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The Effects of 21st Century Teaching Methods on the Skill Development of Biology Students in Secondary Schools within Fako Division in the South West Region of Cameroon

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Abstract

The study examined the effects of 21st century teaching methods on skill development of biology students in secondary schools in Fako Division. Four research objectives guided the study which sought to investigate: the effects of blended learning on skills development of biology students in secondary schools in Fako Division, the effects of flipped classroom on skills development of biology students in secondary schools in Fako Division, the effects of differentiated instruction on skills development of biology students in secondary schools in Fako Division and the effects of cooperative learning on skills development of biology students in secondary schools in Fako Division. The objectives were converted to research questions while the questions were transformed to four research hypotheses. The research design used for this study was the explanatory sequential design which combines both quantitative and qualitative research approaches. The target population was Lower Sixth biology students and teachers drawn from selected secondary schools in Fako Division. The accessible population consist of 820 students and 11 teachers from lay private, public, and confessional schools. Multi-stage sampling procedures which included stratified, simple random and purposive sampling procedures was used to select a sample size of 206 Lower Sixth students drawn from five schools; public, lay private and confessional secondary schools in Fako Division. The researcher used a Likert scale student questionnaire for students and an interview guide for teachers as instruments for data collection for the study in order to get enough data from a large population and to have first-hand information. The instruments were subjected to face and content validation and to test for reliability, a test re-test reliability was carried out in a public school in Fako Division which was not part of the sample. Coefficient was established using Cronbach's Alpha (α) and the reliability index here was 0.804 which implies that the questionnaire was reliable and the interview was analysed using thematic analysis. The data collected were analysed using descriptive through mean scores standard deviation frequency and percentages and inferential Analysis of Pearson Product Moment Correlation was used to test the hypotheses at the level of significance. The findings revealed that blended learning, flipped classroom, differentiated instruction and cooperative learning have significant influence on skill development of biology students in secondary schools within Fako Division in the South West Region of Cameroon. It is recommended that students learn to participate in the learning process and also that students follow the order given by the teacher so as to facilitate learning. Teachers should assess students' learning need regularly and also encourage students' voice and choice.

Keywords: 21st Century Teaching Methods, Skill Development, Fako Division

Introduction

Skill development is a very important aspect of a student's journey through education. Skill development in Biology nurtures problem-solving abilities essential for addressing complex biological questions and challenges. It enables researchers to devise creative solutions and make evidence-based decisions (Kaufman, 2016) [8]. It boosts biology students' confidence in scientific inquiry and experimentation as well as fosters curiosity and interest in Biology and other related fields. Skill development fosters a mindset of continuous learning and adaptation in the life of a biology student (Parker, 2020) [13]. Skill development is the process by which individuals acquire, expand, and fine-tune a set of abilities, expertise, or competencies that enable them

to perform specific tasks, solve problems, and achieve goals effectively in diverse domains of life (Kuijpers, & Meijer, 2012) [10].

According to Moliki and Neba (2023) [12], the rising changes of classroom factors such as teaching methods, class size, teacher students interaction and instructional materials, implemented for the teaching-learning process has been accompanied by a relatively sharp increasing change in students' academic achievement. One factor that can influence skill development in Biology is the 21st century teaching methods. 21st century teaching methods refer to the emphases laid on students' centred learning, technology integration, and real-world applications to develop essential skills for the 21st century (Partnership for 21st Century Learning, 2019). Currently, some biology students lack metacognitive skills necessary for self-regulating their learning process and without this skill students will not recognize when they need to change their approach to solving problems and understand biological concept (Schraw & Crippen, 2011) [15]. Most secondary school biology students lack collaboration among them, they do not know how to work with their peers and communicate ideas. They do not have good communication skills since they have limited exposure to communication training and think communication have to do with language study and because of this mindset they are unable to communicate their ideas in class and outside (Harris & Mendez, 2005) [17].

Despite the progress made in researching skill development in biology, several gaps remain. Most of the existing literature is centred on western culture. Also, the curriculum for biology has little or no focus on the acquisition of these skills, especially the communication skill. Many studies have been carried out on teacher training and skill development in biology, but biology students still lack these skills. This study informs educators on how to optimize 21st century teaching methods to effectively foster skill development in biology classes. It provides insight into the effect of 21st century teaching methods on skill development of students. The problem posed as research question was therefore: What are the effects of 21st century teaching methods on skills development of biology students in secondary schools in Fako Division?

Research Objectives

The study seeks to investigate the effects of 21st century teaching methods on skills development of biology students in secondary schools in Fako Division.

Specifically, the study was the study was guided by four research objectives which sought to investigate:

1. The effects of blended learning on skills development of biology students in secondary schools.
2. The effects of flipped classroom on skills development of biology students in secondary schools.
3. The effects of differentiated instruction on skills development of biology students in secondary schools.
4. The effects of cooperative learning on skills development of biology students in secondary schools.

Research Hypotheses

The research hypothesis was:

Ho: 21st century teaching methods have no significant effects on skills development of biology students in secondary schools in Fako Division.

Specifically, the following hypotheses were formulated to guide the study:

Ho_1: Blended learning has no significant effect on skills development of biology students in secondary schools.

Ho_2: Flipped classroom has no significant effect on skills development of biology students in secondary schools.

Ho_3: Differentiated instruction has no significant effect on skills development of biology students in secondary schools.

Ho_4: Cooperative learning has no significant effect on skills development of biology students in secondary schools.

Research Methodology

The study was descriptive in nature and the primary research design adopted for the study was the explanatory sequential design. The explanatory sequential design was adopted for the study because the study sought to investigate the effects of 21st century teaching methods on skills development of biology students in secondary schools by amalgamating quantitative and qualitative data. This was to provide a comprehensive analysis (Creswell, 2014) [2]. The mixed research method from which this kind of design emanated required that both quantitative and qualitative approaches be used. The survey design was the secondary design that was used for the study. It employed the quantitative research method. This required that a sample be drawn from the population and studied with the aim that, results obtained from the sample were used to make predictions about the population. To add, the survey design is the most suitable design used in social sciences research studies. This is for proper elaboration of characteristics and variation of population. This helps to describe samples as per demands of the study for further description of educational phenomena (Gay, Mills & Airasian, 2009 [5]; Leob, *et al*., 2017). The purpose of this design is to provide a valid and accurate representation of the factors or variables that are relevant to the research question and to gather data from samples of a defined population at a particular time (Endeley & Zama, 2021) [4].

This study was carried out in Fako Division. Fako is a division located in the South west Region of Cameroon, covering an area of approximately 2,093 square kilometers with an estimated population of 52,691. The capital city of this division is Limbe. Fako Division comprises seven subdivision which are; Limbe I, Limbe II, Limbe III, Buea, Tiko, Muyuka, and Idenau (Kabo, 2020) [7]. The climate of the division is tropical, characterized by two main seasons that is the rainy season and a dry season which support agriculture with crops such as Bananas, cassava, palm oil and other economic activities. The division is predominantly inhibited by the Bakweri people who have a unique cultural identity and are known for their traditional customs, dances and festivals (Koenig, 2015) [9].

Fako Division has various educational institutions. Looking at notable institutions in the Fako Division, The University of Buea, Cameroon's first Anglo-Saxon state-owned university is found in the Fako Division and the division is the site of a good number of privately owned universities. Several other higher institutes of learning including the St Francis Schools of Nursing and Midwifery presently known as Biaka University Institute of Buea (BUIB) and one of Cameroon's three Catholic Universities are found in the division. In terms of basic and secondary education, the Fako division has schools of all strata in the region. It is

made up of many public schools, confessional schools and lay private schools, which are owned by the government, private and missionary bodies. The schools range from kindergarten to Higher Institutions of Learning. These schools are more dominant in the area, making it a fertile ground for such studies to be carried out. Amongst the schools found in the Fako Division are Arabic schools, schools for the deaf and dumb, a rehabilitation centre for the blind and a reformatory school for young delinquents. Fako Division hosts a Linguistic center found in Buea which was created in 1963 for the promotion of the two official languages in Cameroon; French and English as well as the Buea Linguistic center annex in Limbe. Given the importance of technical education, technical schools ranging from secondary to university levels are dotted all over the division. Today, the Fako division harbours a huge metropolitan population made up of people from other villages, cities, divisions, regions, and nations mainly due to the presence of institutions of learning like the University of Buea, the Cameroon Christian Universities and the Higher Institute of Management Studies (HIMS).

The main population of the study consisted of all secondary school students and teachers (63, 428) in Fako Division. The reason for this choice is that the aforementioned area has diverse kinds of livelihood and schools that have Biology as a subject. The target population in the study were Lower Sixth biology students and teachers drawn from a parent population of 63, 428 students and teachers of Biology in Fako Division. The target population was made up of 4 (04) schools (public, confessional and lay private). 206 students were targeted while 05 teachers were targeted making a total of 211 targeted respondents for the study. The accessible population of the study was made up of 820 Lower Sixth students and 11 teachers randomly selected. The sample size for the study was 206 respondents (206 Lower Sixth Biology students and 8 teachers) drawn from the accessible population. The researcher used the Krejcie and Morgan (1970) table to determine the sample size and the sample population.

Multiple-stage sampling technique was applied in the study which included the stratified sampling, simple random sampling (which are probability sampling techniques) and the purposive sampling (which is a non-probability sampling technique) procedures (Taherdoost, 2016) [16]. The stratified sampling (stratification) technique was used to divide schools from the sampling frame into separate homogenous sub groups called strata (Taherdoost, 2016) [16] before simple random sampling (Mishra & Alok, 2017) [11]. There were three strata (Stratum 1= public, stratum 2= confessional and stratum 3= lay-private) and the sampled schools were selected from each stratum. This was followed by a simple random sampling procedure which was used to select schools from stratum 1, stratum 2 and stratum 3 which formed the accessible population of students and teachers from the various schools randomly selected as each and every member of the population in this type of sampling technique had an equal chance and the probability of being selected for sample of the study (Alvi, 2016 [1]; Mishra & Alok, 2017 [11]; Mills & Gay, 2018). The simple random sampling technique involved writing all names of schools in each stratum on slips of paper that were folded and put in three separate strata containers, mixed up and shaken and three slips of paper were picked from each stratum at random apart from stratum 1 where just two slips of papers were picked. The names of the schools on each of the picked slips of paper were the ones to be included in the study. This method, according to Mishra and Alok, (2017) [11] is called the lottery method. After identifying the sample frame, purposive sampling was used to deliberately select the form(s) suitable for providing the required information. It was to build up a sample that is satisfactory to the researchers' specific needs since the researchers simply hand-picked the subject to be included in the sample on the basis of the researcher's judgement of their typicality. Five schools were selected for the study. The researchers also used the purposive or judgmental sampling which was mainly used for the qualitative part of the study (Yin, 2003) [18] to select the teachers.

Data was collected from Biology students and teachers of secondary schools who constituted the study's population. In order to gather data for this study, a questionnaire (administered to students) and an interview guide (administered to teachers) were the instruments used for the study. On the one hand, the questionnaire was the primary instrument used for data collection. The questionnaire was a self-reporting instrument consisting of a set of questions to which the respondents responded in writing (Endeley & Zama, 2021) [4]. The questionnaire was cautiously designed to collect needed data in a simple format that covered a great deal of information and a wide geographical area. The questionnaire was ideal for the quantitative part of the study because it is a research instrument that gathers data over a large sample. The questionnaire was therefore, the principal instruments for data collection in the study. The questionnaire was self-developed (prepared by the researcher) under the supervision of the researcher's supervisor. It was administered to students. The questionnaire used in this study was the Likert scale questionnaire comprising four points. The questionnaires were formulated on the basis of the research questions. Each respondent was expected to place a tick to the right response of their choice.

The questionnaire began with a letter of introduction revealing the researcher's information and the research topic to the respondents. The questionnaire was made up of two main sections. The first section (Section A) of the questionnaire was a demographic section which requested respondents to supply personal information. This included information about their school type, gender and age range. The second section (Section B) was used for exploring respondents' perceptions regarding effect of 21st century teaching method on skills development of Biology students in secondary school and it required that the respondents placed a tick on the appropriate response or option of their choices as follows: strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD). Section B comprised five sub-sections which were presented following the research objectives with eight items/statements each which made a total of forty items. Hence, each of all indicators of 21st century teaching methods contained eight measures each on a four-point Likert scale. The four-point Likert scale for a positive and negative worded measure in the questionnaire were as 1 = SD, 2 = D, 3 = A, 4 =SA and 4 = SD, 3 = D, 2 =A, 1 = SA respectively, where SD = Strongly Disagreed, D = Disagreed, A = Agreed and SA = Strongly Agreed.

On the other hand, in the study, interviews involving five (05) secondary school teachers were also conducted as a secondary instrument for the qualitative part of the study.

The teachers of each of the sampled schools were interviewed. Interviews were conducted to elicit information from five (05) key informants (school teachers) who had in-depth knowledge on 21st century teaching methods' effect on skills development of Biology students. This was aimed at complementing and verifying data captured through the questionnaire. This enabled the researcher to capture the nature of 21st century teaching methods and better understand how 21st century teaching methods affect skills development of Biology students. Face to face interviews were carried out with teachers to cross check the response from the questionnaire (Endeley & Zama, 2021) [4]. The interview was conducted with the help of tape recorder, a piece of paper and pen where the interviewee was either recorded or information from him or her was jotted down on the paper. This was designed in that way in order to get more specific and truthful answers. These helped capture information, not provided by the questionnaires. This method is preferred because of its flexibility and ability to provide new ideas on the subject.

To conclude on this section, the questionnaire was one of the instruments (primary instrument) chosen and used in this study because they were relevant to the topic and it is easy to use on a large number of subjects. The questionnaire permitted wide coverage, helped the researcher assessed large population's perceptions to be assessed with relative ease on individual's perspective. Furthermore, it was a systematic compilation of questions subject for sampling of population used for receiving requisite information from respondents (Mill & Gay, 2018). Also, Questionnaire was more reliable. The interview guide was also used because it allowed the researchers made use of the senses to classify and record pertinent happenings according to planned schemes (Endeley & Zama, 2021) [4]. Again, the interview provided a unique insight that is not achievable through the questionnaire. It also had the advantage of providing first-hand information and evidence.

In ensuring validity, the researchers consulted and sought opinions of many experts in the researchers' field. Face validity was assessed through peer and expert reading. The instruments were handed to peers and then to experts to make a visual appraisal of the document by verifying whether the items truly appeared to measure what they intended to measure. Content validation looked for the extent of representativeness of items of the defined constructs. The content validity index (CVI) was calculated per test items. This was calculated by dividing the number of judges who declared the items valid by the total number of judges. Item validity index of most measures ranged from 0.75 to 0.90 indicating that the instrument was valid. Therefore, since all these were considered and ensured, it was concluded that the instruments were valid and good for data collection.

To ensure the reliability of the instrument the researcher used the test-retest reliability which evaluate the consistency of the instrument over time. This method involves administering the same test to the same group of participants on two separate occasion and calculating the mean between the set of scores. 10 copies of questionnaire were administered to a group of students and the result were noted after a day that same questionnaire was given to the same group of students to see if the result is consistent. A high mean value indicated that the instrument produces stable and consistent result over time, confirming the reliability. To ensure accuracy, the time interval between test administrations was carefully chosen to minimize the effect of memory recall or learning. The test-retest reliability value indicated that the instrument can be trusted to yield consistent results used under similar conditions and as for the interview for teachers the researcher used the semi-structured format with standardized questions ensuring that all interviewees are asked the same questions in the same way.

Test-retest reliability analysis calculated using the Cronbach Alpha formula.

$$\alpha = k / (k - 1) \times (1 - \sum(s^2) / s^2)$$

Where:

α = Cronbach's Alpha

k = number of items (questions or test items)

s^2 = variance of the total score$\sum(s^2)$ = sum of the variances of each item

Table 1: Internal Consistency Reliability Analyses of 21st Century Teaching Methods

Variables	Cronbach's Alpha (α)	N_{cases}	N_{items}
Blended learning	0.78	10	8
Flipped classroom	0.83	10	8
Differentiated instruction	0.84	10	8
Cooperative learning	0.75	10	8
Biology students' skills development	0.82	10	8
Mean Value of Reliability (α)	**0.804**	**50**	**40**

From the analyses in the table above, the internal consistency reliability coefficient of instructional scaffolding techniques for economics students in Fako Division was estimated at $\alpha = 0.80$ which compared to the 0.70 level, shows that the instrument was reliable and could be used for the study.

The data were analysed both quantitatively and qualitatively. The data that were obtained from the questionnaire for the quantitative method were coded using serial numbers that could help match them to the data base if there was need for cross-verification and then put in tabular forms for analysis by using a software package known as the statistical package for social sciences (SPSS) version 23. The SPSS was used to compute the data and facilitate the calculations. Therefore, the statistical processing of the data were done through the SPSS software (SPSS 23 for Window). Quantitative data for the study were analysed using both the descriptive statistic with the aid of mean which were summarized and presented on frequency distribution tables, percentages and in charts and the inferential statistical method of data analysis. The inferential statistics data analysis tool for this study was the spearman's Rho correlation technique for transforming and calculating data from the studys' interviewed variables The non-parametric Spearman's Rho correlation test was performed with the statistical package for social sciences (SPSS). As a statistical tool, the Spearman's Rho statistical technique was used to test and verify the research hypotheses in order to allow the verification or falsification of hypotheses and the following formula was used:

$$R = 1 - \frac{6\sum_d 2}{n(n^2-1)}$$

Where **d** is the difference in the ranks, and **n** is the number of data pairs which showed how students' developmental skill is affected by 21st century teaching methods. The difference in rank was computed and if both set had the same difference, **R** was to be **+1**. If the two sets of data were ranked opposite ways, **R=-1** and if there was no similarity between ranks, **R** was to be 0 or very close to 0.

Quantitative data was edited to eliminate inconsistencies, summarized and coded for easy classification in order to facilitate tabulation and interpretation. Questionnaires that were not properly filled were sorted out; this consisted of questionnaires that were not completely filled because the respondent refused to continue or omitted relevant questions.

Ethical Considerations

The researcher amply ensured a plethora of research ethics before, during and after conducting the study. The researcher ensured appropriate data analysis by fully disclosing all methods that were used to obtain the data and all issues of bias were clearly dealt with in the design and interpretation of the study (Jenn, 2006) [6]. This ensures that the readers will not misinterpret the results of the study.

Again, the researcher declares no conflicts of interest (Creswell, 2014) [2]. The researcher had no personal, commercial, political, or financial interest. The researcher contends that no such conflicts of interest exist which means methodology and outcome of the research were not in any way driven by such forces. Furthermore, the researcher has given credit for the works of others used in this study by disclosing all sources of information and ideas used during the course of the study. Even when material was paraphrased, credit was given to the original source. This was done by properly citing and referencing the authors of whose works the researcher consulted during the course of this exercise.

Furthermore, to conduct data collection for the study, the researcher obtained permission (Creswell, 2014) [2] through an authorisation from the administration of the University of Buea, Faculty of Education. Apart from that, the researcher sought the consent of respondent as the researcher made sure that there was an informed consent of the participants through approval from the administrative authorities of selected secondary schools whose students and teacher made up the sample for the study. The researcher made every effort to explain to the respondents the researcher's agenda. The purpose of this study was explained to the participants so that they gave just what was required of them. The interests of the respondents were taken into consideration.

Moreover, only personal details that were relevant to the study were sought. However, respondents were not obliged to give their names or anything that could reveal their identity. They were not even allowed to identify themselves either by name or by any other means as their responses to the questionnaire were done anonymously. Those who were not willing to participate were not forced to do so (Creswell, 2014) [2]. Only participants who consented and agreed to take part in the study did so. It was therefore a voluntary exercise. The researcher rewarded and appreciated those who provided valuable inputs (data, proofreading and sponsorship) in the study in order to avoid exploitation of participants and instead ensure reciprocity and respect (Creswell, 2014) [2].

Presentation of Findings

Research Question One: What are the effects of blended learning on skills development of biology students in secondary schools?

Findings showing the relationship between 21st century teaching methods and skills development of Biology students in Secondary Schools in Fako Division were presented in table 2 below. In addition, the statistical tool for data analysis for the study was computed and following that, research questions were answered and various research hypotheses tested.

Table 2: Frequency and Percentages of Students' Responses on Blended Learning

Blended learning	SA	A	D	SD	Collapsed	
					SA/A	D/SD
I understand lessons better when we learn both in class and online.	88 (42.7%)	94 (45.6%)	15 (7.3%)	9 (4.4%)	182 (88.3%)	24 (11.7%)
I enjoy learning more when I do activities outside class, like watching videos.	74 (35.9%)	75 (36.4%)	35 (17.0%)	22 (10.7%)	149 (72.3%)	57 (27.7%)
Moving between classroom lessons and online work help me learn better.	66 (32.0%)	93 (45.1%)	42 (20.4%)	5 (2.4%)	159 (77.2%)	47 (22.8%)
It is easier to follow the lessons when teachers use both class time and online tools.	65 (31.6%)	115 (55.8%)	17 (8.3%)	9 (4.4%)	180 (87.4%)	26 (12.6%)
I feel more interested in learning when the teacher uses both class time and online tools.	77 (37.4%)	87 (42.2%)	35 (17.0%)	7 (3.4%)	164 (79.6%)	42 (20.4%)
I know how to use apps to help me with my school work.	102 (49.5%)	78 (37.9%)	19 (9.2%)	7 (3.4%)	180 (87.4%)	26 (12.6%)
It helps to improve my understanding.	92 (44.7%)	90 (43.7%)	18 (8.7%)	6 (2.9%)	182 (88.3%)	24 (11.7%)
I think using both class lessons and online learning should continue in the future.	104 (50.5%)	82 (39.8%)	18 (8.7%)	2 (1.0%)	186 (90.3%)	20 (9.7%)
MRS	**668 (40.5%)**	**714 (43.3%)**	**199 (12.1%)**	**67 (4.1%)**	**1,382 (83.9%)**	**266 (16.1%)**

Findings from the study revealed that, students had different opinions on the use of blended learning, as closed to nine-tenth of the respondents agreed that they understand lessons better when they learn both in class and online. Also, closed to three-quarters of the respondents equally agreed that they enjoy learning more when they do activities outside class, like watching videos. In addition, a similar number of the respondents also agreed that moving between classroom lessons and online work help me learn better. Also, more than four-fifth of the respondents agreed that it is easier to follow the lessons when teachers use both class time and online tools. Moreover, exactly four-fifth of the students agreed that they feel more interested in learning when the teacher uses both class time and online tools. Furthermore, an overwhelming majority of the respondents agreed that they know how to use apps to help them with their school work. Furthermore, closed to four-fifth of respondents equally agreed that, it helps to improve their understanding. Also, more than nine-tenth of the respondents agreed that they think using both class lessons and online learning should continue in the future. Finally, as is evident in the multiple response set statistics, that the majority of respondents favourably perceived the use of blended leaning methods in the teaching of Biology.

Verification of Hypothesis One

Ho_1: Blended learning has no significant effect on skill development of biology students in secondary schools in Fako Division.

Ha_1: Blended learning has a significant effect on skill development of biology students in secondary schools in Fako Division.

The findings of the study revealed that the p-value for the relationship between blended learning and skill development of biology students in secondary schools in Fako Division was less than the cut-off p-value of 0.05 (0.002 < 0.05), implying that the relationship was statistically significant. The researcher therefore rejected the null hypothesis and concluded that blended learning has a significant effect on skill development of biology students in secondary schools in Fako Division.

Table 3: Correlation of Blended Learning and skills Development

		Skills Development
Blended Learning	Correlation Coefficient	.214**
	Sig. (2-tailed)	·002
	N	206

**. Correlation is significant at the 0.01 level (2-tailed).

The findings from the correlation table above revealed that the correlation coefficient for the relationship between blended learning and skill development of Biology students in secondary schools in Fako Division was 0.214^{**} implying a weak positive relationship between blended learning and skill development of biology students in secondary schools in Fako Division.

Qualitative Analyses on Blended Learning

Two research questions were; Do your students ever use learning materials like phones? Can you give an example of a lessons where students had to think carefully?

Table 4: Teachers' Opinions on Whether their Students Ever Used Learning Materials like Phones

S. No	Themes	Sample Quotations
1	Personal phone use	"Students often use their own phones in learning historical facts" "Only a few students use phones due to strict school policies" "The teacher sends notes and records in the class WhatsApp group"
2	Parents phones	"…especially their parents' phones for those who not have phones of their own"
3	Using other print material	"Very few students have devices but they use printed materials when they can.".
4	Other digital platforms	"They use digital platforms and tablets during lab simulations"

As seen in the table above, findings revealed that teachers had different views on whether their students ever used learning materials like phones in teaching. Four main themes emerged from the transcribed data. Firstly, some teachers were of the opinion that their students had phones for personal use. Specifically, respondents R1 and R5 were quoted as *"students often use their own phones in learning historical facts"*, and *"only a few students use phones due to strict school policies"* respectively. In addition, a teacher was of the opinion that their students used their parents' phones to learn. Specifically, respondent R1 stated that; *"…especially their parents' phones for those who not have phones of their own"*. Moreover, another teacher believed their students used other print materials to learn. In particular, R3 stated that; *"very few students have devices but they use printed materials when they can."*. Finally, a teacher was of the opinion that their students used other digital platforms to learn in Biology. Specifically, respondent R4 stated that; *"they use digital platforms and tablets during lab simulations"*.

Table 5: Teachers' Examples of Lessons Where Students' Thought Carefully

S. No	Themes	Sample Quotations
1	Lesson in ecology	"In ecology students often create a food web poster"
2	Photosynthesis lesson	"A photosynthesis learning for example, involves analysing diagrams. even though challenging it is engaging"
3	Lesson on skeletal system	"For a lesson on the skeletal system, I gave case study, students had to diagnose conditions based on symptoms".
4	Evolution lesson	"In an evolution lesson, students had to trace human ancestry using virtual databases"

As seen in the table above, findings revealed that teachers had different views on examples of lessons in which students were thought carefully. Four main themes emerged from the transcribed data. Firstly, a teacher cited lessons in ecology as an example of well thought lessons in Biology. Specifically, respondents R1 was quoted as *"in ecology students often create a food web poster"*. In addition, another teacher cited photosynthesis lessons as examples of well thought lessons in Biology. Specifically, respondent R2 stated that; *"A photosynthesis learning for example, involves analysing diagrams even though challenging it is*

engaging". Moreover, a teacher also cited lessons on skeletal system as examples of well thought lessons in Biology. In particular, R3 stated that; *"for a lesson on skeletal system, I gave case study, students had to diagnose conditions based on symptoms"*. Finally, one teacher cited evolution lessons as examples of well thought lessons in Biology. Specifically, respondent R4 stated that; *"in an evolution lesson, students had to trace human ancestry using virtual databases"*.

Research Question Two: What are the effects of flipped classroom on skills development of biology students in secondary schools in Fako Division?

Concerning the influence of flipped classroom on skills development of biology students in secondary schools in Fako Division, the frequencies of students' responses were displayed in the table below.

Table 6: Frequency and Percentages of Teachers' Responses on Flipped Classroom

Flipped classroom	SA	A	D	SD	Collapsed	
					SA/A	D/SD
I read learning materials like notes before class.	82 (39.8%)	101 (49.0%)	23 (11.2%)	0 (0.0%)	183 (88.8%)	23 (11.2%)
I understand better when I study before class.	119 (57.8%)	69 (33.5%)	15 (7.3%)	3 (1.5%)	188 (91.3%)	18 (8.7%)
Doing activities in class helps me learn more.	99 (48.1%)	93 (45.1%)	11 (5.3%)	3 (1.5%)	192 (93.2)	14 (6.8%)
I feel more ready to join class discussions when I go through the materials first.	84 (40.8%)	102 (49.5%)	18 (8.7%)	2 (1.0%)	186 (90.3%)	20 (9.7%)
I like learning at home before class so I can ask questions in class.	119 (57.8%)	69 (33.5%)	16 (7.8%)	2 (1.0%)	188 (91.3%)	18 (8.7%)
I remember lessons better when I first learn them on my own and then practice in class.	103 (50.0%)	76 (36.9%)	23 (11.2%)	4 (1.9%)	179 (86.9%)	27 (13.1%)
Reading lessons before class makes class time more useful.	112 (54.4%)	80 (38.8%)	14 (6.8%)	0 (0.0%)	192 (93.2%)	14 (6.8%)
I feel like my teacher wants every student to do their best.	122 (59.2%)	60 (29.1%)	17 (8.3%)	7 (3.4%)	172 (87.8%)	24 (12.2%)
MRS	**830 (50.7%)**	**650 (39.7%)**	**137 (8.4%)**	**21 (1.3%)**	**1,480 (90.4%)**	**158 (9.6%)**

Findings from the study revealed that, students had different opinions on the use of flipped classroom in learning, as close to nine-tenth of the respondents agreed that they read learning materials like notes before class. Also, a similar proportion of respondents equally agreed that. In addition, over four-fifth of the respondents agreed that they understand better when they study before class. Next, exactly nine-tenth of the respondents agreed that doing activities in class helps them to learn more. Moreover, an overwhelming majority of students also agreed that they feel more ready to join class discussions when they go through the materials first. Also, more than three-quarters of the respondents agreed that they like learning at home before class so they can ask questions in class. Furthermore, a similar proportion of respondents equally agreed that they remember lessons better when they first learn them on their own and then practice in class. Apart from that, more than nine-tenth of the respondents agreed that reading lessons before class makes class time more useful. More than three-quarters of respondents also agreed that they feel like their teacher wants every student to do their best. Finally, as is evident in the multiple response set statistics, the majority of respondents favourably perceived the use of flipped classroom learning.

Verification of Hypothesis Two

H_{O2}: Flipped classroom has no significant effect on skills development of biology students in secondary schools in Fako Division.

H_{a2}: Flipped classroom has a significant effect on skills development of biology students in secondary schools in Fako Division.

The findings of the study revealed that the p-value for the relationship between flipped classroom and skills development of biology students in secondary schools in Fako division was less than the cut-off p-value of 0.05 ($0.000 < 0.05$), implying that the relationship was statistically significant. The researcher therefore rejected the null hypothesis and concluded that flipped classroom has a significant effect on skills development of biology students in secondary schools in Fako division.

Table 7: Correlation of Flipped Classroom and Skills Development

		Skills Development
Flipped Classroom	Correlation Coefficient	.275**
	Sig. (2-tailed)	·000
	N	206

**. Correlation is significant at the 0.01 level (2-tailed).

The findings from the correlation table above revealed that the correlation coefficient for the relationship between flipped classroom and skills development of biology students in secondary schools in Fako division was 0.275^{**} implying a weakly positive relationship between flipped classroom and skills development of biology students in secondary schools in Fako division.

Qualitative Analyses on Flipped Classroom

Two research questions were; How do you help students get ready for a new topic before teaching it in class? How do your lessons help students communicate ideas clearly?

Table 8: Teachers' Opinions on How They Get Students Ready for a New Topic

S. No	Themes	Sample Quotations
1	Hands-on activities,	"During genetic lessons I usually ask students to design Punnett squares for real-life inherited cases"
2	Giving assignments	"I usually give students reading assignments"
3	Sending notes earlier	"I usually send notes online through their parents' phones before I begin a new topic". "I usually assign voice records on WhatsApp and then use class time for deeper activities".
4	Using audio notes	"I often send recorded lectures for students to watch well enough before our class time where we meet to discuss"
5	Using video recordings	"I usually upload videos to WhatsApp groups before introducing the topics".

As seen in the table above, findings revealed that teachers had different views on how they get students ready for a new topic. Five main themes emerged from the transcribed data. Firstly, a teacher was of the opinion that they get their students to do hands-on activities. Specifically, respondents R1 was quoted as *"during genetic lessons I usually ask students to design Punnett squares for real-life inherited cases"*. In addition, another teacher was of the opinion they give their students assignments to get them ready for the topic. In particular, respondent R2 stated that; *"I usually give students reading assignments"*. Moreover, another teacher believed they sent notes to get their students ready for a new topic. In particular, respondent R3 stated that; *"I usually send notes online either through their parents' phones or in class before I begin a new topic"*. Furthermore, one other teacher was of the opinion to get them ready for the topic they use audio notes. In particular, respondent R4 stated that; *"I usually assigned voice records on WhatsApp and then use class time for deeper activities"*. Finally, one teacher was of the opinion they use video recordings to get their students ready for the topic. Specifically, respondent R1 and R5 stated that; *"I usually upload videos to WhatsApp groups before introducing the topics"*, and *"I often send video lectures for students to watch well enough before our class time where we meet to discuss"* respectively.

Table 9: Teachers' Opinions on How their Lessons Help Students Clearly Communicate Ideas

S. No	Themes	Sample Quotations
1	Deep thinking	"They analyse traits and explain probability and it pushes them to think deeply" "It builds their ability to explain processes using both scientific and Layman terms"
2	Peer collaboration	"Students work together in pairs to summarize concepts and it helps reinforce communication" "Students prepare debates and presentations which develop logical and persuasive communication" "My lessons usually involve peer discussions and presentations which improve their clarity and confidence when communicating"
3	Using local vocabulary	"Students explain ideas using local terms and examples. It makes biology more relatable and improves expression".

As seen in the table above, findings revealed that teachers had different views on how their lessons help students clearly communicate ideas. Three main themes emerged from the transcribed data. Firstly, a teacher was of the opinion that their lessons helped students to communicate ideas by getting them to think deeply. Specifically, respondents R1 and R4 were quoted as;*" they analyse traits and explain probability and it pushes them to think deeply"*, and *"it builds their ability to explain processes using both scientific and Layman terms"* respectively. In addition, a teacher was also of the opinion that their lessons helped students to communicate ideas by fostering peer collaboration. In particular, respondent R1, R2, and R5 stated that; *"my lessons usually involve peer discussions and presentations which improve their clarity and confidence when communicating"*, *"students work together in pairs to summarize concepts and it helps reinforce communication"*, and *"students prepare debates and presentations which develop logical and persuasive communication"* respectively. Finally, one teacher was of the opinion that their lessons helped students to communicate ideas by encouraging the use of local vocabulary in learning. Specifically, respondent R3 stated that; *"students explain ideas using local terms and examples. It makes biology more relatable and improves expression"*.

Research Question Three: What are the effects of differentiated instruction on skills development of biology students in secondary schools in Fako Division?

Concerning the influence of differentiated instruction in the learning of Biology in secondary schools in Fako Division, the frequencies of students' responses were displayed in the table below.

Table 10: Frequency and Percentages of Teachers' Responses on Differentiated Instruction

Differentiated instruction	SA	A	D	SD	Collapsed	
					SA/A	D/SD
My teacher helps me when the work is too challenging	69 (33.5%)	95 (46.1%)	28 (13.6%)	14 (6.8%)	164 (79.6%)	42 (20.4%)
My teacher teaches in different ways to help me understand.	83 (40.3%)	90 (43.7%)	16 (7.8%)	17 (8.3%)	173 (84.0%)	33 (16.0%)
I can choose how to do some of my class work.	40 (19.4%)	111 (53.9%)	43 (20.9%)	12 (5.8%)	151 (73.3%)	55 (26.7%)
If I don't understand my teacher explains it in another way.	60 (29.1%)	109 (52.9%)	29 (14.1%)	8 (3.9%)	169 (82.0%)	37 (18.0%)
My teacher checks if I understand the lesson.	49 (23.8%)	109 (52.9%)	27 (13.1%)	21 (10.2%)	158 (76.7%)	48 (23.3%)
We use fun things like games to learn.	35 (17.0%)	65 (31.6%)	58 (28.2%)	48 (23.3%)	100 (48.5%)	106 (51.5%)
My teacher understands that students learning different ways.	70 (34.0%)	98 (47.6%)	23 (11.2%)	15 (7.3%)	168 (81.6%)	38 (18.4%)
My teacher wants every student to do their best.	99 (48.1%)	86 (41.7%)	19 (9.2%)	2 (1.0%)	185 (89.8%)	21 (10.2%)
MRS	**505 (30.6%)**	**763 (46.3%)**	**243 (14.7%)**	**137 (8.3%)**	**11,268 (76.9%)**	**380 (23.1%)**

Findings from the study revealed that, students had different opinions on the use of differentiated instruction in learning, as closed to three-quarters of the respondents agreed that their teacher helps them when the work is too challenging. Also, a similar proportion of respondents, closed to three-quarters agreed that equally agreed that their teacher teaches in different ways to help them understand. In addition, just slightly under three-quarters of the respondents agreed that they can choose how to do some of their class work. Also, exactly four-fifth of the respondents also agreed that if they don't understand their teacher explains it in another way. Moreover, as slightly above three-quarters of the respondents agreed that. their teacher checks if they understand the lesson. On the contrary, more than half of the respondents disagreed that they use fun things like games to learn. Furthermore, exactly four-fifth of the respondents also agreed that their teacher understands that students learning different ways. Also, closed to nine-tenth of the respondents agreed that their teacher wants every student to do their best. Finally, as is evident in the multiple response set statistics, the majority of respondents favourably perceived the use of differentiated instruction in classroom learning.

Verification of Hypothesis Three

Ho_3: Differentiated instruction has no significant effect on skill development of biology students in secondary schools in Fako Division.

Ha_3: Differentiated instruction has a significant effect on skill development of biology students in secondary schools in Fako Division.

The findings of the study revealed that the p-value for the relationship between differentiated instruction and skill development of biology students in secondary schools in Fako division was less than the cut-off p-value of 0.05 (0.000 < 0.05), implying that the relationship was statistically significant. The researcher therefore rejected the null hypothesis and concluded that differentiated instruction has a significant effect on skill development of biology students in secondary schools in Fako Division.

Table 11: Correlation of Differentiated Instruction and Skills Development

		Skills Development
Differentiated Instruction	Correlation Coefficient	.353**
	Sig. (2-tailed)	·000
	N	206

**. Correlation is significant at the 0.01 level (2-tailed).

The findings from the relationship table above revealed that the correlation coefficient between differentiated instruction and skill development of biology students in secondary schools in Fako Division was 0.353^{**} implying a moderately positive relationship between differentiated instruction and skill development of biology students in secondary schools in Fako division.

Qualitative Analyses on Differentiated Instruction

Two research questions were; How do you handle students who learn at different speed? and How does differentiated instruction affect students' collaborative skills?

Table 12: Teachers' Opinions on How They Handle Students Who Learn at Different Speeds

S. N0	Themes	Sample Quotations
1	Ability groupings	"I usually group students by skill level and give tasks to faster learners while supporting the slower ones with extra materials" "I usually give struggling learners extra learning time and pair them with high ability peers"
2	Adjusting pace of lesson	"I usually adjust the pace of the lesson and give extra visual or real-life examples for struggling students"
3	Using learner's profiles	"I use learners' profile to tailor tasks, visual aids for some".
4	Incorporating personalized instruction	"I use tiered assignments and let students choose their preferred learning methods".

As seen in the table above, findings revealed that teachers had different views on how they handle students who learn at different speeds. Four main themes emerged from the transcribed data. Firstly, a teacher was of the opinion that they use ability groupings to handle students who learn at different speeds. Specifically, respondent R1 quoted as; *"I usually group students by skill level and give tasks to faster learners while supporting the slower ones with extra materials"*, and *"I usually give struggling learners extra learning time and pair them with high ability peers"* respectively. In addition, another teacher was of the opinion that they adjusted the pace of the lesson in order to handle students who learn at different speeds. In particular, respondent R2 stated that; *"I usually adjust the pace of the lesson and give extra visual or real-life examples for struggling students*. Moreover, one other teacher was of the opinion that they use leaner's profiles to handle students who learn at different speeds. Specifically, respondent R3 stated that; *"I use learners' profile to tailor tasks, visual aids for some"*. Finally, one teacher was of the opinion that they incorporate personalized instruction to handle students who learn at different speeds. Specifically, respondent R4 stated that; *"I use tiered assignments and let students choose their preferred learning methods"*.

Table 13: Teachers' Opinions on How Differentiated Instruction Affect Students' Collaboration

S. No	Themes	Sample Quotations
1	Instils peer collaboration	"When I group students for instruction, they teach each other in these kinds of settings boosting teamwork and empathy" "Students get used to collaborating across different skills levels, it makes them more patient" "It encourages peer teaching and mutual support, strengthening their collaboration"
2	Builds confidence	"They gradually gain confidence and are more likely to contribute in team task"
3	Improves communication	"Mixed ability groupings enhance cooperation and communication".

As seen in the table above, findings revealed that teachers had different views on how differentiated instruction affect students' collaboration. Three main themes emerged from the transcribed data. Firstly, some teachers were of the opinion that differentiated instruction instils peer collaboration among students. Specifically, respondents R1, R4 and R5 were quoted as; *"when I group students for instruction, they teach each other in these kinds of settings boosting teamwork and empathy"*, *"students get used to collaborating across different skills levels, it makes them more patient"*, and *"it encourages peer teaching and mutual support, strengthening their collaboration"* respectively. In addition, another teacher was of the opinion that differentiated instruction builds students' confidence in learning. In particular, respondent R2 stated that; *"they gradually gain confidence and are more likely to contribute in team task"*. Finally, one other teacher was of the opinion that differentiated instruction improves communication. Specifically, respondent R5 stated that; *"mixed ability groupings enhance cooperation and communication"*

Findings from the study revealed that, students had different opinions on the use of differentiated instruction in learning, as closed to three-quarters of the respondents agreed that their teacher helps them when the work is too challenging.

Research Question Four: What are the effects of cooperative learning on skills development of biology students in secondary schools in Fako Division?

Concerning the use of cooperative learning, the frequencies of students' responses were displayed in the table below.

Table 14: Frequency and Percentages of Teachers' Responses on Cooperative Learning

Cooperative learning	SA	A	D	SD	Collapsed	
					SA/A	D/SD
I often work with other students.	83 (40.3%)	98 (47.6%)	19 (9.2%)	6 (2.9%)	181 (87.9%)	25 (12.1%)
I learn better when I work with classmate.	88 (42.7%)	93 (45.1%)	16 (7.8%)	9 (4.4%)	181 87.9%)	25 (12.1%)
My teacher often gives us group work.	106 (51.5%)	55 (26.7%)	26 (12.6%)	19 (9.2%)	161 (78.2%)	45 (21.8%)
In my group everyone gets a chance to share their ideas.	67 (32.5%)	93 (45.1%)	30 (14.6%)	16 (7.8%)	160 (77.7%)	46 (22.3%)
I help others when we work together in class.	75 (36.4%)	105 (51.0%)	19 (9.2%)	7 (3.4%)	180 (87.4%)	26 (12.6%)
I feel comfortable working with different classmates.	51 (24.8%)	104 (50.5%)	37 (18.0%)	14 (6.8%)	155 (75.2%)	51 (24.8%)
Working in a group helps me understand the lesson better.	75 (36.4%)	101 (49.0%)	18 (8.7%)	12 (5.8%)	176 (85.4%)	30 (14.6%)
My teacher shows us how to work well together.	46 (22.3%)	98 (47.6%)	45 (21.8%)	17 (8.3%)	144 (69.9%)	62 (30.1%)
MRS	**591 (35.9%)**	**747 (45.3%)**	**210 (12.7%)**	**100 (6.1%)**	**1,338 (81.2%)**	**310 (18.8%)**

Findings from the study revealed that, students had different opinions on the use of cooperative learning, as closed to nine-tenth of the respondents agreed that they often work with other students. Also, a similar proportion of respondents, closed to nine-tenth agreed that equally agreed that they learn better when they work with classmate. In addition, slightly above three-quarters of the respondents agreed that their teacher often gives them group work. Also, exactly three-quarters of the respondents also agreed that in their group everyone gets a chance to share their ideas. Moreover, as more than four-fifth of the respondents agreed that they help others when they work together in class. Also, exactly three-quarters of the respondents agreed that they feel comfortable working with different classmates. Furthermore, more than four-fifth of the respondents also agreed that working in a group helps them understand the lesson better. Also, more than three-fifth of the respondents agreed that their teacher shows them how to work well together. Finally, as is evident in the multiple response set statistics, the majority of respondents favourably perceived the use of cooperative instruction in classroom learning.

Verification of Hypothesis Four

Ho_4: Cooperative learning has no significant effect on skill development of biology students in secondary schools in Fako Division.

Ha_4: Cooperative learning has a significant effect on skill development of biology students in secondary schools in Fako Division.

The findings of the study revealed that the p-value for the relationship between cooperative learning and skills development of biology students in secondary schools in Fako Division was less than the cut-off p-value of 0.05 (0.000 < 0.05), implying that the relationship was statistically significant. The researcher therefore rejected the null hypothesis and concluded that cooperative learning has a significant effect on skill development of biology students in secondary schools in Fako division.

Table 15: Correlation of Cooperative Learning and Skills Development

		Skills Development
Cooperative Learning	Correlation Coefficient	.474**
	Sig. (2-tailed)	·000
	N	206

**. Correlation is significant at the 0.01 level (2-tailed).

The findings from the relationship table above revealed that the correlation coefficient for the relationship between cooperative learning and skills development of biology students in secondary schools in Fako Division was 0.474^{**} implying a moderately positive relationship between cooperative learning and skills development of biology students in secondary schools in Fako Division.

Qualitative Analyses on Cooperative Learning

Three research questions were; How often do your students work together in class? and What do student learn when they work together on group tasks?

Table 16: Teachers' Opinions on How often their Students Work Together in Class

S. No	Themes	Sample Quotations
1	Working together	"My students often work together in almost every class especially during experiments"
2	Group work	"My students often do group work once a weak"
		"Groups work is a core part of my teaching and is once a week"

As seen in the table above, findings revealed that teachers had different views on how often their students work together in class. Three main themes emerged from the transcribed data. Firstly, one teacher was of the opinion that their students work together in class during every lesson. Specifically, respondents R1 was quoted as; *"my students often work together in almost every class especially during experiments"*. In addition, a teacher was of the opinion that their students work together in class weekly. In particular, respondent R2 stated that; *"my students often do group work once a weak"*. Finally, another teacher was of the opinion that their students work together in class during thrice weekly. Specifically, respondent R3 stated that; *"groups work is a core part of my teaching and is done thrice a week"*.

Table 17: Teachers' Opinions on What Students Learn When They Work in Groups

S. No	Themes	Sample Quotations
1	Leadership	"They learn leadership, responsibility when they work in groups"
2	Tolerance	"They learn negotiation skills and how to value different perspectives"
3	Critical thinking skills	"They learn critical thinking skills, task sharing and other vital skills"
4	Learning soft skills	"Practical are always team-based, so they build organization skills, time management, and listening skills.

As seen in the table above, findings revealed that teachers had different views on what students learn when they work in groups. Four main themes emerged from the transcribed data. Firstly, a teacher was of the opinion that students learn tolerance when they work in groups. Specifically, respondents R1 was quoted as; *""they learn leadership, responsibility when they work in groups"*. In addition, another teacher was of the opinion that students learn leadership when they work in groups. In particular, respondent R2 stated that; *"they learn negotiation skills and how to value different perspectives"*. Moreover, one other teacher was of the opinion that students learn critical thinking skills when they work in groups. In particular, respondent R3 stated that; *"they learn critical thinking skills, task sharing and other vital skills"*. Finally, one teacher was of the opinion that students learn learning soft skills when they work in groups. Specifically, respondent R4 stated that; *"practical are always team-based, so they build organization skills, time management, and listening skills"*.

Table 18: Frequency and Percentages of Teachers' Responses on Skills Development

S. No	Skill development	SA	A	D	SD	Collapsed	
						SA/A	D/SD
1	I feel comfortable expressing my thought during class discussion.	54 (26.2%)	74 (35.9%)	48 (23.3%)	30 (14.6%)	128 (62.1%)	78 (37.9%)
2	Class activities help me improve my ability to communicate effectively.	69 (33.5%)	99 (48.1%)	29 (14.1%)	9 (4.4%)	168 (81.6%)	38 (18.4%)
3	I am able to clearly explain my point of view to others.	44 (21.4%)	102 (49.5%)	50 (24.3%)	10 (4.9%)	146 (70.9%)	45 (21.8%)
4	Sometimes I am challenge to think critically.	70 (34.0%)	93 (45.1%)	27 (13.1%)	16 (7.8%)	163 (79.1%)	43 (20.9%)
5	I am encouraged to ask questions.	75 (36.4%)	105 (51.0%)	19 (9.2%)	7 (3.4%)	180 (87.4%)	26 (12.6%)
6	I am able to share responsibilities.	32 (15.5%)	101 (49.0%)	54 (26.2%)	19 (9.2%)	433 (85.6%)	73 (14.4%)
7	I am open to the opinions of my peers.	52 (25.2%)	101 (49.0%)	37 (18.0%)	16 (7.8%)	153 (74.3%)	53 (25.7%)
8	Working in groups improves collaborative skills.	96 (46.6%)	90 (43.7%)	12 (5.8%)	8 (3.9%)	186 (90.3%)	20 (9.7%)
	MRS	**777 (39.9%)**	**755 (38.8%)**	**291 (14.9%)**	**125 (6.4%)**	**1,532 (78.6%)**	**416 (21.4%)**

Findings from the study revealed that, students had different opinions on their level of skills development in the learning of Biology, as more than three-fifth of the respondents agreed that they feel comfortable expressing their thought during class discussion. Also, more than four-fifth of the respondents agreed that class activities help me improve their ability to communicate effectively. In addition, seven out of ten respondents agreed that they are able to clearly explain their point of view to others. Also, closed to four-fifth of the respondents agreed that sometimes they are challenged to think critically. Moreover, exactly three-quarters of the respondents agreed that they are encouraged to ask questions. Also, more than four-fifth of the respondents agreed that they are able to share responsibilities. Furthermore, as closed to three-quarters of the respondents agreed that they are open to the opinions of their peers. Also, more than nine-tenth of the respondents agreed that working in groups improves collaborative skills. Finally, as is evident in the multiple response set statistics, the majority of respondents favourably perceived their level of skills development in the learning of Biology.

Conclusions

Based on the discussions, the findings of this study revealed that, 21st century teaching methods have a great significance on the skill development of biology students. This is because the integration of technology and interactive strategies allows students to engage in real-world contexts, deepening both comprehension and their ability to apply knowledge. For example, flipped classroom shift the delivery of content to home, using class time for hands-on experiments and problem-solving activities that strengthen communication and problem-solving skills. Similarly, blended learning environments offer flexible and personalized learning pathways, encouraging students to take ownership of their learning.

From the findings, it can be concluded that 21st century teaching methods significantly enhance the development of essential skills in biology by promoting active, student-centred learning. These 21st century teaching methods do not only improve students' understanding of biological concepts but also improve students' critical thinking, problem solving skill communication and collaborative skills which is also necessary for other subjects. Also, the incorporation of these 21st century teaching methods in the teaching learning process can be beneficial to all learners irrespective of their background.

Recommendations

Based on the findings of this study, the following recommendations are made to enhance the 21st century teaching methods on skills development of biology students in secondary schools in Fako division.

Objective one was to find out the effects of blended learning on skills development of biology students in secondary schools in Fako Division. The findings revealed that blended learning has a significant effect on skill development of biology students in secondary schools in Fako Division. It is recommended that students learn to participate in the learning process and also that students follow the order given by the teacher so as to attain the learning objectives. It is also recommended that affordable workshops should be organized to train teachers on how to implement this method so as to achieve desired outcomes.

Objective two was to find out the effects of flipped classroom on skills development of biology students in secondary schools in Fako Division. The findings revealed that flipped classroom has a significant effect on skill development of biology students in secondary schools in Fako Division. It is recommended that parents should provide enough tablets or laptops for students to use for assignments and also to watch recommended videos by the teacher. It is also recommended that teachers should be encouraged to use these learning materials.

Objective three was to find out the effects of differentiated instruction on skills development of biology students in secondary schools in Fako Division. The finding revealed that differentiated instruction has a significant effect on skill development of biology students in secondary schools in Fako Division. It is recommended that teachers should assess students' learning need regularly and also encourage students' voice and choice.

Objective four was to find out the effects of cooperative learning on skills development of biology students in secondary schools in Fako Division. The findings revealed that cooperative learning have a significant effect on skill

development of biology students in secondary schools in Fako Division. It is recommended that teachers that are not practicing the teaching method should start practicing it while those practicing it should be encouraged to put more effort. All teachers should learn to prepare lesson notes and give students after lectures so that if they don't understand anything during lectures, they might get it through reading the notes.

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