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Research Article

DESIGNING ENRICHMENT PROGRAM IN SCIENCE UTILIZING BLENDED LEARNING MODELS

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ABSTRACT

Aims: Implementing efficient teaching and learning strategies is vital in the ever-evolving field of education. In today's rapidly changing educational scene, blended learning emerges as a potential solution to fulfil the diverse demands of students. The main objective of this study was to examine the effective utilization of blended learning models to enhance academic outcomes. **Study design:** The study used a descriptive-developmental research design.
Place and Duration of Study: The study's respondents are one hundred (100) Grade 7 students of Janopol Oriental NHS during the school year 2023-2024.
Methodology: The study used a survey questionnaire. The researcher focused on the students' perceptions of the blended learning components, blended learning models, and student engagement. **Results:** According to the findings, using the blended learning model focusing on the rotation model is effective in science academic performance. It is approved by rejecting the null hypothesis about the significant differences between the pretest and post-test. Furthermore, there is no significant relationship between the blended learning components and science learning outcomes. **Conclusion:** There is no significant relationship between the science learning outcomes and the blended learning models implemented at JONHS. The school administration may consider improving the curriculum by implementing blended learning models as part of learning in the science curriculum. Further studies on the different blended learning models in teaching science were also recommended. Aside from additional studies, crafting of an intervention program may be utilized for different blended learning models. Broadening the scope of research on the influence of blended learning in other subjects or increasing the sample size can all be considered.

Keywords: Blended Learning, Learning Outcomes, Rotation Model, Science Learning Experience.

INTRODUCTION

In the constantly changing field of education, there is a pressing need to discover and implement effective teaching and learning methods. Teachers and educational institutions are currently facing a crucial juncture where they must adjust to the evolving requirements of contemporary learners. They are also under pressure to consistently seek fresh and creative methods to nurture academic achievement based on the books of Coman, C., Țîru, L. G., Meseșan-Schmitz, L., Stanciu, C., & Bularca, M. C. [3]. Blended learning, an instructional approach that cleverly integrates conventional in-person teaching with online elements, emerges as a promising remedy to meet the varied demands of students in the swiftly transforming educational landscape of today.

In response to this changing educational landscape, blended learning has emerged as a pedagogical approach that bridges the gap between traditional instruction and the digital realm, based on Alvarez's article [2]. Blended, hybrid or mixed-mode learning encompasses a spectrum of models, each offering a unique blend of face-to-face and online components. These models include the rotation model, flipped classroom, flex model, and many others, each with advantages and characteristics.

Various educational theories and principles guide the incorporation of blended learning. Among these is constructivism, a theory that suggests learners play an active role in building knowledge through their interactions with their surroundings, as stated by Mcleod [8]. Blended learning aligns with this theory by allowing students to participate in self-directed online tasks promoting exploration, critical thinking, and problem-solving. These online components can be carefully crafted to support active learning, wherein students engage actively in the learning process rather than merely absorbing information passively. Moreover, in the book of Lapitan, L. D. S., Jr, Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M. [6] blended learning follows the tenets of differentiated instruction. This teaching methodology acknowledges the diverse learning requirements and preferences of students. By employing blended learning models, educators can offer personalized instruction for individuals or small groups alongside whole-class activities. The online elements can be customized to accommodate different proficiency levels, empowering students to advance at their learning rates.

Furthermore, In the journal of El-Sabagh, [5] blended learning facilitates tailored learning experiences by granting students access to online resources and materials customized to their specific needs and learning preferences. This customization can potentially enhance the effectiveness and efficiency of the learning process. Additionally, this mode of education offers flexibility regarding both time and location. Students can access online components outside of regular class hours, accommodating various schedules and permitting self-paced learning based on the journal of Singh, J., Steele, K., & Singh, L. [11].

Incorporating blended learning models into the Grade 7 curriculum at Janopol Oriental National High School represents a strategic move toward creating a comprehensive learning environment. This approach acknowledges the distinct needs of Grade 7 students, who are at a critical juncture in their academic journey. The school aspires to engage students on multiple levels and cater to their diverse learning preferences through the fusion of traditional classroom instruction with thoughtfully crafted online components.

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Moreover, a body of supporting research consistently demonstrates that blended learning can lead to heightened student engagement, improved learning outcomes, and increased flexibility. Additionally, it equips students with indispensable digital literacy skills, preparing them for the challenges of the digital era. Janopol Oriental National High School's initiative to implement blended learning in Grade 7 underscores its commitment to remaining at the forefront of educational innovation.

In this study, the researcher will delve deeply into the specifics of the blended learning implementation at Janopol Oriental National High School, explore encountered challenges and benefits, and present findings and implications for educational administration at both the school and district levels. Through this comprehensive exploration, the study aims to assess the effective utilization of blended learning models to enhance academic achievements in Grade 7 education. The research on the effective utilization of blended learning models to enhance academic outcomes in Grade 7 education at Janopol Oriental National High School holds significant importance on Blended learning represents a modern and innovative approach to teaching and learning. This study serves as a platform for educators and institutions to explore and adopt cutting-edge instructional methods that align with the digital age and cater to students' diverse needs. For teachers, this highlights the vital role of teacher training and support in implementing blended learning. It underscores the need for ongoing professional development, which can have a lasting impact on educators' ability to utilize technology in the classroom effectively. Then, for the students, this study seeks to enhance education at the Grade 7 level by exploring innovative pedagogical approaches. The findings have the potential to lead to improved academic performance, increased student engagement, and better learning outcomes, ultimately benefiting the educational journey of Grade 7 students.

Literature Review. Blended learning models are essential in modern education because they can accommodate diverse learning styles and individual student needs.

Moreover, blended learning offers unparalleled flexibility and accessibility. Beyond traditional class hours, students can access online components at their convenience, accommodating diverse schedules and fostering self-paced learning based on the statements of Seo, A. K. S.-, SMO, & Specialist, O. R. M[10]. This flexibility is particularly valuable in today's educational landscape, where students juggle various commitments and responsibilities. Contrary to the misconception that technology-driven learning diminishes teacher-student interaction, blended learning often amplifies meaningful engagements. Educators leverage online platforms for communication, feedback, and individualized support, fostering a more personalized and responsive learning environment in the studies of Rabbitt, B., Finegan, J., & Kellogg, N. [9].

According to Cunningham [4], blended teaching requires that teachers not only understand the technology and its uses but also that they can think through how technology can serve the learning. Teachers must be capable of using digital tools, creating online curricula, and facilitating meaningful online interactions. Research has repeatedly underlined the significance of teacher preparation and support in blended learning contexts. The benefit of blended learning on academic achievement has attracted much interest in educational studies. Students who learn in blended contexts routinely outperform their classmates in traditional settings, according to a study by Al Musawi & Ammar [1] that looked at the effect of blended learning on academic attainment. The researchers attributed this improvement to the personalized and adaptive aspects of blended learning, which allow students to review content, get quick feedback, and change their learning experiences. Blended learning classes offer a unique environment in which to analyze the level of involvement shown by students. These blended approaches encourage both individual learning and cooperation, according to Talan and Gulsecen [12], and enable more channels of communication among students as well as between students and their teachers based on the works of McCutcheon, K., O'Halloran, P., and Lohan, M [7]. According to Utami [13], through blended learning, the students prepare for the course in the classroom, and it can be more efficient because the students may discuss with their teachers and classmates what they cannot do during classroom interaction

Additionally, Tiedemann [12] found that blended learning environments nurtured a sense of community among students, contributing to a more positive overall educational experience. Students' motivation to learn was also positively influenced, as they felt a greater sense of ownership over their learning process.

Objectives of the Study. The study's main objective was to examine the effective utilization of blended learning models to enhance academic outcomes in Grade 7 science class education at Janopol Oriental National High School, Tanauan Batangas. the study addressed the students' perceptions of the science learning outcomes. It focused on finding data about the students' perceptions of the blended learning components in terms of online content delivery, interactive learning activities, digital tools and resources and teacher training and support. The research also aimed to know the respondents' perception of the blended learning models chosen for the study, such as the rotation model, flex model, ala carte model and enriched virtual model. The respondents also obtained the pre assessment and post-assessment scores of the students in science learning. Academic performance, student engagement with motivation, engagement in learning, meaningful communication and overall educational experience were also analyzed in this study. The difference between the pretest and the post-test scores of the respondents in science learning was also the focus of the study. To analyze the significant relationship, the following was chosen to answer also: between blended learning components and science learning outcomes and the difference between blended learning models and science learning outcomes.

METHODOLOGY

Research Design. In this study, descriptive-developmental research was employed coupled with quantitative research. Each component of this research design was carefully selected to ensure the study effectively addresses its research objectives and generates meaningful insights into the impact of blended learning on academic enhancement. Random sampling is used in this study. This method offers several advantages that are well-suited to research objectives. Students in grade 7 at Janopol Oriental National High School in Tanauan, Batangas, will serve as the study's main responders. Students in grade 7 were chosen because they reflect the target audience for researching blended learning's effects in a classroom context. Specifically, the target respondents are four sections.

Sampling Technique. Random sampling is a method of choosing a sample of observations from a population to make assumptions about the population. (Admin BYJU, 2021) It ensures that every Grade 7 student at Janopol Oriental National High School has an equal and unbiased chance of being included in the study, thus reducing the potential for bias. This approach enhanced the generalizability of the findings, as the sample is more likely to represent the entire population of Grade 7 students accurately. Random sampling also

facilitates the application of statistical techniques for rigorous analysis, aligning with the study's quantitative approach.

Research Instrument. The primary research tool for this study is a survey questionnaire. The questionnaire collects students' perceptions of blended learning, academic performance, engagement levels, and overall educational experience. It employs a 4-point Likert scale to gauge respondents' degrees of agreement, with options ranging from "Highly Observed" to "Not Observed." Additionally, the questionnaire undergoes validation and reliability testing to ensure its effectiveness and accuracy in measuring the intended variables.

Part I: Blended Learning Components: This section delves into students' perceptions of various facets of blended learning. It comprises four subsections, each addressing specific elements of blended learning:

Online Content Delivery: This subsection evaluated the effectiveness and user-friendliness of online content delivery in the school. It also explores the complementarity of online content with traditional classroom lessons and its impact on student's ability to study independently. Interactive Learning Activities: This section assesses students' opinions about engaging and enjoying interactive activities in blended learning. It investigates how collaborative projects and discussions contribute to the learning experience and promote critical thinking and problem-solving.

Digital Tools and Resources: This part investigates students' perceptions of the ease of using digital tools and resources. It examines how digital resources expand access to learning materials and aid in understanding complex topics, thereby enhancing the overall learning experience. Teacher Training and Support: This subsection assesses teachers' preparedness to implement blended learning and the adequacy of student support. It also explores how teacher training impacts the quality of blended learning and students' confidence in using this approach.

Part II: Blended Learning Models: This section explores the students' perspectives on Blended Learning Models. This section is divided into four subsections, each focusing on the distinct characteristics of the respective models based on students' experiences.

Rotation Model- this subsection will evaluate students' perceptions about switching from one workstation to another, whether in face-to-face or online mode

Flex Model- students' perception of their learning autonomy will be evaluated in this subsection.

A La Carte Model: This subsection will evaluate how students perceive a certain amount of freedom and opportunity to get more involved in their learning.

Enriched Virtual Model- this subsection will evaluate how students perceive integrating different learning materials to maximize their understanding of the subject.

Part IV: Academic Enhancement: This section centers on academic enhancement and is divided into five subsections, each focusing on specific dimensions:

Academic Performance: This shows the fourth-quarter grades of the grade 7 students. The grades combine the activities, performance and product, quizzes, and posttest results. It also assesses the impact of blended learning on academic achievements and whether students have witnessed improved grades. Student Engagement: This subsection evaluates how blended learning methods foster active student participation and motivation, ultimately making learning enjoyable. It explores whether blended learning increases participation in class activities.

Learning Outcomes: This part explores students' beliefs regarding their knowledge retention, critical thinking skills, and overall understanding of subjects due to blended learning.

Overall Educational Experience: This section investigates how blended learning has influenced the educational experience. It assesses whether it has made learning more enjoyable, flexible, and satisfying and its impact on students' motivation to engage in educational activities.

Part IV. Aside from the survey, to allow the students to experience science learning, the researcher crafted lesson plans and Power Points recorded with voice instructions from the science teacher uploaded to their respective Google classrooms. The content of the lessons is delivered online. The learning's will be measured through a pen-and-paper test, pre-assessment and post-assessments. The Academic Performance of the students will be the 4th Quarterly Grades by the Grade 7 students in Earth Science utilizing the raw scores of the students from the summative assessment of each Most Essential Learning Competency from the Department of Education K to 12 Curriculum. The instrument's validation process will involve three experts in education evaluating and endorsing the questionnaire. Pilot testing was conducted to identify and rectify potential issues with clarity and comprehensibility.

Research Procedure. Upon passing the proposed study, the researcher will have the proposed questionnaire undergo validation and reliability testing. To validate the instrument, the researcher will ask three (4) experts in education, statistics, and research to evaluate the statements in the questionnaire. Upon validation, the researcher will adjust and revise according to the comments and suggestions of the validators.

Furthermore, reliability testing is an important step in the research process as it assesses the consistency and stability of a measurement tool, such as a questionnaire, over time and across different samples. It helps ensure the instrument yields reliable and consistent results when used repeatedly. The level of consistency typically acceptable for a research instrument, as measured by Cronbach's alpha, is often set at a minimum threshold of 0.70, although higher levels of consistency are desirable.

In the proposed study, the questionnaire will undergo both validation and reliability testing to ensure the quality of data collected. Validation involves seeking input from experts in the field to evaluate the questionnaire's content, ensuring that it accurately measures what it intends to measure. The three experts, each with expertise in education, statistics, and research, will provide comments and suggestions to improve the clarity and relevance of the questionnaire items. Their feedback is valuable in refining the instrument and increasing its validity. On the other hand, reliability testing focuses on the questionnaire's internal consistency. In this study, ten Grade 7 students will be selected from the science class to answer the survey questionnaire during the pilot testing phase. The pilot testing serves as a trial run of the questionnaire to identify any issues related to comprehension, clarity, or ambiguity in the items.

The most widely used measure of internal consistency is Cronbach's alpha, which quantifies how closely related a set of items in a questionnaire is as a group. It assesses whether all the scale items measure the same underlying construct. The researcher will calculate Cronbach's alpha to determine the level of consistency among the responses to the questionnaire items.

After the validation and reliability testing, the researcher will seek permission from the school principal to collect data from the science class of 100 Grade 7 students from four (4) sections. Informed consent will be obtained from both students and their parents or guardians. Data will be collected using survey questionnaires, distributed through Google Forms for online responses or printed questionnaires for in-person data collection. The students were exposed to the 4th Quarter Most Essential Learning Competency of Earth Science. During the first questionnaire, the results of the Preferred Blended Learning Models of the students were obtained using the highest mean score and are as follows:

Table 1: Comparison of the Mean Score of the Blended Learning Models

Blended Learning Model	Mean	SD	VI
Rotation Model	3.24	.499	Preferred
Flex Model	3.16	.411	Preferred
Ala Carte Model	3.06	.521	Preferred
Enriched Virtual Model	3.15	.508	Preferred

Legend: *1.0-1.49 (Not Preferred); 1.50-2.49 (Least Preferred); 2.50-3.49 (Preferred); 3.50-4.0 (Highly Preferred).*

Comparing the mean scores of the blended learning models, the Enriched Virtual Model has the highest mean score of 3.24. This indicates that students rated the Rotation Model as the most preferred option among the four models (Rotation, Flex, Ala Carte, and Enriched Virtual). This high mean score suggests that students found the Rotation Model positive compared to the other models regarding their learning experience. The students preferred this because most of the Janopol Oriental National High School implements the Rotation model during asynchronous learning during the school year. Hence, justifies the student's choice. The researcher used the first survey results as the basis for crafting the lesson plan and lectures uploaded to Google Classroom and utilized by the students during the research. After the students' exposure to the rotational model, the summative results were used to craft and calculate the final grade as the basis for academic performance. The researcher gave the respondents another set of surveys measuring student engagement in the blended learning model; this includes Motivation, Engagement in Learning and Meaningful Communication. The results were statistically analyzed to be compared to the blended learning models. Upon analyzing the results, the researcher crafted an enhancement program utilizing the rotational blended learning model.

Data Analysis. Appropriate statistical treatments will be employed to address the research questions. Descriptive statistics such as frequency, percentage, and mean will describe and illustrate the data's properties. These statistics are necessary to summarize the study variables in the student's perception thoroughly.

Inferential statistics, specifically correlation analysis, will be used to investigate the links between variables. Suppose a correlation exists between students' impressions of blended learning and their academic achievement, engagement, and overall educational experience. In that case, correlation analysis will show whether that association is statistically significant (Pallant, 2021). This analytical method permits the investigation of probable correlations and offers insightful information regarding the effect of blended learning on academic improvement in Grade 7 education.

RESULTS AND DISCUSSION

Table 2: Students' Perception of Blended Learning Components in Terms of Online Content Delivery

Indicators	Mean	SD	VI
1. I observe that my teacher is knowledgeable and has mastery of the topics.	3.72	.510	HO
2. How my teacher teaches online makes me understand the lessons well.	2.84	.632	O
3. My teacher explains the lesson's objectives clearly at the start of every lesson.	3.75	.497	HO
4. My teacher is updated with the latest trends and issues relevant to the subject matter.	3.20	.706	O
5. My teacher uses various strategies, techniques, and teaching aids/devices in presenting the lessons.	3.48	.649	O
6. My teacher is organized and systematic in presenting the lessons.	3.60	.580	HO
7. The lessons, activities, and materials provided to us encourage me to study independently.	3.27	.576	O
8. Lessons taught during face-to-face classes help me in online learning and vice versa.	3.26	.691	O
Overall	**3.39**	**.357**	**O**

Legend: *3.50-4.0 – Highly Observed (HO) 2.50-3.49 -Observed(O) 1.50-2.49 -Slightly Observed (SO) 1.0-1.49 – Not Observed (NO)*

Table 2 shows students' positive perceptions of blended learning, especially online content delivery. Indicators 1, 2, and 6 received "Highly Observed," suggesting the facilitator excels in the online content delivery. Overall, the mean value across all indicators is 3.39, with a standard deviation of 0.357, indicating a generally positive perception of online content delivery among students. Teachers can boost student satisfaction and engagement while improving the online material delivery experience.

Table 3: Students' Perception of Blended Learning Components in Terms of Interactive Learning Activities

Indicators	Mean	SD	VI
1. My teacher encourages us to interact and collaborate both online and in person.	3.67	.528	HO
2. The activities help us be creative, determine the best way to approach group projects, and divide tasks equally among us.	3.59	.513	HO
3. My teacher encourages us to exchange ideas and participate in brainstorming and small group discussions.	3.21	.710	O
4. My teacher assigns us tasks that allow us to interact with printed materials and digital learning resources, such as animations and images.	3.39	.579	O
5. I like expressing my ideas and receiving feedback from my classmates and my teacher.	3.13	.688	O
Overall	**3.40**	**.423**	**O**

Legend: *3.50-4.0 – Highly Observed (HO) 2.50-3.49 -Observed(O) 1.50-2.49 -Slightly Observed(SO) 1.0-1.49 – Not Observed (NO)*

Table 3 shows students' positive views on interactive learning activities in a blended learning environment, which are often viewed well by students. With a mean score of 3.67, teachers successfully promote student engagement and teamwork in-person and virtually. With a score of 3.59, activities that promote creativity and efficient group project management are likewise highly valued. Such insights

underscore the significance of fostering collaborative and creative environments within educational settings to optimize student outcomes and promote holistic learning experiences.

Table 4: Students' Perception of Blended Learning Components in Terms of Digital Tools and Resources

Indicators	Mean	SD	VI
1. The learning materials (e.g., video lessons, PowerPoint presentations, modules, etc.) help me understand the lessons.	3.50	.635	HO
2. various communication platforms (e.g., Facebook Messenger, Google Classroom, etc.) effectively support my learning.	3.36	.730	O
3. I have reliable data/internet connectivity, which allows me to participate in online classes and search for the study materials I need.	3.42	.599	O
4. My teacher explains how we can find information online (Google Scholar, Worldwide Science) and offline resources (books, newspapers, and magazines).	3.36	.587	O
5. My teacher gives clear instructions for using devices (e.g., laptops, smartphones, tablets) in online and offline learning tasks.	3.22	.705	O
6. My teacher uses digital tools such as Google Classroom, Zoom or Google Meet to check our participation, learning progress, and achievement.	3.21	.701	O
Overall	**3.35**	**.456**	**O**

Legend: *3.50-4.0 – Highly Observed (HO) 2.50-3.49 -Observed(O) 1.50-2.49 -Slightly Observed (SO) 1.0-1.49 – Not Observed (NO)*

Table 4 offers valuable insights into the respondents' perspectives on integrating digital tools and learning resources within the blended learning framework. Notably, the strong agreement expressed through verbal interpretations underscores the perceived indispensability of digital resources in this educational approach. The resounding agreement among respondents highlights the key role of technology in augmenting the learning experience. Most respondents endorsed that digital tool, including video lessons, PowerPoint presentations, and modules, substantially enhance their understanding of course material, as evidenced by the strong agreement in verbal interpretations. This acknowledgment underscores the effectiveness of multimedia resources in catering to diverse learning styles and facilitating comprehension.

The appreciation for the flexibility offered by pre-recorded lectures and the interactive nature of live lectures underscores the complex benefits of blended learning approaches. While recorded lectures facilitate content comprehension, live sessions play a fundamental role in nurturing social connections among students, enriching the overall learning experience. The strong preference for a blend of live and recorded instruction underscores students' preferences in contemporary educational settings.

Table 5: Students' Perception of Blended Learning Components in Terms of Teacher Training and Support

Indicators	Mean	SD	VI
1. My teacher is always prepared and capable of teaching online and face-to-face classes.	3.56	.535	HO
2. My teacher's knowledge and skills in using digital tools and resources indicate that he/she is well-trained.	3.40	.564	O
3. I can rely on my teacher for help and support during blended learning.	3.21	.765	O
4. My teacher and our school can give us the best-blended learning experience.	3.51	.604	HO
5. My teacher will help us become familiar and comfortable with blended learning	3.62	.560	HO
Overall	**3.46**	**.450**	**O**

Legend: *3.50-4.0 – Highly Observed (HO) 2.50-3.49 -Observed(O) 1.50-2.49 -Slightly Observed (SO) 1.0-1.49 – Not Observed (NO)*

Table 5 presents compelling insights into the students' perceptions of their teacher's role in facilitating their learning experiences in science education. Notably, the indicators highlighted in the highly observed verbal interpretations shed light on various facets of teacher support and preparedness, which are crucial for effective instruction in both face-to-face and online settings.

Firstly, Indicator 1 underscores the students' overwhelming agreement regarding their teacher's preparedness to deliver science education across different modalities, including face-to-face and online teaching. This signifies the teacher's adeptness in navigating diverse instructional formats, ensuring a seamless learning experience for students irrespective of the mode of delivery.

Furthermore, Indicator 4 emphasizes the students' confidence in their teacher's ability to provide the best blended learning experience. This reflects the teacher's proficiency in integrating technology with traditional teaching methods, enriching the learning process, and catering to diverse learning preferences. Indicator 5 highlights the teacher's proactive approach in familiarizing students with blended learning environments, fostering a sense of comfort and confidence among learners. This proactive support is instrumental in mitigating potential apprehensions and empowering students to leverage technology effectively in their educational journey. The commendable overall mean score of 3.46 underscores a collective vote of confidence from students regarding their teacher's preparedness, supportiveness, and the quality of the blended learning experience facilitated by the school.

Table 6: Students' Perception of Blended Learning Models – Rotation Model

Indicators	Mean	SD	VI
I prefer..			
1. doing activities online but want to attend lectures and assessments in person.	3.22	.744	Preferred
2. doing activities in virtual platforms or laboratory and redoing it in person by following my teacher's supplemental activities.	3.21	.683	Preferred
3. doing activities based on the time set by my teacher.	3.43	.702	Preferred
4. doing group activities with my classmates and rotating with other group mates while receiving individual tutoring.	3.11	.731	Preferred
5. having choices on how to learn whether watching video-assisted learning modules from my teachers or conducting my own research about topic from online sources.	3.25	.741	Preferred
Overall	**3.24**	**.499**	**Preferred**

Legend: *1.0-1.49 (Not Preferred); 1.50-2.49 (Least Preferred); 2.50-3.49 (Preferred); 3.50-4.0 (Highly Preferred).*

The students' opinions of blended learning models about the rotation model are shown in Table 6. It indicates that item number three received the highest mean of 3.43 with an interpretation of "Preferred" out of the five (5) indicators of rotation models. This indicates that

students value completing tasks depending on the teacher-set time in the blended learning rotation model. However, with the lowest mean of 3.11 and a "Preferred" interpretation, the indicator that stated, "doing activities in groups with my classmates and rotating with other group mates while also receiving individual tutoring" suggests that while still receiving guidance from the teacher, students should be encouraged to participate in more group activities.

Table 7: Students' Perception of Blended Learning Models – Flex Model

Indicators	Mean	SD	VI
I prefer..			
1. learning topics through videos and PowerPoint.	3.13	.688	Preferred
2. group discussion of topics through online platforms like Zoom and Google Meet.	3.01	.666	Preferred
3. taking quizzes and formative activities with limited time but with immediate feedback.	3.19	.689	Preferred
4. doing school activities at my own pace which I can personalize learning.	3.15	.750	Preferred
5. doing activities independently with my teacher's support and supervision	3.35	.584	Preferred
Overall	**3.16**	**.411**	**Preferred**

Legend: *1.0-1.49 (Not Preferred); 1.50-2.49 (Least Preferred); 2.50-3.49 (Preferred); 3.50-4.0 (Highly Preferred).*

Students' preferences for the Flex model in blended learning are summarized in Table 7. Students are greatly involved in working independently on tasks while receiving support and supervision from their teachers out of the five (5) indicators of the Flex model. With a mean score of 3.35, this method received the highest mean score from the students, indicating that they place high importance on having a degree of independence over their work if they are guaranteed support and supervision from their teachers. However, indicator number one has the lowest mean (3.13), yet it continues to be classified as "Preferred." Even with the lowest range of responses among the given indications, students prefer learning subjects via PowerPoint presentations and videos. This implies that although this teaching strategy may not be the most popular with students, it is still a typically successful and interesting way to learn.

Table 8: Students' Perception of Blended Learning Models – Ala Carte Model

Indicators	Mean	SD	VI
I prefer…	2.97	.783	Preferred
1. pre-recorded videos of my teacher, which I can watch repeatedly than PowerPoints.			
2. to study independently and seek solutions rather than in group discussions.	2.90	.868	Preferred
3. interacting and communicating with different teachers and classmates.	3.37	.666	Preferred
4. doing a one-on-one session and discussion with my teacher rather than group discussions	2.98	.777	Preferred
5. doing activities and lectures in a synchronous or asynchronous mode.	3.07	.756	Preferred
Overall	**3.06**	**.521**	**Preferred**

Legend: 1.0-1.49 (Not Preferred); 1.50-2.49 (Least Preferred); 2.50-3.49 (Preferred); 3.50-4.0 (Highly Preferred).

Students' choices within the La carte blended learning model are shown in Table 8, which provides insights into their preferred methods of instruction, participation, and collaboration. The study shows the understanding of how students view and interact with the Ala carte model by looking at variables like their preferred learning materials, learning autonomy, interaction preferences, and method of engagement. With a mean score of 3.37, students highly preferred collaborative learning experiences and placed high importance on interacting and talking with teachers and peers. Indicator 2, "To study independently and seek solutions on my own rather than through group discussions," had the lowest mean score (mean = 2.90). This suggests that although studying alone is somewhat preferable, students still value the chance to participate in group discussions as part of the Ala carte learning model.

Table 9: Students' Perception of Blended Learning Models – Enriched Virtual Model

Indicators	Mean	SD	VI
I prefer...		.	
1. doing activities and lectures offline and online.	3.15	641	Preferred
2. being part of a virtual classroom and engaging in discussions on offline platforms.	3.11	.691	Preferred
3. doing online activities but with printed supplementary materials given by my teacher.	3.07	.634	Preferred
4. taking assessments being guided by my teacher and in-person modality.	3.28	.641	Preferred
5. taking tests and activities on a fixed schedule.	3.15	.724	Preferred
Overall	**3.15**	**.508**	**Preferred**

Legend: *1.0-1.49 (Not Preferred); 1.50-2.49 (Least Preferred); 2.50-3.49 (Preferred); 3.50-4.0 (Highly Preferred).*

Table 9 provides information on students' preferences in the enriched virtual learning environment. Indicator 4: "Taking assessments being guided by my teacher and in person modality" had the highest mean score (mean = 3.28). This suggests that students place a high value on their teacher's presence during exams, highlighting the significance of direction and assistance in this area of their education. "Doing online activities but with printed supplementary materials given by my teacher" (Indicator 3, mean = 3.07) had the lowest mean score. This shows that students prefer online activities enhanced with digital resources over printed materials, even though physical materials are still accepted.

Table 10: Pre-assessment and Post-assessment Scores of the Grade 7 Students in Learning Science

	Mean Score	SD
Pre-Assessment	16.78	5.424
Post-Assessment	36.08	3.379

Legend: 0 - 25 (Low); 26 – 50 (Moderate); 51 – 75 (High); 76 - 100 (Very High)

The pre-assessment mean score of 16.78 with a standard deviation of 5.424 implies that, on average, Grade 7 students began the course with a relatively low level of understanding or proficiency in the subject matter based on the pre-assessment results. The higher standard deviation indicates a wider range of scores, indicating considerable variability in students' initial knowledge levels.

On the other hand, the post-assessment mean score of 36.08, supplemented by a standard deviation of 3.379, is interpreted with a "moderate" interpretation, which shows a significant improvement in

students' understanding and performance. The significant increase in the mean score from pre-assessment to post-assessment indicates that the intervention or teaching method employed during the course effectively enhanced students' learning outcomes.

Table 11: Science Learning Outcomes in Terms of Academic Performance

Level	F	%	Remarks
74 & below	-	-	Beginning
75-79	-	-	Developing
80-84	8	7.5	Approaching Proficiency
85-89	32	29.9	Proficient
90 & above	67	62.6	Advanced
Overall	**Mean=90.15**	**SD=3.74**	**Advanced**

Legend: 0 - 25 (Low); 26 – 50 (Moderate)*;* 51 – 75 (High)*;* 76 - 100 (Very High)

The data obtained from the student's fourth quarter-final grades offers a comprehensive insight into the academic performance levels of students who engaged in science learning within the blended learning model, specifically the rotation model. The basis of the fourth quarter grades is the combination of activities, quizzes, and post-tests. The analysis unveils noteworthy patterns and trends in student achievement by categorizing students into distinct score ranges and corresponding percentages.

Firstly, none of the students scored below 74, indicating a foundational level of knowledge upon which instructors could build. This baseline proficiency sets a promising starting point for all students, ensuring a solid foundation for further academic growth. The data reveals that 7.5% of students fall within the approaching proficiency category, with eight scoring between 80 and 84. This subset demonstrates promising potential, as they are in between reaching proficiency, highlighting the efficacy of the instructional approach in supporting student progress.

Subsequently, nearly 30% of the class, comprising 32 students, is classified as proficient, scoring between 85 and 89. This suggests a commendable level of understanding among students regarding the essential learning competencies of grade 7-earth science, indicating the effectiveness of the instructional methods employed. Most notably, the advanced category comprises most students, an additional 62.6%, with 67 students scoring 90 or above. This remarkable proportion underscores an impressive depth of understanding and mastery of the material among students, reflecting the efficacy of the blended learning model in facilitating advanced learning outcomes. The grades show that a substantially higher number of students have reached the advanced level compared to the proficient category, indicating the model's efficacy in promoting higher-order thinking skills and academic excellence.

Table 12: Science Learning Outcomes in Terms of Student Engagement – Motivation

Indicators	Mean	SD	VI
1. The blended learning model develops the motivation to learn earth science.	3.55	.602	Highly Engaged
2. The blended learning model addresses the encouraging conditions for learning science.	3.36	.690	Engaged
3. The blended learning model inhibits attention toward learning earth science.	3.28	.762	Engaged
4. It results in active participation in science's teaching and learning process.	3.38	.735	Engaged
5. Earth science education interests me because of the blended learning concept.	3.36	.756	Engaged
Overall	**3.39**	**.561**	**Engaged**

Legend: *1.0-1.49 (Highly Engaged); 1.50-2.49 (Engaged); 2.50-3.49 (Slightly Engaged); 3.50-4.0 (Not Engaged.*

The indicators show differences in the mean scores between 3.28 and 3.55, corresponding to different levels of agreement with statements about the motivation behind learning earth science. There may be some variation in the replies among the indicators, as indicated by the standard deviation (SD) values, which vary from 0.602 to 0.762.

Students are engaged with the integrated learning model, which promotes a desire to learn earth science (Mean = 3.55), and the teacher addresses beneficial conditions for science learning (Mean = 3.36). However, the students are engaged that the model hinders interest in studying earth science (Mean = 3.28). Furthermore, students concur that the blended learning approach encourages active engagement in science teaching and learning (Mean = 3.38) and promotes interest in earth science education (Mean = 3.36).

The total mean score of 3.3850 supports the students' good assessment of blended learning's ability to motivate learning. The indicator "Blended learning model develops the motivation to learn earth science" has the highest mean score (Mean = 3.55), which highly engaged with this claim. The indication "Blended learning model inhibits attention towards learning earth science" has the lowest mean score (Mean = 3.28), indicating a somewhat more engaged than the other indicators.

Overall, most students believe that blended learning fosters active engagement in the learning process and motivation to learn earth science. However, answers to claims about attention inhibition show a little greater variation. Students believe that learning earth science can be motivated through blended learning.

Table 13: Science Learning Outcomes in Terms of Student Engagement - Engagement in Learning

Indicators	Mean	SD	VI
1. The blended learning model helps to engage more in learning.	3.40	.712	Engaged
2. The blended learning model helps to increase the level of comprehension in learning earth science.	3.38	.722	Engaged
3. The blended learning model is useful for learning new earth science ideas.	3.33	.774	Engaged
4. The learning of concepts in earth science becomes more understandable with the use of a Blended learning model	3.39	.670	Engaged
5. The blended learning model helps to support the process of engagement in learning earth science.	3.36	.690	Engaged
Overall	**3.37**	**.559**	**Engaged**

Legend: *1.0-1.49 (Highly Engaged); 1.50-2.49 (Engaged); 2.50-3.49 (Slightly Engaged); 3.50-4.0 (Not Engaged.*

The mean scores across all indicators suggest a generally positive perception of the blended learning model's effectiveness in enhancing student engagement and comprehension in earth science. The mean scores ranging from 3.33 to 3.40 indicate that the students are engaged with the statements presented.

The overall mean score of 3.3720 further supports the notion that most respondents agree with the statements regarding the benefits of the blended learning model in enhancing student engagement in learning earth science. When the highest and lowest mean scores are compared, indicators 1 and 3 have the highest mean scores of 3.40 and 3.33, respectively. This indicates a slight engagement with the effectiveness of the blended learning model in engaging students and facilitating the learning of new ideas in earth science.

In contrast, indicators 2, 4, and 5 have mean scores ranging from 3.36 to 3.39, indicating slightly lower but generally positive perceptions of the model's impact on comprehension and concept understanding.

Regarding the standard deviation (SD), there is minimal variation among the indicators, suggesting a consistent level of agreement across all aspects of student engagement and comprehension in learning earth science with the blended learning model.

Table 14: Science Learning Outcomes in Terms of Student Engagement – Meaningful Communication

Indicators	Mean	SD	VI
1. The blended learning model creates a virtual classroom to make communication possible.	3.43	.715	Engaged
2. Technology improved the social development of the learners.	3.50	.664	Engaged
3. The blended learning model helps to express ideas.	3.47	.705	Engaged
4. ICT is a tool that innovates how to deliver lessons.	3.36	.633	Engaged
5. It makes the understanding more comprehensive and initiates meaningful communication.	3.41	.752	Engaged
Overall	**3.43**	**.508**	**Engaged**

Legend: *1.0-1.49 (Highly Engaged); 1.50-2.49 (Engaged); 2.50-3.49 (Slightly Engaged); 3.50-4.0 (Not Engaged.*

The average ratings for all the variables range from 3.36 to 3.50, suggesting that the blended learning strategy promotes meaningful communication positively. Students agree that the blended learning model innovates how lessons are delivered (Mean = 3.36), that technology fosters meaningful communication and understanding (Mean = 3.41), that the model helps express ideas (Mean = 3.47), that technology improves social development (Mean = 3.50), and that it creates virtual classrooms for communication (Mean = 3.41). The overall mean score of 3.43 adds importance to students' positive opinion of the meaningful communication that blended learning enables.

The indicator "Technology improved social development of the learners" has the highest mean score (Mean = 3.50), which was engaged in the verbal interpretation of this statement. The indicator "ICT is a tool that innovates the way of delivering the lessons" has the lowest mean score (Mean = 3.36), suggesting a somewhat lower agreement than the other indicators.

Students agree that blended learning encourages meaningful communication, although their answers to questions about comprehension and starting conversations vary slightly. The generally helpful opinion suggests that blended learning facilitates meaningful student interaction efficiently.

Being involved in learning is a crucial component of education. A good learning environment might be created by combining components of in-person and online lectures. This would allow for the practical advantages of online learning without sacrificing the in-person interaction that many students desire. Additionally, the environment in a mixture of classes is greater than that of in-person and online courses, boosting student engagement and fostering a closer connection between students and teachers. The use of blended learning has the potential to improve student-teacher interaction. There are various methods for interactions, including in-person and virtual classrooms.

Table 15: Science Learning Outcomes in Terms of Overall Educational Experience

Indicators	Mean	SD	VI
1. How would you rate the overall blended learning experience in the Earth Science subject?	3.48	.649	Good
2. How well do you feel the subject content in Earth Science was delivered in the blended learning approach?	3.41	.700	Good
3. How would you rate the communication and availability of your teacher in the blended learning environment for Earth Science?	3.45	.633	Good
4. How would you rate the blended learning approach in addressing your individual needs in understanding lessons in Earth Science?	3.47	.691	Good
5. How would you rate your level of satisfaction with your overall educational experience in the blended learning format in the Earth Science subject?	3.42	.630	Good
Overall	**3.44**	**.468**	**Good**

Legend: *1.0-1.49 (Poor); 1.50-2.49 (Fair); 2.50-3.49 (Good); 3.50-4.0 (Excellent).*

In the background of blended learning for Earth Science, the facts related to student engagement and overall educational experience are as follows: The mean scores for all indicators range from 3.41 to 3.48, indicating a generally positive perception of the blended learning experience. The standard deviation (SD) values, ranging from 0.630 to 0.700, suggest moderate response variability across the indicators.

Specifically, students rated the overall blended learning experience, delivery of subject content, communication, and teacher availability, addressing individual needs, and overall educational experience as "Good" across all indicators.

The overall mean score of 3.44 further supports students' positive perception towards their blended learning experience in Earth Science. Comparing the differences in mean scores, ranging only from 3.41 to 3.48, suggests a consistent level of satisfaction across various aspects of the blended learning approach.

The data reveals a generally positive perception of student engagement and overall educational experience in Earth Science within the blended learning format. Students consistently rated various aspects of the blended learning approach as "Good," indicating satisfaction with the delivery of subject content, teacher communication, individualized support, and overall educational experience.

Table 16: Pre-test and Post-test Results of the Learning Experience of the Students

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		T	Df	Sig. (2-tailed)
				Lower	Upper			
POSTTEST – PRETEST	19.308	6.52	.630	18.10	20.56	30.66	106	.000

The test of difference compares and contrasts the pre-assessment and post-assessment scores. Table 14 shows the significant difference at the 0.05 level. The difference shows a t-value of 30.66 and a p-value of .000. The results revealed that the blended learning model under the rotational model is significant in using science learning experiences by Grade 7 students.

The table presents the mean difference between the post-test and pretest scores is 19.308, with a standard deviation of 6.52. This indicates that, on average, there was a significant improvement in the student's performance from the pretest to the post-test. The standard error of the mean is 0.630, suggesting a small degree of variability in the mean difference across samples. The 95% confidence interval of the difference ranges from 18.10 to 20.56. It can be 95% confident that the true mean difference between the post-test and pretest scores falls within this interval. The t-value of 30.66 with 106 degrees of freedom indicates a highly significant difference between the post-test and pretest scores. The p-value is less than 0.001, suggesting that this difference is unlikely to have occurred by chance.

Overall, the data reveals a significant improvement in the student's learning experience from the pretest to the post-test. The results are highly significant, indicating that the intervention or learning experience positively impacted student performance. There is a significant difference between the students' pre-test and post-test scores.

Table 17: Relationship Between the Blended Learning Components and Science Learning Outcomes

Blended Learning Components	Science Learning Outcomes				
	AP	Student Engagement			OEE
		M	EL	MC	
Online Content Delivery	.012	.114	.095	.076	.129
Interactive Learning Activities	.053	-.064	.020	-.079	-.036
Digital Tools and Resources	-.079	.088	.046	-.004	.067
Teacher Training and Support	.038	.051	.038	-.022	.044

***Correlation is significant at the 0.01 level (2-tailed).*
**Correlation is significant at the 0.05 level (2-tailed).*

In this study, it is crucial to correlate blended learning components with outcomes because this enables teachers to concentrate on the strategy that produces the greatest results by identifying the most successful practices. This knowledge makes it possible to develop instructional strategies highlighting the elements influencing learning and providing better learning outcomes. It also enables the customization of educational experiences to meet the various needs of students. This data-driven strategy encourages improvement and raises student participation while supporting evidence-based decision-making. The instructions in the rotation blended learning model provide improved student results by assisting in creating learning experiences.

Table 17 presents the findings of the correlation analysis conducted to examine the relationship between various components of blended learning and science learning outcomes. The results indicated a low correlation coefficient across all constructs: online content delivery, interactive learning activities, digital tools and resources, and teacher training and support. This suggests no significant relationships between academic performance, student engagement, and overall educational experience.

Table 18: Relationship Between the Blended Learning Models and Science Learning Outcomes

Blended Learning Models	Science Learning Outcomes				
	AP	Student Engagement			OEE
		M	EL	MC	
Flex Model	-.011	.071	-.018	-.047	.081
Ala Carte Model	.005	-.050	-.033	-.057	.039
Enriched Virtual Model	.084	.155	.052	-.001	.143
Rotation Model	.040	.015	-.009	.012	.075

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

**Correlation is significant at the 0.05 level (2-tailed).*

Analyzing the preferred blended learning model of the students before the classes done by the researcher greatly impacts the students' academic performance, science learning outcomes and overall educational experiences. By adopting the rotation model into science instruction, teachers can improve student engagement and accomplishment in science by utilizing technology and adaptable learning strategies. This provided chances for personalized learning experiences catered to students' interests and requirements. Using deliberate execution and continuous evaluation, the researcher can maximize the rotation model and science learning outcomes, assuring learners acquire the abilities and understanding required for successful science learning.

Table 18 provides an in-depth examination of the correlation between various blended learning models and science learning outcomes. The analysis uncovers a noteworthy observation: a minimal correlation coefficient was observed across all constructs of blended learning models—namely, the flex model, ala carte model, enriched virtual model, and rotation model—concerning science learning outcomes. This suggests no significant relationship exists between these diverse virtual learning approaches and crucial indicators such as academic performance, student engagement, and overall educational experience.

CONCLUSION

The respondents rated the blended learning components' effectiveness with an understanding of 3.39 for online content delivery, 3.40 for interactive learning activities, 3.35 for digital tools and resources, and 3.46 for teacher training support. There was also agreement regarding how blended learning models were perceived; the rotation model received a rating of 3.24, the enhanced virtual model 3.15, the flex model 3.16, and the ala carte model 3.06. Respondents' mean pre-test score was 16.78 before using blended learning models, indicating low competency. The mean post-test score increased to 36.08 upon implementation, indicating a noteworthy improvement.

The respondents' academic performance ranged from proficient to advanced. Motivation was scored at 3.38, learning engagement at 3.37, and meaningful communication at 3.43, indicating a high level of involvement. The respondents' overall educational experiences were good. The difference in the pre-test and post-test results demonstrated the influence of blended learning. The different blended learning methods, components, and science learning outcomes showed no variations.

Competing interests

The authors declare no competing interests.

Authors' Contributions

Mr. Postrado designed the study, managed the literature searches, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Mr. Aliazas managed the study analyses. All authors read and approved the final manuscript."

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