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ENHANCING STUDENTS' PERFORMANCE IN BIOLOGY USING FLIPPED CLASSROOM AND PROJECT BASED LEARNING (FC-PJBL)

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Abstract *Biology is a discipline that needs to be taught effectively by educators because of the variety of applications it has in our world. At present, students found this subject and its concepts difficult to understand which contributes to their low performance in Biology. Studies revealed that teacher's pedagogy is one of the reasons why students find the subject Biology difficult. This study intended to determine the effect of flipped classroom and project-based learning (FC-PjBL) on the performance ofGrade 11 students in Biology, specifically in cellular respiration. Quasi-experimental with pretest-posttest nonequivalent control group design was used in this study. Two class sections were chosen purposively as participants in this study: the experimental group which received the intervention and the control group which was taught using conventional method. Paired t-test and independent samples t-test were the statistical tools applied to test the research hypotheses. Results show that there is a significant difference in the posttest scores of the two groups, in favor of the experimental group. This implies that the students exposed in FC-PjBL performed better than those taught with conventional method. It can be concluded that flipped classroom and project based learning can help in enhancing students' performance in Biology.*

Keywords *biology education, flipped classroom, project based learning, biology performance, blended learn*

INTRODUCTION

In the 21st century, mankind has faced a lot of concerns: environmental pollution, food crisis, demand for renewable fuels and spread of new diseases. These require nations to focus their attention in science and technology innovations especially in Biology and its numerous applications. Educational institutions are great venues where the passion for the field of Biology can be cultivated. On the other hand, most students in the secondary level find Biology as a difficult subject (Keles&Keppeli, 2010). This has many abstract concepts that are difficult to understand. Etobro and Fabinu (2017) found out that teaching strategies is the main reason why Biology topics are difficult as perceived by the students.

In addition, Tekkaya as cited in Khan &Masood (2013) study revealed that many students have a lot of misconceptions in biology especially in topics such as cellular respiration. Furthermore, the complex processes and terms used in cellular respiration make the students find this topic difficult. The results of the diagnostic test given to Grade 11 students of Rizal National Science High school showed that the least mastered competencies belong to cellular respiration.In additionto keep the students abreast with the latest breakthroughs in life sciences and to increase their academic performance in Biology, accurate and effective teaching must be done in schools.Likewise, to compensate students' difficulty in Biology, teachers must use varied teaching strategies with appropriate instructional materials, integration of life science concepts in daily life with emphasis on hands-on and minds-on approaches (Etobro&Fabinu, 2017). The 21st century learning environment, where there is a continuous advancement of information and communication technology and a rapidly growing global knowledge, poses a huge impact in today's generation. Students as young as pre-schoolers are better than many adults in using various devices (Malto et al.,2017). Thus, educators should develop and adopt teaching

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innovations to cater the new breed of students for effective learning to happen.

Overall, this study aimed to determine the effect of flipped classroom approach and project based learning versus the lecture method in the performance of Grade 11 students in Biology, specifically in cellular respiration.

LITERATURE REVIEW

In this study, the teacher-researcher used Flipped classroom as the teaching strategy and Project Based Learning (PjBL) as the learning method for the students.

One of the recent trends in different educational institutions that utilize online technology is the flipped classroom approach.Flipped classroom is a teaching method which is one form of blended learning. In this strategy, the content of the lesson is delivered online where the students are at home or out of school. In class sessions, the students participate in teacher guided activities and projects that promote active learning (Malto, Dalida&Lagunzad, 2017). Likewise, flipped classroom approach can be implemented in science lessons to improve the students' conceptual understanding (DarmaPutri, Rusdiana&Rochintaniawati, 2018). In this study, the students have undergone two stages in the flipped classroom: pre-classroom/home sessions and class sessions using PjBL.During the home sessions, the students were exposed to a combination of video lectures made by the teacher and those from Youtube, and Khan Academy. The students accessed these materials through Edmodo, an online learning platform. Similarly in learning science subjects like Biology, students learn better when they apply the concepts taught (Crouch, 2017). Project-based learning (PjBL) is a student-centered pedagogy that involves an approach in which the students are believed to acquire subject content retention through experiencing and solving real-world problems (Vega, 2015). In PjBL, teachers can ask a real-world problem solving situation and students create an actual product or artefact (Vega, 2015). Andrini, Pratama and Maduretno (2019) cited the PjBL is done following these steps: (1) start with essential question/s, (2) design a plan, (3) create a schedule, (4) monitor student's progress with the project, (5) assess the outcome and, (6) evaluate the experiences. In this action research, the researcher utilized PjBL during the class sessions. The PjBL worksheets were created based on Engineering Design Process (EDP), which is aprocess used by engineers to guide them in problem solving (NASA, 2018). The steps in EDP are asked, imagine, plan, create, test, and improve.

Consequently, the present study used a teaching model which may benefit both students and teachers: students are provided with opportunities to apply their content knowledge to solve real-world problems while teachers enhance their effectiveness as facilitators of learning in the current age of digitalization in the world.

RESEARCH QUESTIONS

The study determined the effect of Flipped Classroom and Project Based Learning (FC-PjBL) on the performance of students in Biology. Specifically, it answered the following:

1. Is there a significant difference in the pretest and posttest mean scores of the control group?
2. Is there a significant difference in the pretest and posttest scores of the experimental group?
3. Is there a significant difference in the performance of the experimental and control groups as revealed by their mean pretest and posttest scores?

SIGNIFICANCE OF THE STUDY

The results of this research could be beneficial to educators to address concerns in their classes. The flipped classroom linked to project based learning can be a solution to help the students

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learn the necessary content in an engaging manner. Class suspensions due to pandemic or natural calamities and absences due to sickness or extra-curricular activities of students may hinder their learning. It is in this case where the flipped classroom would work better as compared to conventional teaching (Malto et al., 2017).

RESEARCH METHODOLOGY

SAMPLING

A total of 56 Grade 11 students of Rizal National Science High School served as participants of this study. They were grouped into control group, which was taught conventionally, and experimental group, which received face-to-face and online instruction using flipped classroom and project based learning. Purposive sampling was used in selecting the participants of this study. There are only two sections handled by the teacher-researcher at the time of the conduct of this study. Prior to the grouping of the students, the grades in Biology of the previous quarter were used to ensure that both groups are equated in terms of performance. For ethical reasons, all student participants were made aware of the purpose of the study, after which the teacher-researcher wrote a letter of consent to the parents/guardians to ensure that their participation would be voluntary.

INSTRUMENTS

The following are the instruments used to collect data for this study.

Instructional materials

The teacher researcher developed lesson plans, video clip and worksheets focused on the topic Cellular Respiration. These materials were validated by experts in science education for content and English for grammar. Both groups were taught using the same set of competencies as prescribed by the Department of Education curriculum for General Biology 1.

Pretest and posttest items

A 20-item multiple choice tests was piloted and subjected to item analysis in terms of indices of difficulty and discrimination.

DATA COLLECTION

This research utilized quasi-experiment with non-equivalent pretest-posttest control group design. Pretest was administered before exposure of the students to FC-PjBL and conventional teaching to determine their performance in Biology prior to experimentation. During the flipped classroom teaching or home sessions, students were asked to study a combination of videos, documents and slide presentations uploaded online. The students were given questions to guide them in studying. In this manner, the students can learn at their own pace and study the resources repeatedly enough to answer the study questions. For class sessions, the students were introduced to collaborative learning using PjBL. After the teacher gave the essential question/s for the lesson, the students worked in groups to accomplish the worksheets based on the steps in project based learning. These encouraged the students to spend more time in applying the concepts learned in doing projects based on cellular respiration.

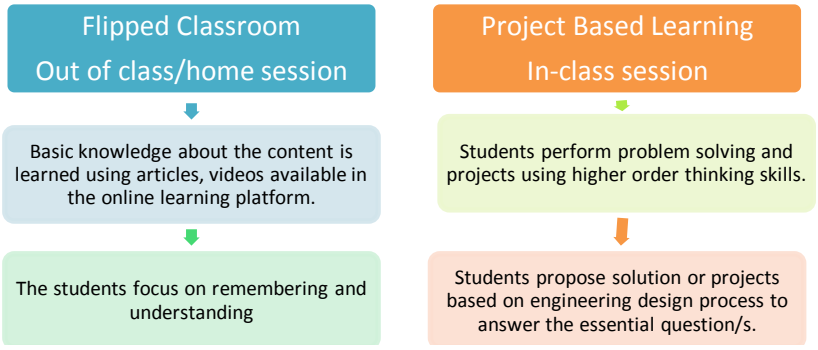

Figure 1

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COMBINED FLIPPED CLASSROOM AND PROJECT BASED LEARNING MODEL

It can be gleaned in Figure 1 that the project based learning in this model involves the students in active learning. According to Andrini et al (2019), project-based learning enables the students to make a plan and solve the problems which help their learning interesting and meaningful. While the flipped classroom approach prepares the students to have a foundation of the material for the lesson (Andrini et. al, 2019).

For the conventional/traditional teaching, discussions of the lessons were done in the classroom using lecture coupled with problem sets and exercises. Posttest was given to the two groups after the experimentation/instructional process.

DATA ANALYSIS

The data obtained from this research satisfied the assumption for normality using Shapiro-Wilk test. According to Mishra et al. (2019) it is a prerequisite to assess the normality of data since it is one of the assumptions for parametric testing. Additionally, if the data is normally distributed, parametric test is used to compare the means. On the other hand, if the data is not normally distributed, the medians are used in comparing the groups using nonparametric analysis (Mishra et al., 2019). Paired t-test wasutilized to determine if there is a significant difference in the mean scores within groups. While t-test for independent samples was used to determine if there is a significant difference in the mean scores of the experimental and control groups in the pretest and posttest.

DISCUSSION OF RESULTS

Table 1. Paired t-Test of Pretest and Posttest Results of the Control Group

Control	Mean	Stdev.	SE Mean	t	p-value	Interpretation
Pre-test	8.46	2.53	0.48	-11.95	0.000	Significant
Post-test	16.75	2.76	0.52			

Based on the table above, the p-value of 0.000 is lower that the significance level of 0.05 which indicates that there is a significant difference in the performance of the students in the control group after exposure to conventional teaching.

Table 2 shows the effect of the flipped classroom and project based learning in the performance of the experimental group in Biology. The t-value of -20.40 with p-value of 0.000 is lower that the significant value of 0.05. This implies that the performance of the experimental group improved after exposure to FC-PjBL. Both the conventional teaching and FC-PjBL were effective in enhancing the performance of the students in Biology.

Table 2. Paired t-test of Pretest and Posttest Results of the Experimental Group

Experimental	Mean	Stdev.	SE Mean	t	p-value	Interpretation
Pre-test	7.96	2.08	0.39	-20.40	0.000	Significant
Post-test	18.43	1.64	0.31			

Table 3 shows the mean scores of both groups in the pretest. After using the independent samples t-test, the p-value obtained was 0.423, which is higher than the standard value of 0.05. This shows that there is no significant difference in the pretest scores of the control and experimental group.This also implies that both groups have equal competence in Biology prior to exposure to conventional teaching and FC-PjBL.

Table 3. Performance of the Experimental and Control Groups with Respect to Pretest

Pre-test	Mean	Stdev	SE Mean	t	Df	p-value	Interpretation
Control	8.46	2.53	0.48	0.81	52	0.423	Not significant
Experimental	7.96	2.08	0.39				

As reflected from Table 4, the experimental group got a higher mean score of 18.43 as compared to 16.75 of the control group in the posttest. The t-value of -2.77 with a p-value of 0.008 is lower than 0.05 level of significance which indicate that there is a significant difference in the mean scores in favor of the experimental group. It can be concluded that the flipped classroom and

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project based learning significantly increased the performance of the experimental group in Biology. This finding is consistent with the study of Andrini et al. (2019) that flipped classroom and project based learning have positive effect with students' learning. This finding also contributes to the claim of Mohamed, Saidalvi and Tashiron (2019) that project based learning in flipped classroom has a positive impact on students' achievement.

Table 4. Performance of the Experimental and Control Groups with Respect to Posttest

Post-test	Mean	Stdev	SE Mean	t	Df	p-value	Interpretation
Control	16.75	2.76	0.52	-2.77	44	0.008	Significant
Experimental	18.43	1.64	0.31				

RECOMMENDATIONS

This research found out that some participants did not have stable internet connection at home and relied to internet cafes to access the online learning platform. As a backup, it is recommended to save the documents or files needed in a flash drive. The students can use a television or laptop to play the videos or study the articles at home offline. Future researchers can also consider the learning styles of the students as a requirement in developing materials for classroom flipping. Choosing an appropriate method of grouping the students in the project-based learning part can also be done to ensure maximum participation of the students in collaborative activities. Other models such as virtual flipping and double flipped classroom can also be explored in future researches to determine their effect in students learning.

REFERENCES

1. Andrini, V.S., Pratama, H. &Maduretno, T.W. (2019).The effect of flipped classroom and project based learning model on student's critical thinking ability. Retrieved from https://iopscience.iop.org/article/10.1088/1742-6596/1171/1/012010
2. DarmaPutri, M., Rusdiana, D.&Rochintaniawati, D. (2019). Students' conceptual understanding in modified flipped classroom approach: An experimental study in junior high school science learning. Journal of Physics: Conference Series. 1157. 022046. 10.1088/1742-6596/1157/2/022046.
3. Etobro, A.B. &Fabinu, O.E., (2017). Students' perceptions of difficult concepts in biology in senior secondary schools in Lagos state. Retrieved from https://www.ajol.info/index.php/gjedr/article/view/162440
4. Gayeta, N. (2017). Flipped classroom as an alternative strategy for teaching stoichiometry. Retrieved from http://www.apjmr.com/wp-content/uploads/2017/12/APJMR-2017.5.4.2.10.pdf
5. Keleş, Esra&Kefeli, pınar. (2010). Determination of student misconceptions in "photosynthesis and respiration" unit and correcting them with the help of cai material. Procedia - Social and Behavioral Sciences. 2. 3111-3118. 10.1016/j.sbspro.2010.03.474.
6. Khan, F.M.A &Masood, M. (2013). The development and testing of multimedia-assisted mastery learning courseware with regard to the learning of cellularrespiration. Retrieved from https://www.sciencedirect.com/science/article/pii/S187704281303869X#bibl0005
7. Khan, F.M.A &Masood, M. (2014).Potential of interactive multimedia learning courseware using three different strategies in the learning of biology for matriculation students in malaysia. Retrieved from https://www.sciencedirect.com/science/article/pii/S1877042814006211
8. Malto, G.A., Dalida, C. &Lagunzad, C.G.(2017).Flipped classroom approach in teaching biology: assessing students' academic achievement and attitude towards biology. KnE Social Sciences. 3. 540. 10.18502/kss.v3i6.2403.

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www.uijir.com

9. Mishra, P., Pandey, C.M., Singh, U., Gupta, A., Sahu, C. &Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. Annals of Cardiac Anaesthesia. 22. 67-72. 10.4103/aca.ACA_157_18.
10. Mohamed, H., Saidalvi, A., &Tashiron, N.A. (2019). Efficacy of usingproject-based learning in a flipped classroom based on cognitive styles of the students. Retrieved from https://www.ijrte.org/wp-content/uploads/papers/v7i6s5/F11220476S519.pdf
11. National Aeronautics and Space Administration (2018, January 30). Engineering design process. Retrieved from https://www.nasa.gov/audience/foreducators/best/edp.html
12. Papadakis, S., Gariou-Papalexiou, A., Manousou, E.&Georgiadu, I. (2017). Implementing a flipped classroom: a case study of biology teaching in a greek high school. Turkish Online Journal of Distance Education. 18. 10.17718/tojde.328932.
13. Shih, W.& Tsai, C. (2017). Students' perception of a flipped classroom approach to facilitating online project-based learning in marketing research courses. Australasian Journal of Educational Technology. 33. 32-49. 10.14742/ajet.2884.