Influence of Remote and Flipped Blended Classroom Learning Approaches on the Academic Performance of Senior High School Biology Students in Muscat, Oman

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ABSTRACT

This study focused on determining the influences of the Remote and Flipped Blended Classroom Learning approaches on the academic performance of Grade 11 senior high school students in Biology in one of the private schools in Muscat, Oman, the first semester of the school year 2019-2020. The study relied on the use of content analysis of the qualitative approach and the evaluation, causal-comparative, and quasi-experimental designs of the quantitative approach. The homogeneity of the treatment group and control group was established. The data collected were statistically treated with the use of percentage, frequency distribution, mean, weighted mean, Chi-Square test for homogeneity, and t-test for two independent samples. The study concluded that the pedagogical approaches of Remote Blended Learning and Flipped Blended Classroom Learning are both effective or extremely effective in terms of course material, learner interaction and interactivity, graphic competencies, technological aspects, motivation to learn, and learning outcomes. Both Remote Blended Learning and Flipped Blended Classroom Learning students perform very well on post-tests in Biology. Both the Remote Blended Learning and the Flipped Blended Classroom students' academic performance in Biology (as measured by assessment tools and post-test scores/final examination) is deemed to be very good; therefore, they profess comparable academic performance, and the Teacher's Guide demonstrates how remote and flipped blended learning pedagogical methods can be used to improve senior high school biology student learning.

Keywords: classroom management, pedagogical approach, student- centered, biology students

INTRODUCTION

Today's students live in a technologically advanced world. The majority of them use technology on a regular basis, whether it's texting, social networking, or web browsing. They regard these types of innovations as both beneficial and enjoyable. Students who are used to these types of innovations will understand how to use technology in the classroom. If the learning environment reflects how they interact with the world, they can succeed in school (Christen, 2015).

Students who struggle with biology concepts and topics would have a negative effect on their enthusiasm and acquisition of biology learning outcomes. The primary difficulties encountered by students when studying the topics are the use of the scientific name, the topic's difficulty, and the student's learning habits. Additionally, the survey showed teacher difficulties during the preparation stage (23.27 percent), implementation stage (48.63 percent), and assessment stage (28.10 percent) (Hadiprayitno, Muhlis, &

Kusmiyati, 2019).

Technological advancements have fundamentally altered the educational environment, as teaching is no longer limited to conventional face-to-face instruction. Students will also learn outside of the classroom through the use of the Internet. Students benefit from the best of both worlds when conventional and modern approaches are combined – they can be tutored in school and receive additional lessons through the Web. Educational agencies and education authorities have long acknowledged the ease and usefulness of e-learning. Numerous schools across the country have enthusiastically adopted new educational technology in which lectures are supplemented by computer-based, or gadget-based, learning. Netbooks have largely supplanted notebooks in some classrooms, and some lessons are now delivered electronically.

Statement of the Problem

It was the purpose of this study to determine the influences of pedagogical approaches on the academic performance of Grade 11 senior high school students in Biology in one of the private schools in Muscat, Oman, covering the first semester of the school year 2019-2020. Specifically, the following research questions guided the conduct of the study:

1. How do the experts and science teachers assess the effectiveness of the remote and flipped blended classroom learning approaches in terms of the following:

1.1 Remote Blended Learning

1.2 Flipped Blended Classroom Learning

2. What is the pre-test performance of the Remote Blended Learning Group and the Flipped Blended Classroom Learning Group in Biology?
3. What is the difference between the pre-test scores of the students when compared by pedagogical approaches?
4. What are the post-test scores of the students in the Remote Blended learning Group and the Flipped Blended Classroom Learning Group?
5. How significant are the mean gains in the post-test scores of the Remote Blended Learning Group and the Flipped Blended Classroom Learning Group when compared to their respective pre-test score?
6. What is the academic performance of the Remote Blended Learning Group and the Flipped Blended Classroom Learning Group in Biology 11?
7. What is the difference between the academic performance of the students in the Remote Blended Learning and students in the Flipped Blended Classroom Learning?
8. What Teachers' Guide for the two pedagogical approaches may be developed to enhance the teaching of Biology in Grade 11?

Hypotheses

The study tested the following hypotheses:

1. There is a significant difference in pre-test scores between Remote Blended Learning and Flipped Blended Classroom Learning students in Biology;
2. There is a significant mean benefit in post-test results for students in each group as compared to their pre-test performance; and
3. There is a substantial gap in academic success between students enrolled in Remote Blended Learning and those enrolled in Flipped Blended Classroom in Biology.

LITERATURE VIEW

Over the years, the flipped learning approach has gained popularity, especially in higher educational institutions that place a premium on more personalized learning for students. In this context, the current research evaluates a flipped learning approach that was introduced as a pilot project by a higher education institution in the Middle East region and analyzes the flipped approach's effect on student success from the educator's perspective. The research examines various topics, including the effect of the flipped approach on student success on various types of tests, academic performance, learning and growth, and academic support activities (Pandow, 2020). The study's findings indicate that the flipped learning approach has a major positive effect on students' academic performance, learning, progress, and overall performance. It demonstrates that the flipped classroom approach enables students to develop into self-learners, which can be considered a necessary characteristic of today's learners.

Remote blended learning, alternatively referred to as enhanced virtual blended learning, is a form of blended learning that places a premium on online coursework. In this model, students complete the majority of their coursework online and meet with the teacher only for particular sessions. Although certain meetings will take place in person, the online portion will take precedence. Face-to-face meetings are less common than in a formal course and are usually reserved for special occasions or training (Lee & Choi, 2019). This educational model necessitates the establishment of suitable conditions, which are inextricably linked to the use of information technology resources. In this case, educational materials are accessible through the Internet, which enables people to access them at any time and from any place. Practical tasks, when combined with web-based work, maximize the number of time students will devote to scheduled practices. Trainees may easily consult with tutors when planning to teach a new lesson using the platform.

This literature and studies summarized all of the required methods that teachers should use in order to conduct themselves appropriately with students. Interactions between teachers and students both within and outside the classroom are critical for students' learning outcomes. Nowadays, technology has a significant effect on facilitating learners' capacity and skills. Teachers should receive extensive training to become familiar with the various pedagogical methods for 21st century students since the majority of teachers came from the traditional curriculum, which is most likely teacher-centered. Teachers will find it easier to carry out their plans for learners and provide them with the appropriate learning results for their futures with the assistance of technology.

METHODOLOGY

This study used both the quantitative and qualitative approaches to research. The specific qualitative design used was content analysis. Content analysis is a research design that allows the qualitative data collected in research to be analyzed systematically and reliably so that generalizations can be made from them in relation to the categories of interest to the researcher (Leedy & Ormrod, 2016). In this study, the content analysis design was utilized to gather and analyze data regarding pedagogic approaches in teaching senior high school Biology. The quantitative approach was likewise used through the evaluation and causal-comparative designs of descriptive research. The evaluation design was used to determine the pedagogical approaches that were more effective in teaching Biology and to assess the effectiveness of the combined approaches in facilitating benefits in terms of course content, learner engagement and interactivity, graphical competencies, technical aspects, learning motivation, and learning outcomes provided through the pedagogical approach. Evaluation research is concerned with the evaluation of such occurrences as interventions. It generally looks into the worthiness of a program, project, approach, or process (Ahmed, Bisschoff & Botha, 2017).

The other descriptive research utilized was the causal-comparative design, where the differences in the pre-test and post-test performances of the Remote Blended Learning Group and the Flipped Learning Group were determined. The causal-comparative design provides the means by which the researcher can examine how specific independent variables affect the dependent variable of interest. The design requires two or more groups to compare (Leedy & Ormrod, 2016).

The study also used the experimental research method, particularly the pre-test and post-test design of the quasi-experimental type. This design involved two different pedagogical approaches to which participants were not randomly assigned. As such, the design identified match pairs in two groups, which was one way of strengthening the validity of the design since the participants were purposely selected (Leedy & Ormrod, 2016). The researcher relied on the personal characteristics and grade averages in science class during the school year 2018 – 2019 for pairing and for the determination of homogeneity of the two groups of respondents. Only students in Grade 11 enrolled during the first semester of the school year 2019-2020 participated in the study. The interview technique was also used to check the accuracy of the data gathered through the content analysis and evaluation designs and the quasi-experimental design. The results of the post-test served as one of the bases in determining the academic achievements of the student participants. This actually constituted 60% of the academic performance. The assessment tools represented the other 40%.

The Population of the Study

The study used a purposive sampling scheme in the selection of five (5) experts and five (5) science teachers in the evaluation of pedagogical approach effectiveness. Two (2) different sections of fifteen (15) students each in Grade 11 in one of the private schools in Mina Alfahal, Sultanate of Oman, participated in the study. These participants constituted 100 percent of the study population in each section. The respondents were selected based on the special characteristics required by the approaches and designs of the study. The purposive sampling was a non-probability sampling strategy in which participants are selected based on special characteristics required by the study. They are considered to be typical of a wider population (Gay, Mills, & Airasian, 2012). It should be mentioned that the sample for the validation of the instruments did not participate as respondents in the actual conduct of the study. Section 1 was constituted by the students representing the Remote Blended Learning Group, while Section 2 was represented by the students taught with the use of the Flipped Learning Approach. The Remote Blended Learning served as the Treatment Group and the other approach as the Control Group.

Description of Subjects

Experts. The expert respondents were mostly females, aged 30 and above, master's degree holders, with various training in modern pedagogic approaches, and with ten years and above of experience in teaching science.

Faculty members. The faculty member respondents were predominantly females, aged 26 and above, college degree holders, science faculty, with training in modern pedagogic approaches, and with three years and above of teaching experience in science.

Students. The student respondents were mostly males (60%) and aged 16-17 years (83%). They all belonged to Grade 11 senior high school in one of the schools in Sultanate of Oman with a Grade 10 Science grade average of 90.78. The homogeneity of the Blended Learning Group (Treatment Group) and the Flipped Blended Classroom Learning Group (Control Group) was established on the above personal characteristics. The chi-square values and p-values of .089 and .9563 for gender, .139 and .9333 for age bracket, and .640 and .8873 for Grade 10 Science grade average were not significant at Alpha .05. The homogeneity scores indicated that the two groups of respondents belonged to a single class. They showed

similar personal characteristics.

Instruments of the Study

The experts and science faculty members used a modified questionnaire to evaluate the effectiveness of the combined pedagogical approaches in terms of course content, learner engagement and interactivity, graphical competencies, technical aspects, learning motivation, and learning outcomes. The pre-test instrument was used to determine the baseline data on the knowledge and skills level of students in Biology. The post-test and the assessment tools, on the other hand, were used to determine the academic performance in Biology. The assessment tools and post-test instruments used grade rubrics for post-test performance, short questions, projects, practical questions, and short tests for students in remote blended learning and flipped classroom-learning groups.

The study also used Biology Yearly Plan for Grade 11 (2019-2020) and Biology Syllabus for Grade 11 (2019-2020). The Biology Yearly Plan defined the month, the number of lessons, the science branch/ unit, the topic objectives, the unit resources, the teaching strategies, the teaching aids, the assessment tools, and the remarks. The strategies referred to the discussion, scientific experiments, cooperative learning, group work, roleplaying, imagination, self-learning, Inquiry, concepts map.

Validation of the instruments

The questionnaire, pre-test, and post-test instruments have undergone the following process of validation:

Table of specifications. The table was used to establish content validity. Here, the researcher constructed a two-dimensional grid that reflected the specific topics and behaviors that reflected achievement in the domain. In each cell of the grid, the researcher indicated the relative importance of each topic's behavior combinations. The researcher then developed a series of tasks or test items that reflected the various topics and behaviors in appropriate proportions;

Judgment by Panel of Experts. Five experts and three science teachers in the science department of another private school were asked to scrutinize the instrument to ascertain its validity for measuring the characteristics in question; and

Dry Run or Pilot Test. The evaluation instrument was administered to a group of two experts and three science faculty members to facilitate the conduct of item analysis for the effectiveness of pedagogical approaches. The pre-test and post-test instruments were administered to a group of ten Grade 11 students in other private schools. Items found to be vague or inappropriate were rephrased to ensure the high content validity of the instrument, where it measures all behaviors that were supposed to be measured. The instruments were then finalized and administered to the respondents only after the approval of the adviser.

The evaluation questionnaire used the arbitrary ratings below:

Scale	Verbal Interpretation
4.51 – 5.00	Highly Effective
3.50 – 4.50	Effective
2.51 – 3.49	Moderately Effective
1.50 – 2.50	Slightly Effective
1.00 – 1.49	Not Effective

The arbitrary ratings for the pre-test and post-test instruments were as follows:

Pre-test and Posttest (60 items)

Score	Description
56 – 60	Excellent
51 – 55	Very Good
46 – 50	Good
41 – 45	Fair
36 – 40	Passing
31 – 35	Very Poor
30 and below	Failed

The semester grades of the Blended Learning Group and the Flipped Classroom Group were calculated as follows:

Assessment Tools	40%
Post- Test: Major Examination	60%
Total	100%

Statistical Treatment of Data

The study employed the following statistical formulas:

Percent (Korb, 2013). It is calculated by taking the frequency in the category divided by the total number of participants and multiplying by 100%.

Formula:

$$\% = \frac{F}{N} \times 100$$

Where:

% is the percentage

F is the Frequency

N is the total number of respondents

100 is a constant value

Frequency distribution (Triola, 2018). A frequency distribution was an arrangement of values that shows the number of times a given score or group of scores occurs. This is used to describe the respondents.

Mean (Triola, 2018.) was used to determine the averages of the pre-test and post-test scores of the remote blended learning group and the Flipped Blended Classroom Learning group.

Formula:

$$\bar{x} = \frac{\Sigma xi}{n}$$

Where:

x̄ just stands for the "sample mean."

Σ means "add up."

xi "all of the x-values."

n means "the number of items in the sample."

Weighted Mean (Triola, 2018). This formula was used in the evaluation of pedagogical approaches' effectiveness.

Formula:

$$\overline{X}_w = \frac{\sum w_i X_i}{\sum w_i}$$

Where:

Xw = Weighted Item

wi = weight of ith item X

Xi = value of the ith item X

t-test – Two Samples (University of Texas, 2015). This was used to determine differences in the academic achievements of the Remote Blended Learning Group and the Flipped Blended Classroom Learning Group.

Formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{SE}$$

Where:

t = test value for two small samples

$\bar{X}_1$ = mean of sample 1

$\bar{X}_2$ = mean of sample 2

SE = Standard error of the difference between two sample means

Chi-Square Test for Homogeneity (Studywalk, 2021). This formula was used to determine the homogeneity of the characteristics of the Remote Blended Learning Group (Treatment Group) and the Flipped Blended Classroom Learning Group (Control Group).

RESULTS AND DISCUSSION

These are the results of the treatment made on the quantitative and qualitative data collected to answer the research questions posed in this study.

How the Experts and Science Teachers Assess the Effectiveness of the Remote and Flipped Blended Classroom Learning Approaches

The data for this research question were gathered through the administration of the questionnaire to the experts and science teachers. The questionnaires were accompanied by the biology syllabus for Grade 11 students and handouts on the pedagogical approaches used in the study. Data were personally gathered by the researcher, the results of which are shown in Tables I and II. The combined pedagogical approaches were evaluated in six learning and teaching dimensions.

Remote Blended Learning

Table I shows the weighted means obtained in the evaluation of experts and science teachers on the effectiveness of remote blended learning.

Table I Weighted Means Obtained in the Evaluation of Experts and Science Teachers on the Effectiveness of Remote Blended Learning

Dimensions	Experts		Science Teachers	
	WM	VI	WM	VI
1. Course Content	4.33	E	4.87	HE
2. Learner Engagement and Interactivity	4.47	E	4.40	E
3. Graphical Competencies	4.11	E	4.44	E
4. Technical Aspects	4.17	E	4.28	E
5. Learning Motivation	4.48	E	4.62	HE
6. Learning Outcomes	4.50	E	4.33	E

Legend:

WM = weighted mean HE = Highly Effective

VI = verbal Interpretation E = Effective

The results suggest that the Remote Blended Learning approach used in this study is either effective or highly effective in providing all the factors covered by the dimensions as to course content, learner engagement and interactivity, graphical competencies, technical aspects, learning motivation, and learning outcomes. With these assessment results of experts and science teachers, the researcher has the confidence that the use of remote blended learning in the teaching of Biology in the Grade 11 senior high school would be beneficial foremost to students and also to science teachers and school administrators.

Flipped Blended Classroom Learning

Table II presents the weighted means obtained in the evaluation of experts and science teachers on the effectiveness of flipped blended classroom learning.

Table II Weighted Means Obtained in the Evaluation of Experts and Science Teachers on the Effectiveness of Flipped Classroom Learning

Dimensions	Experts		Science Teachers	
	WM	VI	WM	VI
1. Course Content	4.40	E	4.20	E
2. Learner Engagement and Interactivity	4.47	E	4.23	E
3. Graphical Competencies	4.44	E	4.19	E
4. Technical Aspects	4.56	HE	4.22	E
5. Learning Motivation	4.52	HE	4.39	E
6. Learning Outcomes	4.38	E	4.50	E

Legend:

WM = weighted mean HE = Highly Effective

VI = verbal Interpretation E = Effective

The results could be taken to mean that, just like the remote blended learning approach, the flipped classroom learning is also effective or highly effective in terms of course content, learner engagement and interactivity, graphical competencies, technical aspects, learning motivation, and learning outcomes.

Pre-test Performance of the Remote Blended Learning Group and the Flipped Blended Classroom Learning Group in Biology

Table III shows the means obtained in the pre-test performance of the students by pedagogical approaches in Biology.

Table III Means Obtained in the Pre-Test Performance of the Students by Pedagogical Approaches

Group	**Mean Score**	**Description**
Remote blended learning	46.67	Good
Flipped Classroom	43.40	Fair

It is shown from the data that the students in the remote blended learning group exhibited a pre-test mean score of 46.6, which was described as good, while the flipped classroom learning group showed a pre-test mean score of 43.40 with a verbal description of fair. The results indicate that students in the remote blended learning group have a good understanding of the cell structure, biological molecules, enzymes, cell membranes and transport, and the mitotic cell cycle. Those in the flipped classroom group manifest a fair understanding of the said first semester topics of senior high school Biology.

Difference Between the Pre-Test Scores of the Students when Compared by Pedagogical Approaches

The t-value and p-value obtained in the pre-test scores of the students by the pedagogical approaches are

reflected in Table IV

Table IV T-Value and P-Value in the Pre-Test Scores of the Students by Pedagogical Approaches

Group	Pretest Weighted Mean	Critical Value	t-value	p-value	Decision
Remote blended learning	46.67	2.048	1.064	0.9605	Not Significant at .05
Flipped Classroom	43.40				

Two- tailed test Degree of Freedom = 28 Alpha = .05

It is apparent from the data that no significant difference was revealed in the pre-test scores of the students in the remote blended learning group and those in the flipped learning group, as indicated by the critical value of 1.064 and p-value of .9605. The t-value failed to reach the critical value of 2.048 at .05 Alpha level under 28 degrees of freedom at a two-tailed test. This was supported by the p-value of 0.9605, which was very much higher than the .05 Alpha level. The hypothesis indicating that "there is a significant difference in pre-test scores between Remote Blended Learning and Flipped Blended Classroom Learning students in Biology" was rejected. Hence, they only differed in the description of the mean scores as there was no statistical significance in terms of t-value and p-value.

Post-test Scores of the Students in the Remote blended learning Group and the Flipped Learning Group

The means obtained in the post-test scores of the remote blended learning group and flipped classroom learning group are shown in Table V.

Table V Means Obtained in the Post-Test Performance of the Students by Pedagogical Approaches

Group	Mean Score	Description
Remote blended learning	55.07	Very Good
Flipped Classroom	52.22	Very Good

Based on the results of the 60-item post-test administered to the two experiment Sections at the end of the first semester of the School Year 2019-2020, the Remote blended learning Group of 15 students came out with a very good performance as revealed by their mean score of 55.07. While the mean score obtained by the 15 Flipped Classroom students was a little bit lower than the Remote blended learning Group, their mean of 52.22 was likewise interpreted as very good. This means that the two groups of students performed well in Biology during the first quarter of the School Year 2019-2020.

Significance of the Mean Gains in the Post-Test Scores When Compared with the Pre-Test Scores

Table VI exhibits the t-value and p-value obtained between the post-test and pre-test scores of each group.

Table VI T-Value and P-Value Between Post-Test and Pre-Test Scores

Group	Posttest	Pretest	Critical Value	t-value	p-value	Decision
Remote blended learning	55.07	46.67	2.0484	4.011	0.0004	Significant at .05
Flipped Classroom	52.22	43.40	2.0484	7.864	0.0034	Significant at .05

Two- tailed test Degree of Freedom= 28 Alpha= .05

The results supported the alternative hypothesis that "there is a significant mean benefit in post-test results for students in each group as compared to their pre-test performance".

The results imply that after being taught in remote blended learning and flipped learning approaches, the respondents gained scores as compared to their pre-test scores. The results suggest that the Remote blended learning Approach and the Flipped Classroom Learning Approach positively influenced the post-test results. The two groups exhibited significant mean gains in their post-test scores as compared to their pre-test scores. While their pre-test scores were respectively described as reasonable and fair, both groups have their post-test scores interpreted as very good.

Academic Performance of the Students in the Remote blended learning and Students in the Flipped Blended Classroom Learning

The academic performance of the Grade 11 senior high school students in the Remote blended learning Group and those in the Flipped Classroom Learning Group is shown in the table below. The data covered the performance of the students in the assessment tools (40%) and the final examination or post-test (60%). The means obtained are reflected in the table below.

Table VII Final Grades of Remote Blended Learning and Flipped Classroom Students in Biology

Group	Assessment Tools (40%)	Final Examination/ Post-Test (60%)	Final Grade	Description
Remote blended learning	37.34	55.07	92.41	Very Good
Flipped Classroom	38.92	52.22	91.14	Very Good

Scrutiny of the data shows that the remote blended learning students reported an assessment tool grade of 37.34 and a final examination or post-test grade of 55. 07 for a final grade of 92.41. The Flipped Classroom students posted a higher grade of 38.92 in assessment tools but lower in the final examination or post-test for a final grade of 91.14. Both final grades, however, were described as very good.

Difference Between the Academic Performance of the Students in the Remote Blended Learning and Students in the Flipped Blended Classroom Learning

The t-value and p-value obtained between the performance of remote blended learning and flipped classroom learning students, as shown in Table VIII.

Table VIII T-Value and P-Value Between the Academic Performance of Remote Blended Learning and Flipped Classroom Students in Biology

Group	Final Grade	Degree of Freedom	Critical Value	t-value	p-value	Decision
Remote blended learning	92.41	28	2.0484	0.275	0.7852	Not Significant at .05
Flipped Classroom	91.14					

As shown in the table, no significant difference was found in the biology academic performance of the remote blended learning students and their counterparts in the flipped classroom learning approach in senior

high school, as indicated by the obtained t-value of 0.275 and p-value of 0.7852. The t-value failed to reach the critical value of 2.048 at Alpha.05 under the degrees of 28. The p-value was very much higher than the Alpha value of .05. Hence, the alternative hypothesis that "there is a substantial gap in academic success between students enrolled in Remote Blended Learning and those enrolled in Flipped Blended Classroom in Biology" was rejected.

It should be recalled that the academic performance of the students was based on assessment tools that included short questions (5 marks), projects (10 marks), practical examinations (5 marks), short tests (20 marks), and post-test/final examination (60 marks) that covered first semester topics of S.Y.2019- 2020, for a total of 100%.

The results could be taken to mean that the students in the remote blended learning group and those in the flipped classroom learning group profess similar academic performance in Senior High School Biology. Both groups have final grades in the first semester of the school year 2019- 2020, which is described as very good.

Development of a Teacher's Guide for the Use of Remote Blended Learning and Flipped Blended Classroom Learning to Enhance Teaching of Biology in Grade 11

The researcher developed a Teacher's Guide for biology teaching and learning in senior high school. The Teacher's Guide is a comprehensive guide that shows the flow on how to incorporate assessment into the classroom effectively. Written for all groups of teachers, this Teacher's Guide offers a practical aid for the assessment skills and strategies in improving student learning through the use of remote blended learning and flipped classroom learning.

This Teacher's Guide is filled with descriptions, examples of how classroom assessment works in classrooms where assessment drives the instruction. The researcher presents: Clarifying learning targets, collecting assessment evidence, and Modifying instruction based upon the pedagogic approaches by the researcher. Each chapter details the kinds of assessment evidence that are the most useful for determining student achievement and provides instruction in the analysis of assessment data.

CONCLUSIONS

Based on the findings, the following conclusions were drawn:

The Remote Blended Learning and the flipped classroom learning approaches are either effective or highly effective in terms of course content, learner engagement and interactivity, graphical competencies, technical aspects, learning motivation, and learning outcomes. The student's pre-test performance in Biology is described as good, while the flipped classroom students show acceptable performance and there is no statistical difference in the pre-test performance of the Remote Blended Learning group and the flipped classroom learning group in Biology. The Remote Blended Learning students and the Flipped Classroom learning students are very good in their post-test performance in Biology. Both the Remote Blended Learning students and the flipped classroom students have their post-test mean gains significantly higher than their respective post-test scores.

The Remote Blended Learning students and the flipped classroom students' academic performance (assessment tools and post-test scores/final examination) in Biology are interpreted as very good; hence, they profess similar academic performance. The Teacher's Guide on the use of pedagogical approaches can enhance senior high school student learning in Biology.

RECOMMENDATIONS

Based on the findings and conclusions of this study, the following are recommended:

1. Since the experts and the science teachers found Remote Blended Learning and flipped learning approaches effective in teaching biology in terms of teaching dimensions and learning activities, it is suggested that faculty members use the said approaches in their respective classes. It should be noted that the said approaches are effective in course content, learner engagement and interactivity, graphical competencies, technical aspects, learning motivation, and learning outcomes.
2. The study results demonstrate that Remote Blended Learning and flipped classroom learning strategies can be used as effective tool to move the traditional educational systems to more recent educational models. Such models encourage the adaption of these two approaches, fostering students' analytical and critical thinking skills and encouraging them to work interactively and acquire knowledge in a way that suits their interests and learning styles.
3. It is recommended that the teachers use the newly developed Teacher's Guide in Biology since it will allow them to devote more time to forms of learning that put students on an active role, testing and applying the knowledge presented to the lecture. Group problem solving and student presentations shift the focus of learning to the student themselves to learn through experience and critical discourse. Through these exercises, students can solidify what they heard, test their comprehension, and master the content of the course.
4. As far as the integration of technology, particularly the use of an e- learning platform, in learning contexts is concerned, the results of the study demonstrate that successful use of technology for classroom learning necessitates carefully choosing the tasks and activities (visual and textual) that attract students and increase their willingness to learn.
5. The implemented Remote Blended Learning and flipped learning approaches need further investigation by looking at the goal structures and other combined learning strategies and assess students' academic learning outcomes in accordance with the students' science practical skills development.
6. The research should be carried out, and more data should be collected to make generalizations about students' perceptions with regards to Remote Blended Learning and flipped learning design. The investigation should also determine the types of activities and assignments that promote greater student engagement and improve their experience with Remote Blended Learning and flipped learning models and the types of technical and logistic difficulties that both teachers and students face in the use of these approaches.
7. The results of this study have contributed to a better understanding of technology use in teaching-learning activities. For government or policymakers, they should determine the Remote Blended Learning and flipped classroom as a contemporary model to implement teaching-learning activities for even K–12 students and even higher education. Finally, perhaps the findings and discussion of this study will contribute to a deeper understanding of future research in the Remote Blended Learning and flipped classroom areas.

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