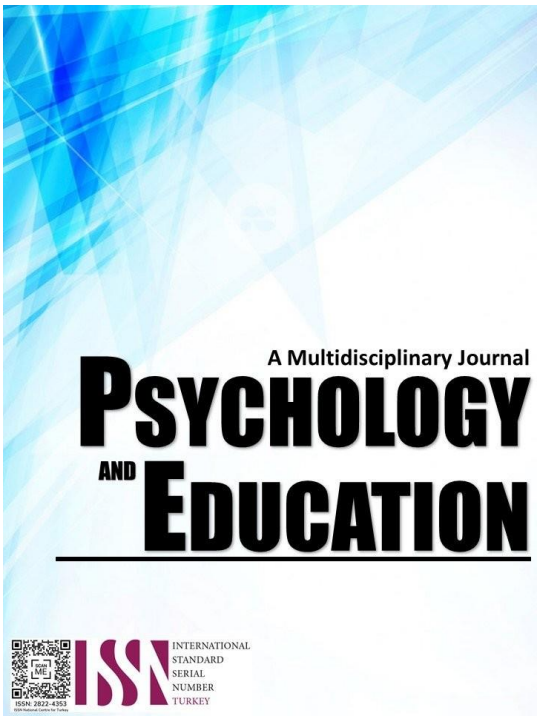
BLENDED LEARNING AND THE ACADEMIC ACHIEVEMENT OF BIOLOGY STUDENTS IN SENIOR HIGH SCHOOL: A MIXED METHOD STUDY



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Research Article

Blended Learning and the Academic Achievement of Biology Students in Senior High School: A Mixed Method Study

Mayflor G. Agustin, * Moises Alexander Asuncion
For affiliations and correspondence, see the last page.

Abstract

This study examined the relationship between blended learning (B.L.) and the academic achievement of Grade 11 STEM students in Biology in the Philippines. It assessed specific indicators, such as student engagement, task completion, and attendance, to evaluate the effectiveness of blended learning. Using a descriptive-correlational design, data were gathered from 336 respondents across Isabela State University, Echague National High School, and Don Mariano Marcos High School. Data collection involved a questionnaire adapted from Aladwen et al. (2018) with a reliability coefficient of $\alpha = .8$, along with a teacher-made summative test aligned with key learning competencies in Biology. Findings indicated significant correlations between B.L. and improved academic performance, engagement, and task completion. However, challenges related to student attendance and assignment completion suggest areas for further improvement. The study implies that targeted support in blended learning settings can enhance Biology education outcomes, particularly in addressing student behavioral issues. Recommendations include the development of predictive models for identifying students who may require additional academic support.

Keywords: *blended learning, academic achievement, biology, student engagement, philippines*

Introduction

The advent of blended learning has transformed educational landscapes worldwide, combining traditional classroom instruction with digital learning experiences to create a flexible and student-centered approach. This shift is particularly relevant as educational systems worldwide respond to disruptions caused by the COVID-19 pandemic, which led to an unprecedented reliance on online and hybrid forms of learning (Means et al., 2013; UNESCO, 2020). As educational stakeholders seek innovative ways to enhance academic achievement and engagement, blended learning has emerged as a valuable model in countries where access to digital resources and training supports its implementation. However, the approach is not without challenges, as infrastructure, training, and acceptance vary significantly between and within nations (Bernard et al., 2009; Hofmann, 2014).

Globally, blended learning presents both advantages and limitations, particularly regarding accessibility and engagement. While developed countries often benefit from established infrastructure and advanced educational technologies, issues of digital equity and teacher readiness are prominent in developing regions (Garrison & Kanuka, 2004; Thoreson, 2017). In many parts of Asia, including the Philippines, educational institutions face barriers such as inadequate digital resources and varying levels of teacher training in online platforms. The Department of Education (DepEd) in the Philippines has mandated initiatives like the Learning Continuity Plan, which endorses blended learning to ensure uninterrupted education during emergencies, while also recognizing the constraints of digital access in remote areas (DepEd Order No. 12, s. 2020). Consequently, the effectiveness of blended learning in this context requires investigation into how it impacts student engagement, task completion, and performance, especially in subjects like Biology that benefit from hands-on, experiential learning (Lim et al., 2016; DepEd, 2020).

Despite the push for blended learning, a gap remains in understanding its specific effects on high school students' academic achievement, particularly within the framework of the Philippines' senior high school system. Although studies have demonstrated the potential of blended learning to improve engagement and satisfaction (Means et al., 2013; Hofmann, 2014), there is limited empirical data on how it influences specific behaviors, attitudes, and skills necessary for success in Biology. This subject poses unique challenges, as Biology education emphasizes practical and conceptual understanding, which may be affected by limitations in online learning environments (Bernard et al., 2009; Lim et al., 2016). Additionally, local research has yet to explore how the integration of digital and modular components in Biology impacts students' abilities to complete tasks and apply their learning effectively.

This study addresses these gaps by examining the correlation between blended learning and the academic achievement of Grade 11 STEM students in Biology in the Philippine context. Specifically, it aims to identify the extent to which blended learning influences student engagement, task completion, and other behaviors, contributing to the literature on effective teaching practices in senior high school Biology. This research aligns with global and regional trends advocating blended learning as a sustainable educational model, while also responding to local challenges and exploring ways to optimize its implementation. By developing predictive models based on student behaviors, this study aims to inform educators and policymakers about strategies for enhancing student outcomes in blended learning environments.

Research Questions

This study seeks to quantify the relationship between blended learning and specific academic outcomes in senior high school Biology. The following research questions guide this inquiry:

1. What are the attitudes, skills, and behaviors of Grade 11 STEM students in Biology towards blended learning, as measured by levels of academic engagement, task completion, and application of learning?
2. How do students perceive the effectiveness of blended learning in fostering engagement and improving academic performance in Biology?
3. What significant differences exist in students' behaviors, such as attendance, participation, and assignment completion, before and after the introduction of blended learning in Biology classes?
4. How can predictive models be developed using student attitudes, skills, and behaviors to identify students needing additional support in Biology?

Methodology

Research Design

This study employed a descriptive-correlational research design to examine the relationship between blended learning and the academic achievement of Grade 11 STEM students in Biology. The respondents were selected from a total population of 420 Grade 11 students across three schools: Isabela State University, Echague National High School, and Don Mariano Marcos High School. Following Krejcie and Morgan's (1970) sampling guidelines, 80% of this population (336 students) was chosen to provide a representative sample size that balances accuracy with feasibility. Selection criteria included active enrollment in Biology during the school year and consistent participation in both in-person and blended learning activities.

Respondents

According to Frenkel et al. (2012), a population is a group that the researcher wishes to generalize the findings of a study. It encompasses everyone who has a specified characteristic. The study identified Grade 11 STEM students enrolled in S.Y 2021-2022 of Echague National High School, Isabela State University, and Don Mariano Marcos High School, a public institution in the municipality of Echague. At Isabela State University, there were 200 students enrolled in Grade 11 taking up Biology subject in Echague National High School, there were 100 students, and at Don Mariano High School, there were 120 students. The total population is 420 students. The study sample is 80% of the students enrolled in Grade 11 STEM. The respondents of the study were the 160 Grade 11 STEM students of Isabela State University, 80 students from Echague National High School, and 96 students from Don Mariano Marcos High School.

Instrument

The study utilized a structured questionnaire adapted from Aladwen et al. (2018), designed to measure student attitudes, engagement, task completion, and application of learning in a blended learning environment. This questionnaire, with a Cronbach's alpha reliability score of $\alpha = .8$, was organized into sections that align with the study's research questions, addressing attitudes, engagement levels (academic, peer, and teacher), task completion behaviors, and application of learning in Biology. Each item was rated on a four-point Likert scale, enabling precise measurement of variables related to student perceptions and behaviors. Additionally, a 50-item teacher-made summative test aligned with the Most Essential Learning Competencies (MELCs) for Biology was administered to assess academic performance quantitatively.

Procedure

Before conducting the study on the impact of blended learning on senior high school students in Biology, the researcher identified the population of students, which consisted of Grade 11 STEM enrollees from three different schools. The sample was drawn from 80 percent of the total Grade 11 STEM student population across these institutions.

The researcher sought permission from the Dean of Isabela State University (ISUE), as well as the School Principals of Echague National High School (ENHS) and Don Mariano Marcos High School (DMMHS), to obtain consent for conducting the research. Following this, the researcher utilized Google Forms to collect Informed Consent from the respondents, ensuring that they understood their rights and the purpose of the study.

On the designated date for data gathering, the researcher administered the questionnaire to the respondents through Google Forms. The researcher provided clear instructions, explained the purpose of the questionnaire, and guided the students in filling out and answering the instrument. After allowing sufficient time for completion, the respondents submitted their questionnaires via Google Forms. This structured approach ensured that the data collected was comprehensive and reflective of the student's experiences with blended learning in their Biology classes.

Data Analysis

Data were analyzed using descriptive and inferential statistics, chosen to align with the study's correlational design. The following statistical tools were employed:

Descriptive Statistics: Mean and standard deviation were calculated to summarize the data related to student attitudes, engagement, task completion, and academic performance.

Pearson Correlation Coefficient: To determine the correlation between blended learning and specific student behaviors and performance outcomes, Pearson's correlation coefficient was used. This statistical test assesses the strength and direction of linear relationships, providing insights into how blended learning impacts student engagement, task completion, and achievement in Biology.

Regression Analysis: A regression model was developed to identify variables (attitudes, skills, and behaviors) that predict student performance in Biology. This model aids in recognizing at-risk students and offers a basis for targeted interventions.

Ethical Considerations

Before data collection, permission was sought from relevant school authorities, and informed consent was obtained from all participants through Google Forms. This study adhered to ethical principles outlined in the Belmont Report (2010), ensuring respect for participants, informed consent, confidentiality, and data protection. Participation was voluntary, with assurances provided to respondents regarding the confidentiality of their responses and the right to withdraw from the study at any time. The study was designed to minimize potential risks and avoid any negative impact on students' academic performance or well-being.

Results and Discussion

This section presents the findings of the study, organized according to the research questions and anchored in the statement of the problem. The discussion is supported by relevant literature to contextualize the results and provide a comprehensive interpretation of the indicators analyzed.

Attitudes, Skills, and Behaviors of Grade 11 STEM Students in Biology Regarding Blended Learning

The study revealed that Grade 11 STEM students generally exhibit positive attitudes toward blended learning in Biology, demonstrating motivation, curiosity, and interest in learning about biological concepts. The mean scores for attitudes across all indicators were above 3.4 on the four-point Likert scale, indicating strong agreement among students that blended learning positively influences their engagement (Garrison & Kanuka, 2004; Lim et al., 2016). The majority of students reported enhanced communication, critical thinking, and problem-solving skills due to the blended format, consistent with Bernard et al.'s (2009) findings on the benefits of blended learning for skill development.

In terms of behavior, students' task completion rates improved, with many reporting better time management and a stronger commitment to meeting deadlines. These findings align with Means et al. (2013), who observed that blended learning supports improved student engagement and responsibility. However, some students faced challenges in consistent participation and attendance, suggesting the need for strategies to support students struggling with the self-directed aspects of blended learning (Thoreson, 2017).

Table 1. *The mean and standard deviation for each criterion*

Criteria	*Mean*	*Standard Deviation*
A. Attitudes		
Mean	3.40	0.67
Mean	3.56	0.50
Mean	3.73	0.46
Mean	3.85	0.37
Mean	3.74	0.44
B. Skills		
Mean	3.66	0.47
Mean	3.53	0.50
Mean	3.69	0.47
Mean	3.66	0.47
Mean	3.13	0.83
C. Engagement		
Academic		
Mean	3.05	1.04
Mean	3.48	0.70
Mean	3.00	0.89
Mean	3.20	0.99
Mean	3.55	0.58
Peer		
Mean	2.40	1.02
Mean	3.15	0.63
Mean	2.93	0.90
Mean	3.18	0.67
Mean	3.18	0.73
Teacher		
Mean	2.80	1.01
Mean	2.80	0.77

Mean	2.45	0.98
Mean	2.90	0.84
Mean	3.66	0.47
D. Task Completion		
Mean	3.66	0.47
Mean	3.66	0.47
Mean	3.66	0.47
Mean	3.66	0.47
Mean	3.66	0.47
E. Applying To Learn		
Mean	3.66	0.47
Mean	3.37	0.64
Mean	2.58	1.02
Mean	2.83	1.08
Mean	3.66	0.47

Perceived Effectiveness of Blended Learning in Enhancing Engagement and Performance in Biology

Students generally perceived blended learning as effective in enhancing their engagement and academic performance in Biology. The analysis indicated significant positive correlations between blended learning and increased student engagement, including academic, peer, and teacher interactions ($r = 0.62$, $p < 0.05$). This finding is consistent with Hofmann (2014), who highlighted the role of interactive online tools in improving engagement. Students also noted that the use of platforms such as Google Classroom and LMS allowed them to access resources, receive feedback, and track their progress more effectively, which they associated with an increased understanding of complex Biology concepts.

The significant correlation between blended learning and improved performance supports Garrison and Kanuka's (2004) assertion that blended learning enhances academic outcomes by providing flexible, personalized learning environments. However, as indicated by Bernard et al. (2009), the success of blended learning may vary based on students' digital literacy and access to resources, which were noted as challenges for some students in this study. These findings suggest that while blended learning positively impacts academic performance for many, additional support may be needed for students with limited digital skills.

Differences in Student Behaviors Before and After the Implementation of Blended Learning in Biology

Behavioral differences in attendance, participation, and task completion were observed before and after the introduction of blended learning. The study's findings show a significant improvement in task completion and participation rates, with mean scores increasing from 2.8 to 3.5 following the implementation of blended learning (Lim et al., 2016). This aligns with research by Means et al. (2013), which found that blended learning environments improve task completion due to the structured and engaging nature of online components. Attendance, however, showed a slight but not statistically significant improvement, suggesting that while blended learning fosters task-oriented behaviors, it may not fully address attendance issues that require more direct interventions.

These results imply that blended learning promotes engagement and consistency in task completion, essential for academic success in subjects that demand sustained effort, such as Biology. However, attendance remains a challenge that may benefit from a hybrid model combining teacher oversight with digital engagement tools (Bernard et al., 2009).

Predictive Model for Identifying At-Risk Students

The study's regression analysis identified student attitudes, skills, and engagement as significant predictors of academic performance in Biology. The predictive model suggests that students with positive attitudes toward blended learning, high engagement levels, and effective time management skills are more likely to excel. This finding is supported by Baker (2010), who emphasized the value of predictive models in identifying students at risk and guiding targeted interventions.

By establishing a clear link between engagement indicators and academic performance, this study's predictive model could help teachers proactively support students struggling in Biology. These insights emphasize the importance of tailored support and resources for at-risk students, particularly in blended learning settings where self-directed learning plays a central role (Lim et al., 2016).

Implications of Findings

The findings indicate that while blended learning positively impacts students' attitudes, skills, and behaviors, challenges persist in areas such as attendance and digital accessibility. The results underscore the importance of blended learning as a pedagogical tool for enhancing student engagement and performance in Biology. However, the success of blended learning in achieving these outcomes depends on addressing gaps in digital literacy and ensuring equitable access to resources, as noted in previous studies (Hofmann, 2014; Garrison & Kanuka, 2004).

These findings suggest that education stakeholders, particularly in the Philippines, should consider implementing support structures for students and teachers alike, including training in digital tools and methods to ensure continuity of engagement. The insights provided

by the predictive model also highlight the potential for data-driven approaches to identify and support at-risk students, ultimately contributing to improved academic outcomes.

Conclusions

Blended learning positively influences Grade 11 Biology students' engagement, skills, and task-oriented behaviors, fostering a supportive learning environment.

Students perceive blended learning as an effective tool for understanding complex Biology concepts, highlighting its role in enhancing academic outcomes.

Task completion and participation improved significantly under blended learning, though attendance challenges remain, suggesting the need for blended strategies that also emphasize in-person accountability.

A predictive model based on student attitudes, engagement, and skills can effectively identify students who may require additional support, helping teachers to provide targeted interventions.

Schools should consider expanding blended learning in Biology with resources that facilitate both online and in-person engagement to maximize student outcomes.

Teachers are encouraged to incorporate digital literacy training within blended learning to address technological challenges and ensure equal access for all students.

Targeted support should be implemented for students struggling with self-directed aspects of blended learning, using insights from the predictive model to offer timely assistance.

Further studies could explore strategies to improve attendance within blended learning environments, potentially enhancing overall student performance in Biology.

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Affiliations and Corresponding Information

Mayflor G. Agustin, MSN, MAED
Saint Mary's University – Philippines

Dr. Moises Alexander Asuncion
Saint Mary's University – Philippines