynthesis	-Explain the importance of light, chlorophyll and (CO2) for photosynthesis. -Explain how plants convert carbon dioxide and water into carbohydrate by describing the light and dark reactions.						

Meskerem Secondary School

Daily lesson plan (SC)

Teacher Name Tamiru Shume Grade: 10, Subject Biology: Topic Unit 4: Food making and growth in plants Sub-Topic: Transport Page 158.

Content	**Specific Objective**: By the end of the lesson student will be able to:	Teacher's Activities				Student Activities	
		Introduction Time 5'	Presentation Time 20'	Stabilization Time 10'	Evaluation Time 10'	Experimental Student activity	Control Student activity
4.1 The leaf	Label the internal structures of leave -Explain the functions of the internal structures of leave	Revising the previous and introducing the new one.	By discussion, asking question and answering group work, individual activity, Student-centered method.	Summarizing the given lesson in short and précised way.	Class work, homework, Assignment, Group work and test.	Recalling the pervious lesson, listening attentively, taking note, asking question, answering question, and working in group, Use the STAD method,	Recalling the pervious lesson, listening attentively, taking note, asking question, answering question, and working individually.
4.2 photosynthesis	Explain the importance of light, chlorophyll and (CO2) for photosynthesis. -Explain how plants convert carbon dioxide and water into carbohydrate by describing the light and dark reactions.						

APPENDIX IV. Students Result Tables

Table 5 Result of tests achieved by grade 10A students (TC)

Student	T1	T2	Average	100%
1	8	5	6.5	65
2	4	7	5.5	55
3	5	6	5.5	55
4	5	5	5	50
5	5	3	4	40
6	3	2	2.5	25
7	2	6	4	40
8	5	4	4.5	45
9	6	5	5.5	55
10	4	5	4.5	45
11	2	5	3.5	35
12	10	9	9.5	95
13	4	4	4	40
14	5	4	4.5	45
15	8	5	6.5	65
16	10	4	7	70
17	6	5	5.5	55
18	3	5	4	40
19	3	6	4.5	45
20	8	4	6	60
21	7	7	7	70
Total	113	106	109.5	1095
Mean(X)	5.38	5.05	5.214	52.14

Table 6 Result of tests achieved by grade 10A students (SC)

N^{O}	T1	T2	Average	100%
1	9	8	8.5	85
2	7	9	8	8
3	6	8	7	7
4	7	8	7.5	75
5	6	7	6.5	65
6	7	6	6.5	65
7	6	9	7.5	75
8	7	9	8	80
9	7	6	6.5	65
10	10	8	9	90
11	7	9	8	80
12	10	8	9	90
13	8	5	6.5	65
14	8	7	7.5	75
15	9	8	8.5	85
16	10	8	9	90
17	8	7	7.5	75
18	7	9	8	80
19	9	10	9.5	95
20	9	8	8.5	85
21	8	9	8.5	85
Total	165	166	165.5	1655
Mean(X)	7.857	7.905	7.881	78.81

Table 7Result of tests achieved by grade 10B students (TC)

No	T1	T2	Average	100%
1	6	5	5.5	55
2	5	5	5	50
3	8	6	7	70
4	6	5	5.5	55
5	4	1	2.5	25
6	6	2	4	40
7	5	5	5	50
8	7	5	6	60
9	3	4	3.5	35
10	6	3	4.5	45
11	4	4	4	40
12	7	7	7	70
13	3	4	3.5	35
14	7	6	6.5	65
15	2	3	2.5	25
16	7	3	5	50
17	8	7	7.5	75
18	7	3	5	50
19	5	2	3.5	35
20	7	4	5.5	55
Total	113	84	98.5	985
Mean(X)	5.65	4.2	4.925	49.25

Table 8Result of tests achieved by grade 10B students (SC)

Students	T1	T2	Average	100%
1	5	9	7	70
2	5	8	6.5	65
3	4	9	6.5	65
4	7	10	8.5	85
5	5	9	7	70
6	7	9	8	80
7	8	8	8	80
8	8	6	7	70
9	7	8	7.5	75
10	5	10	7.5	75
11	4	10	7	70
12	8	9	8.5	85
13	8	10	9	90
14	7	9	8	80
15	5	7	6	60
16	7	9	8	80
17	8	7	7.5	75
18	7	8	7.5	75
19	6	10	8	80
20	8	8	8	80
Total	129	173	151	1510
Mean	6.45	8.65	7.55	75.5

Table 9 Results and Score difference of tests achieved by grade 10A students

Student	SCL result	TCL result	Score difference	SSd	100%
1	8.5	6.5	2	4	20
2	8	5.5	2.5	6.25	25
3	7	5.5	1.5	2.25	15
4	7.5	5	2.5	6.25	25
5	6.5	4	2.5	6.25	25
6	6.5	2.5	4	16	40
7	7.5	4	3.5	12.25	35
8	8	4.5	3.5	12.25	35
9	6.5	5.5	1	1	10
10	9	4.5	4.5	20.25	45
11	8	3.5	4.5	20.25	45
12	9	9.5	-0.5	0.25	5
13	6.5	4	2.5	6.25	25
14	7.5	4.5	3	9	30
15	8.5	6.5	2	4	20
16	9	7	2	4	20
17	7.5	5.5	3	9	30
18	8	4	4	16	40
19	9.5	4.5	5	25	50
20	8.5	6	2.5	6.25	25
21	8.5	7	0.5	0.25	5
Total	165.5	109.5	56	187	1870
Mean	7.881	5.214	2.667	8.905	89.05
St. Dev.	0.921	1.538	1.317	1.37235	-

Table 10 Results and Score difference of tests achieved by grade 10B students

Student	SCL result	TCL result	Score difference	S Score difference	100%
1	7	5.5	1.5	2.25	
2	6.5	5	1.5	2.25	
3	6.5	7	-0.5	0.25	
4	8.5	5.5	3	9	
5	7	2.5	4.5	20.25	
6	8	4	4	16	
7	8	5	3	9	
8	7	6	1	1	
9	7.5	3.5	4	16	
10	7.5	4.5	3	9	
11	7	4	3	9	
12	8.5	7	1.5	2.25	
13	9	3.5	5.5	30.25	
14	8	6.5	1.5	2.25	
15	6	2.5	3.5	12.25	
16	8	5	3	9	
17	7.5	7.5	0	0	
18	7.5	5	2.5	6.25	
19	8	3.5	4.5	20.25	
20	8	5.5	2.5	6.25	
Total	151	98.5	52.5	182.75	
Mean(X)	7.55	4.925	2.625	9.1375	
St. Dev.	0.759	1.444	1.538	1.5379	

APPENDIX-V

APPENDX V. SC classroom rules, Basic classroom rule:

1. Listen to what others have to say.
2. Respect others and their ideas.
3. Take your responsibilities seriously.
4. Stick to the task at hand.

Actions of a SC group member:

1. Stays with the group, speaks quietly and shares ideas and materials.
2. Addresses others by name, looks at the person speaking, and encourages participating.
3. Looks at the group's work and contributes ideas.
4. Allows each person to respond before speaking again.

Actions of an effective group member:

1. Criticizes ideas without criticizing people.
2. States the differences when there is a disagreement.
3. Pulls together all the ideas in to single position.
4. Asks others to verbalize how they would solve problem reach a decision.
5. Asks people to explain their reasoning.
6. Seeks elaboration by referring to other learning or knowledge.
7. Builds on others' ideas.
8. Listens to all ideas before reaching a conclusion.
9. Probes by asking in-depth questions that lead to deeper analysis.

NB: Well-constructed SC-learning exercises may be distinguished simple group work by attention to four factors:

1. Careful distribution of students into groups;
2. Assignments of specific roles and responsibilities to each member of the group;
3. Specific and attainable objectives; and