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THE USE OF FLIPPED CLASSROOM IN TEACHING BIOLOGY TO YEAR 8 STUDENTS

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ABSTRACT

This study focuses on how the Flipped Classroom strategy improved students' engagement and understanding in Year 8 Biology. In this strategy, teachers assigned learning videos and interactive materials for students to study at home, then use class time for discussions and more engaging activities. The research involved 62 year 8 students that came from four different classes in Biology and was assessed using the Wayground® learning application. Data were gathered using the featured tracking system in Wayground®. The results show that students' scores were very similar, with most performing at a comparable level both before and after the intervention. The posttest results reflected generally strong performance, as the scores were closely grouped, indicating low variation among students. However, although a performance improvement was observed, it cannot be confidently linked to the flipped classroom approach and may have occurred by chance. To address this, the proposed enhanced flipped classroom model for Year 8 Biology focuses on strengthening key elements such as student readiness, teacher training, instructional design, access to technology, and ongoing progress monitoring. With more structured and systematic implementation, this improved approach has the potential to increase student engagement and lead to meaningful improvements in Biology learning outcomes.

Keywords: *Flipped classroom, Pretest, Posttest, Aerobic Respiration, Wayground app*

INTRODUCTION

Science education at the secondary level is fundamental to the holistic academic preparation of learners, as it develops higher-order thinking skills, scientific literacy, and problem-solving abilities required for advanced studies and real-world applications (Singh, 2021). Through structured science instruction, students are exposed to inquiry-based learning processes that promote analytical reasoning, experimentation, and evidence-based decision-making (Fernandez et al., 2022). Practical laboratory experiences further enhance learner competencies by fostering attention to detail, perseverance, and effective collaboration—skills that remain relevant across various professional disciplines.

In ensuring uninterrupted learning and safeguarding the welfare of learners and school personnel, the Department of Education in the Philippines has adopted adaptable instructional delivery approaches. These include online, modular, and blended learning modalities that may be implemented during periods when face-to-face classes are not feasible (DepEd Order No. 022, s. 2024). Furthermore, schools are permitted to conduct learner and stakeholder orientations through in-person, virtual, or hybrid formats to communicate institutional goals, curriculum frameworks, and support mechanisms aimed at improving student learning outcomes (DepEd Order No. 034, s. 2022).

The advancement of modern societies is closely tied to the capacity of education systems to strengthen science literacy. Despite this, many countries continue to face persistent challenges in providing equitable and high-quality science education, particularly within marginalized populations (DepEd, 2020). Addressing these challenges, UNESCO has emphasized the growing importance of blended learning and has issued guidelines highlighting the need for enhanced digital proficiency and pedagogical competence among educators as teaching and learning environments increasingly integrate technology (UNESCO SDG 4 Knowledge Hub, 2025).

Recent empirical studies emphasize the need to modernize science education through curriculum redesign, strategic program improvements, and the integration of foundational coursework to enhance instructional effectiveness (Calo et al., 2025). Among emerging instructional approaches, the flipped classroom model has gained prominence for its learner-centered structure, wherein instructional content is accessed outside the classroom and class time is devoted to interactive and experiential activities (Karjanto & Acelaido, 2022). Evidence suggests that this approach increases student engagement, preparedness, motivation, and active participation in learning tasks (Jiang et al., 2022), while also contributing to improved critical thinking skills, conceptual understanding, self-confidence, and academic performance (Mortaza Mardiha et al., 2023).

During the secondary school years, particularly in middle and high school, learners gradually develop independence, responsibility, and organizational skills necessary for managing academic tasks beyond the classroom. Within this developmental stage, the flipped classroom model offers a balanced structure that promotes accountability while supporting collaborative learning and guided teacher interaction, making it a viable alternative to traditional lecture-based instruction in secondary science education (Avery et al., 2023).

Background of the Study

Education has continuously evolved to meet the changing needs of students, yet many schools still rely on traditional teaching methods. MIS follows a conventional strategy where lectures are being done primarily by teachers, and students just remain in their seats listening. While this method is believed to be effective in delivering structured content, it often results in reduced student interaction and engagement, particularly in subjects that require hands-on learning, such as science laboratory classes at the secondary level.

Science education emphasizes practical applications, thinking critically, and solving problems, all of which are best developed through active participation (Mantra et.al., 2023). However, in conventional setup, students often struggle to engage in laboratory

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activities due to time constraints, lack of pre-laboratory preparation, and minimal student-led exploration. This leads to a passive learning experience, limiting their practical knowledge in real-world settings.

Summary of Review of Related Literature

The idea behind the new strategy can be traced back to early work in the United States that questioned the conventional divide between classroom and homework. Although homework has long been a standard element of teaching, the structured approach known as inverted learning was formally introduced in 2000 when Lage, Platt, and Treglia described how they reorganized their college economics courses (Eppard & Rochdi, 2017). Their approach reversed the flow of instruction: what was normally taught reverted to pre-class study, and the students were to complete at home (Lage et.al., 2000). Students watched lesson recordings, coming to class prepared, And during class time, addressing questions will be encourages, clarifying ideas and carrying out laboratory work. Reports from the implementation will show that students and teachers responded positively to the new strategy (Lage et.al., 2000)

From the teachers' perspective, Kariri (2025) noted that while educators had a strong understanding of flipped learning, challenges remained due to students' varying levels of preparedness. Meanwhile, Lotter and Ramnarian (2025) emphasized that the flipped strategy effectively supports inquiry-based learning by shifting teachers' roles to facilitators. Overall, Anjass et al. (2025) concluded that the flipped classroom is an innovative and effective strategy that improves achievement, motivation, independent learning, and long-term learning habits in science education.

The flipped classroom promotes an active, collaborative learning environment and effectively integrates technology in higher education (Gunbatar, 2021). Through the use of interactive and multimedia tools such as gamified simulations, podcasts, video applications, content repositories, and learning management systems, it enhances students' academic performance and engagement (Yildiz et al., 2022).

Implementing the flipped classroom presents several challenges for both teachers and students, including limited resources, skill-related issues, design complexities, and evaluation concerns. Effective implementation requires not only access to technology but also sufficient expertise, confidence, and careful instructional planning (Divjak et al., 2022). Although Baig and Yadegaridehkordi's (2023) systematic review identified significant difficulties in applying the flipped strategy in higher education, it emphasized that these challenges must be addressed to ensure successful and effective use of the approach.

Theory

Constructivism plays an important role in helping educators understand how students learn and in shaping meaningful learning environments. As Thomas (2023) explains, this approach shifts students from being passive listeners to active contributors in their own learning. At its heart, constructivism emphasizes that people make sense of new ideas by connecting them to what they already know, drawing on their past experiences, and interpreting information in their own way.

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The theory of constructivism forms the foundation of the flipped classroom approach (Hao et al., 2024), especially when teaching concepts like Aerobic Respiration. In that study, the researcher applied the flipped strategy, supported by different tools, to intensify strategies that will help the students actively build their knowledge.

Research Questions

The study was designed to answer the following research questions:

1. What are the baseline academic performance (pretest scores) of the Year 8 Biology class before the implementation of the flipped classroom strategy?
2. What are the post-intervention performance scores (post-test results) of the Year 8 Biology class after they have been taught using the flipped classroom model?
3. Does a statistically significant difference exist between the academic performance scores of the Year 8 Biology class compared to the results obtained before and after the introduction of the flipped classroom instruction?
4. What strategic program can be proposed after the empirical findings have been evaluated?

Hypothesis (Null)

There is no significant difference between the Year 8 Biology students' performance scores acquired previously and following the use of the instructional flipped classroom strategy.

Scope and Delimitation

This study examined the effectiveness of the flipped classroom approach in teaching aerobic respiration to Year 8 Science students at Mooltripakdee International School in Pattaya, Thailand. Using a pretest–posttest quasi-experimental design with purposive sampling, the research involved 62 students from four Year 8 classes over one week. Students studied teacher-prepared PowerPoint lessons at home and participated in guided, face-to-face activities in class. The investigation was limited to a specific grade level, topic, and assessment tools to maintain focus and feasibility.

METHODOLOGY

The study used a pretest-posttest quasi-experimental design (Creswell, 2017). The pretest and posttest quasi-experimental design is well-suited for this study because the study's role is to assess the effectiveness of the flipped strategy to improve Year 8 knowledge and understanding of Aerobic respiration in the Biology subject.

The participants were the 62 Year 8 students enrolled at Mooltripakdee International School (MIS) in Pattaya, Thailand, during this academic year 2025-2026. The students were selected purposively as they are all year 8 students taught by the researcher, who was taking Biology. The 62 year 8 students took the pretest before they were instructed on aerobic respiration in Biology using the flipped classroom instruction.

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After instruction for about one week, a posttest was given to the students. All the data gathered from the pretest to the posttest were tabulated and subjected to statistical treatment.

Only one instrument was used in the study: the pretest and posttest. The test questionnaire was adapted from the material provided by the Cambridge curriculum and slightly modified for the research; hence, there was a need for expert validation. The twelve (12) multiple-choice item test questions dwelt on the topic of aerobic respiration, one of the concept topics in Biology 8 class. Other grade levels, subjects, and longer intervention periods were not included. These boundaries were set to keep the investigation focused and manageable while providing a clear view of how the flipped classroom functioned within this particular context.

The questionnaire was administered on the Wayground application tool, where students accessed it through their mobile phones, tablets, laptops, and other devices. The researcher also uses Wayground for students' formative assessment, such as short quizzes, interactive activities, gamification, and engagement tools to check understanding, increase student motivation, and make learning more fun and interactive.

Compliance with Ethical Standards

The study's author ensured that all ethical standards were strictly observed throughout the study. Consent was properly sought from Year 8 participants, who were informed of their right to withdraw from the study at any point without any consequences. The anonymity and confidentiality of the respondents were fully upheld, and the principles of the Data Privacy Act were diligently followed. MIS students' records were also protected in accordance with the school's Child Protection and Safeguarding Policy, specifically states in 7.1.2 Record Keeping, under Safeguarding Roles, Responsibilities and Procedures.
The FEU Roosevelt Institutional Research Ethics Board (IREB) certifies that the research has undergone a comprehensive review and has been found to comply with the required ethical research principles.

RESULTS

To find out the performance of the year 8 students in Biology before and after the implementation of the flipped classroom instruction, the pretest was administered, and the scores' mean and standard deviation were determined. The results are entered in the table below.

Table 1: Performance Scores of Year 8 Biology Class Before Using the Flipped classroom Instruction

Score Interval	Description	Frequency	Percentage
10-12	Excellent	40	64.5
7-9	Good	19	30.6

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4-6	Fair	3	4.8
1-3	Poor		
Total		**62**	**100.0**
Mean	**9.5 (Excellent)**		
Standard Deviation	**1.56**		

Table 2: Performance Scores of Year 8 Biology Class After Using the Flipped Classroom Instruction

Score Interval	Description	Frequency	Percentage
10-12	Excellent	41	66.1
7-9	Good	18	29.0
4-6	Fair	3	4.8
Total		**62**	**100.0**
Mean	**10.5 (Excellent)**		
Standard Deviation	**1.57**		

Table 3: Difference Between the Performance Scores in Year 8 Biology Class Before and After Using Flipped Classroom Instruction

	Mean	% of Increase	Computed t-test value	p-value	Decision	Interpretation
Before	9.5	1 (10.5%)	0.324	0.899	Do not Reject the Hypothesis	Not Significant
After	10.5					

Note: p-value ≤ 0.05 – significant, p-value > 0.05 – not significant

DISCUSSION

Table 1 shows that the mean score of the students in the pretest is 9.5 characterized as excellent with a standard deviation of 1.56, which means that the data points in a set, are clustered closely around the mean (average). This indicates low variability and that the values are very similar to each other, which indicates that most students scored similarly.

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The posttest scores of the students in Table 2 obtained a mean of 10.5 described as excellent and a standard deviation of 1.57 which implies that the values in the dataset are clustered closely around the mean (average). In other words, there is low variability or little spread in the data.

It can be noted that both the mean scores in the pretest and posttest shown in Table 3 indicate excellent performance. The paired t-test comparing students' pretest (M = 9.5) and posttest (M = 10.5) scores after the implementation of the flipped classroom instruction in Biology yielded a p-value of 0.899. Since this value exceeds the significance level of $\alpha = 0.05$, the difference between the two mean scores is not statistically significant. Therefore, the result failed to reject the null hypothesis. This indicates that the observed increase in students' performance cannot be confidently attributed to the flipped classroom intervention and may be due to chance.

Conclusions

Based on the foregoing non-significant findings, the following conclusions were drawn:

1. The data points in a set, are clustered closely around the mean (average). This indicates low variability and that the values are very similar to each other, which indicates that most students scored similarly.
2. The posttest scores of the students indicates an excellent performance, the values in the dataset are clustered closely around the mean (average) which suggests low variability or little spread in the scores. The scores of the students are very close to each other.
3. The observed increase in students' performance cannot be confidently attributed to the flipped classroom intervention and may be due to chance. The flipped classroom did not lead to a significant improvement in students' scores. This result is understandable when considering several factors that may have influenced the outcome, such as:

    a. Limited Duration of the Intervention. The flipped classroom approach was implemented for only a week, which may not have been enough time for students to fully adjust to a new learning model. With a longer implementation period, the results might have been different.

    b. Students' Limited Readiness for Self-Directed Learning. The students were not yet accustomed to independent learning or lacked motivation to engage with the materials; the impact of the intervention would naturally be reduced.

    c. Inconsistent Engagement With Pre-Class Materials. Some students may not have consistently study learning materials before coming to class.

    d. Technology-Related Barriers. Access to stable internet, devices, or a quiet study environment may have varied among students.

    e. Learning Curve of the New Method. Both teacher and students may still have been adjusting to the flipped classroom format. Early implementation often involves trial-and-error, technical adjustments, and instructional refinement, which can affect its initial effectiveness.

    f. External Factors Affecting Performance. Fatigue, workload from other subjects, school activities, or students' personal issues may have influenced test performance.

4. The proposed "Enhanced Learning in Year 8 Biology Class Through Flipped Classroom

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Strategy" strengthens critical components of the flipped model—student preparation, teacher training, instructional design, technology access, and progress monitoring. Through systematic support and implementation, the improved version of the flipped classroom approach aims to enhance student engagement and ultimately lead to significant improvements in Biology performance.

Summary of Findings

Among the important findings of this research were:

1. Of the total 60 students who took the pretest, majority which is 40 or 64.5%, obtained excellent score interval of 10-12, 19 or 30.6% had good scores in the interval of 7-9 and 3 or 4.8% of the students got fair scores in the score range of 4-6. The mean score of the students in the pretest is 9.5 described as excellent with a standard deviation of 1.56.
2. The students who scored in the score interval of 10-12 categorized as excellent is 41 or 66.1% whereas, 18 or 29% had scores in the interval of 7-9 described as good, while 3 students or 4.8% obtained scores in the score interval of 4-6 characterized as fair. The posttest scores of the students obtained a mean of 10.5 described as excellent and a standard deviation of 1.57.
3. The increase in the mean scores of pretest and posttest is 1 or 10.5% while the paired t-test comparing students' pretest (M = 9.5) and posttest (M = 10.5) scores after the implementation of the flipped classroom instruction in Biology yielded a p-value of 0.899. Since this value exceeds the significance level of $\alpha = 0.05$, the difference is not statistically significant. Therefore, the result failed to reject the null hypothesis.
4. The study found no significant difference between the pretest and posttest scores after the use of flipped classroom instruction in Biology. This indicates that, in its current implementation, the flipped classroom approach did not produce measurable gains in student achievement. Several factors may have contributed, including limited student readiness, insufficient engagement with pre-class materials, technology barriers, and variability in the quality of instructional content.

Recommendations

In light of the conclusions drawn from the study, the following are hereby recommended:

1. A structured program to help teachers improve the implementation of the flipped classroom. Training on how to conduct active-learning sessions during class. Offer continuous professional development in flipped pedagogy and active learning strategies.

2. A student digital literacy program is recommended. Activities may include guidance on note-taking from videos, and learning study habits must be exercised. Provide students with devices, offline files, and internet support to remove access barriers. Ensure videos are short, clear, engaging, and aligned with learning objectives.

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3. Improve the pre-class materials through clear video instruction with additional interactive quizzes embedded in videos. Ensure videos are short, clear, engaging, and aligned with learning objectives.

4. Implement the flipped classroom for longer periods, in other Science subjects, in other grade levels to see long-term effects.

5. Ongoing Monitoring. Regularly track student participation, performance, and feedback to refine the flipped classroom approach.

6. Future Research. Conduct studies with larger samples, longer implementation time, or improved fidelity to test the refined version of the program.

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