THE EXTENT OF IMPLEMENTATION OF BLENDED LEARNING IN SENIOR HIGH SCHOOL SCIENCE EDUCATION VIS-A-VIS STUDENTS' ACADEMIC ACHIEVEMENT

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ABSTRACT

This study investigates the extent of implementation of blended learning in senior high school (SHS) science education as to the content, communication, technology, pedagogy, and assessment vis-à-vis students' academic achievement. In this analytical research design, data were gathered from 182 students and 12 science teachers using stratified random sampling. Gathered data were systematically treated and analyzed utilizing descriptive and inferential statistics such as frequency, percentage count, mean, standard deviation, one-way analysis of variance (ANOVA), and Pearson Product-Moment Correlation. Findings revealed the extent of implementation of blended learning in SHS science education as moderately implemented as perceived by the students and teachers. As to the students' profiles, there was a significant relationship between technology and the parent's monthly income. There was no significant difference in the extent of implementation of blended learning across all variables as perceived by the teachers. After implementing blended learning, the student's academic achievement in science was outstanding, and this put forward a significant relationship between content and assessment in their academic achievement. The study concluded that several things should be considered in implementing blended learning in the new normal education. Students' and teachers' involvement in the implementation is essential for improving the modality and the school administrators may consider undertaking specific plans and activities such as the need for teachers to attend training, seminars, and workshops related to blended learning implementation.

Keywords: Blended learning, distance learning, extent of implementation, new normal, science education.

INTRODUCTION

Education should be dynamic and ever evolving, adapting to the demands of students' needs. In this time of pandemic, it must be designed to meet the needs in the present educational set-up. Education and learning are dynamic fields (Bozkurt & Zawacki-Richter, 2021; Harinarayanan & Pazhanivelu, 2018). In previous decades, it has always been associated with the presence of schools, classrooms, examinations, teachers, students, and textbooks. However, as the COVID-19 pandemic impacted the educational system around the world (Owusu-Fordjour, 2020; UNESCO, 2020), the Philippines addressed the challenges through its Basic Education Learning Continuity Plan (BE-LCP), which aims to ensure the safety, health, and well-being of the students, teachers, and personnel and has been designed with a legal framework responsive to the new normal education. One of the learning delivery modalities that has been implemented is blended learning (DepEd, 2020a).

Blended learning integrates face-to-face with online distance learning, modular distance learning, and TV/ Radio-based Instruction (Allen & Seaman, 2016; Auditor & Mutya, 2022; DepEd, 2020b; Llego, 2020, Miller et al.; 2017). As one of the trends in an educational context, it is a better approach as it views learning as a continuous process rather than a single-time event and enables students to be independent learners outside the classroom (Jachin & Usagawa, 2017; Porter et al., 2014).

Several studies were conducted about implementing blended learning (Divayana, 2019; Onguko, 2013; Setiawan, 2019; Yudhana, 2021). Ghani et al. (2021) revealed that blended learning was beneficial in students learning endeavors in providing comfort during assessment and facilitating peer discussion. Students' engagement, achievement, and perceptions of learning increased, and they developed skills such as the ability to self-pace and self-direct using blended learning (Hesse, 2017). However, previous studies only focused on blended learning and its implementation. By this, the researcher wanted to fill in the gap by conducting a study on the extent of the implementation of blended learning in science as to the content, communication, technology, pedagogy, and assessment that will genuinely benefit senior high school students (SHS).

As educators, the researchers believed that in knowing the extent, more programs would be proposed and developed to facilitate and respond to the needs of the students in this time of adversity (Bruggeman et al., 2021; Ma & Lee, 2021), and it is for these reasons that the study has been conducted. Thus, the study aims to investigate the extent of implementation of blended learning in science education in senior high school (SHS) as to the content, communication, technology, pedagogy, assessment, and student's academic achievement in science after implementing blended learning.

LITERATURE REVIEW

Blended learning integrates benefits afforded by both traditional face-to-face education and pure online learning to deliver course content (So & Brush, 2008; Broadbent, 2017). As the pandemic disrupted the educational institutions, blended learning has become popular and has been utilized to address the challenges brought by the pandemic (Bervell & Arkorful, 2020; Hilmi & Ifawati, 2020; Rachmadtullah et al., 2020; Tadlaoui & Chekou, 2021). It provides ultimate flexibility in presenting content (Patterson, 2016) through different asynchronous and synchronous teaching strategies that provide more opportunities for reflection and feedback from students (Dakduk et al., 2018). According to Beaver and Hallar et al. (2015), blended learning is a formal education in which a student engages at least in part through online learning with some element of student control over the location, path, pace, and time; the modalities along each student's learning path within a subject are connected to provide an integrated learning experience.

In science teaching and learning, different strategies can be embedded in blended learning, such as combining different didactic approaches and delivery methods (Klentien & Wannasawade, 2016). Stockwell et al. (2015) revealed that blended learning improves science education. Kwan et al. (2009) provide an alternative practice model to enhance the blended learning experiences in science education. Learners' ability to assess and critically evaluate knowledge sources is established. This can go a long way in producing skilled learners who can be innovative graduates enough to satisfy employment demands (Kintu et al., 2017). Thus, blended learning constitutes a paradigm shift toward more diversified goal-oriented, personalized pedagogies and improves quality education (Jachin & Usagawa, 2017). Learning outcomes in knowledge, skills, attitudes, and values should be assessed (DepEd, 2020b).

As to technology, students nowadays are linked to technology, creating a highly collaborative, community-based mindset. As a result, they are less willing to tolerate the traditional 'sage-on-a-stage' teaching style, with a passive approach to delivering content (Leboff, 2020). A study from Nguyen et al. (2020) found that about 75% of internet users surveyed said that they are more likely to communicate digitally via email, text message, and social media rather than communicating in person. The deployment of technologies in teaching and learning is not a new paradigm. In the 21st century, students are familiar with digital environments, and therefore lecturers are encouraged to use technology in teaching to stimulate and employ students' learning. One of the most significant transitions of access to technology in the classroom has been a shift from traditional learning toward blended learning (Edward et al., 2018).

Teaching and learning with the aid of blended learning practices provide pedagogical productivity, knowledge access, collaborations, personal development, cost-efficiency, simplifies corrections that are necessary for effective and engaging learning experiences, and promote learners' learning success and engagement (Baragash & Al-Samarraie, 2018). Findings from prior studies by Edward et al. (2018) and Ghazal et al. (2018) indicated that blended learning enhances students' learning engagement and experience outside the classroom with synchronous tools and asynchronous tools. Meanwhile, the advantages of blended learning are increasingly being recognized (Jones, 2019). These include the provision of new learning environments, more opportunities for learning, less recognition, and reinforcement of students' efforts (Lee et al., 2016). Wai and Seng (2015) and Nguyen (2017) suggested that blended learning offers benefits and is more productive than traditional e-learning and adds interactivity and more motivation, leading to better feedback, social interactions, and the use of learning materials (Sun and Qiu, 2017). A further study by Panjaitan et al. (2019) suggested that measuring user acceptance and adoption of blended learning implementation is essential to prevent failures and improve the effectiveness of information technology for teaching and learning. For successful blended learning implementation, continuous training for faculty staff and students is necessary to enhance delivery effectiveness (Washington, 2016; Ali et al., 2019). Also, blended learning design should always be based on the learning context, the specific subject, and its actual objective (Mozelius, 2017).

Blended learning approach enhanced students' engagement and experience (Ghazal et al., 2018). The result of the study by Wai and Seng (2015), Nguyen (2017), and Dakduk et al. (2018) gives information about the advantages of blended learning. Owston et al. (2019) recommended how the blended learning implementation in science is composed. Lastly, Baragash & Al-Samarraie (2018), Lee et al. (2016), Klentien & Wannasawade (2016), and Mozelius (2017) discussed the different aspects of the extent of implementation of blended learning.

The studies mentioned above, and the literature reinforced the present study by providing the researcher's knowledge, information, and insights. Various authors' ideas, concepts, results, and findings support the present study, particularly on blended learning and its implementation. However, the researcher also wanted to know the extent of the implementation of blended learning to the SHS students and if it would significantly affect their academic performance in science concerning the content, communication, technology, pedagogy, and assessment.

THEORETICAL FRAMEWORK OF THE STUDY

This study, underpinned by the Complex Adaptive Blended Learning System (CABLS) Framework of Wang, Han, and Yang (2015), is designed to facilitate a deeper, more accurate understanding of the dynamic and adaptive nature. There are six elements in the system, all with their sub-system: the learner, the teacher, the technology, the content, the learning support, and the institution. In this framework, learners' roles vary or adapt when they interact with system pieces for the first time or in new ways. The most crucial factor is the well-documented shift from passive to active learning. This is critical for the development and training of lifelong learners, which has been highlighted as a crucial trait in 21st-century society. On the other hand, teachers' roles are new in mixed classrooms and will change in tandem with students as they interact with and change to one other and the other four aspects of the system. New labels will identify these teachers, such as facilitators, mentors, advisers, and moderators.

The CABLS framework emphasizes how a blended learning environment may help learners acquire metacognitive abilities, such as reflecting on the efficacy of their learning processes and adjusting their learning techniques to reach their intended learning outcomes (Wang et al., 2015). In short, the learner is expected to be self-regulated with learning becoming internally rather than externally controlled (Anthonysamy et al., 2020). Reflecting on this theory, the researcher prompts to get answers about the extent of the implementation of blended learning in SHS science education vis-à-vis Students' Academic Achievement. Thus, this framework is deemed appropriate for this research endeavor.

PURPOSE OF THE STUDY

The study investigates the extent of implementation of blended learning in science education in senior high school as to the content, communication, technology, pedagogy, and assessment vis-à-vis students' academic achievement. Specifically, it determines the significant difference in the extent of implementation of blended learning when grouped according to the respondents' profile and the significant relationship between the extent of implementation of blended learning to the students' academic achievement in science.

METHOD

Design

This study employed an analytical research approach employing the quantitative method. Analytical research brings together subtle details to create more provable assumptions. It needs critical thinking skills and careful assessment to find the gap in a study (Valcarcel, 2017). It helps establish the relevance of an idea and confirm a hypothesis (Omair, 2015). This design is deemed appropriate to find the significant difference in the extent of implementation of blended learning when grouped according to the respondents' profiles and to determine the significant relationship in the extent of implementation of blended learning to the students' academic achievement in science.

Participants

The respondents of the study were the SHS students and science teachers in two public schools utilizing a blended learning modality at the onset of the school year in Surigao del Norte, Philippines. The schools were selected based on the purposive sampling technique, and the SHS students were selected through stratified random sampling with proportional allocation. There were 182 students and 12 science teachers.

Data Collection and Analysis

A certificate from the graduate school, superintendents, and the school principals was secured before the conduct of the study to adhere to the safety and health protocols. Upon approval, researchers sent an invitation, an informed consent form that indicates voluntary participation and roles of the respondents, and a provision to withdraw from the study at any time. A research outline with a copy of the participant's rights and confidentiality protection was also attached to that form. All these were sent to the respondents via email and messenger. All these were given to the respondents. For confidentiality and anonymity, a code was assigned to each respondent. The hard copies of the data gathered from the respondents were kept in locked file cabinets, while the soft ones were stored in password-protected computers.

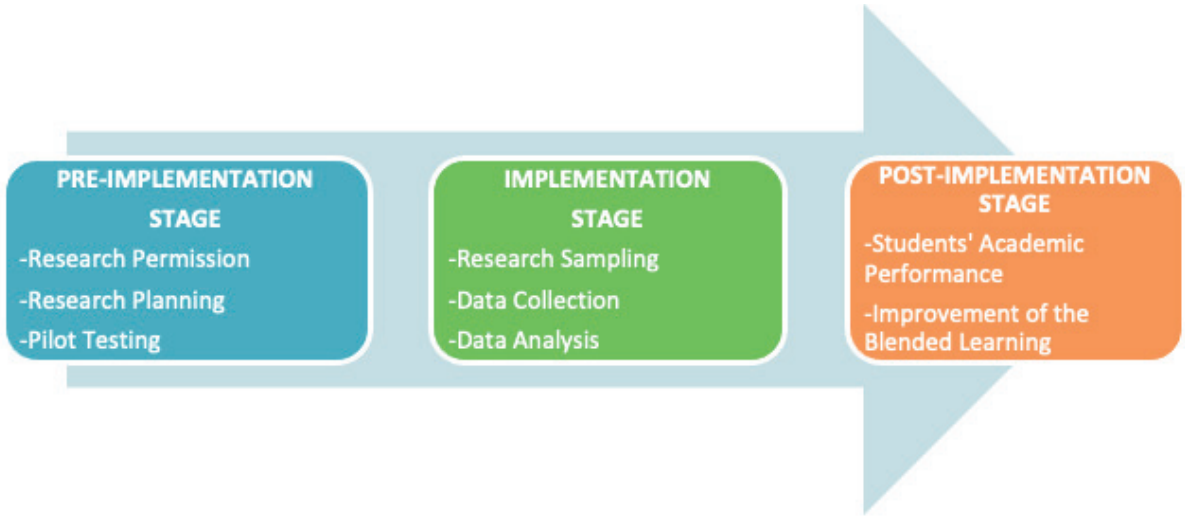

Figure 1. Implementation Process of the Study

Data were systematically treated and analyzed using descriptive and inferential statistics to achieve a correct and reliable result. Frequency and Percentage count were used to describe the variables for the demographic profile of the respondents. Means ± standard deviation (SD) statistical analysis was utilized to evaluate the extent of implementation of blended learning. One-way Analysis of Variance (ANOVA) was utilized to determine the significant difference in the extent of implementation of blended learning variables in science when grouped according to respondents' profiles. Pearson Product-Moment Correlation was used to determine the significant relationship between the extent of blended learning implementation in SHS science and their academic achievement.

Research Instrument

A modified researcher-made questionnaire with some items derived from Cabero et al. (2010) was utilized in the study. Part I obtained the profile of the respondents, part II consisted of 25 – item questions regarding the extent of implementation of blended learning, and part III determined the students' academic achievement. Moreover, the research instrument was reproduced and distributed via email and messenger.

Validity and Reliability

To ensure the validity and reliabilty of the results, the instrument was reviewed and checked by experts. Expert's comments and suggestions were considered in the final draft and the reliability of the instrument was established using Cronbach's alpha (Table 1). The questionnaire consisted of 5 items in every variable of the extent of implementation of blended learning.

Table 1. Reliability testing of research instrument divided into six components and their corresponding Cronbach's alpha coefficient and interpretation

Constructs	No. of Items	Cronbach's alpha	Interpretation*
Content	5	0.91	Excellent
Communication	5	0.93	Excellent
Technology	5	0.87	Good
Pedagogy	5	0.89	Good
Assessment	5	0.88	Good

**Legend: Below 0.50 (unacceptable); 0.50-0.59 (poor); 0.60-0.69 (questionable); 0.70-0.79 (acceptable); 0.80-0.89 (good); 0.90 and above (excellent)*

FINDINGS

Profile of the Respondents

A total of 182 students and 12 teachers participated in the study. Table 2 shows the descriptive statistics of the demographic characteristics of respondents.

Table 2. Profile of the Respondents

Groups	Variable	Profile	Responses	
			f	%
Teachers	Sex	Male	4	33.33
		Female	8	66.67
	Age	21-30	9	75.00
		31-40	3	25.00
	Highest Educational Attainment	Bachelor's Degree	5	41.67
		Master's Degree Unit Earner	5	41.67
		Master's Degree	1	8.33
		EdD/PhD Unit Earner	1	8.33
	Length of Teaching Experience	0 to 3	9	75.00
		4 to 6	2	16.67
		10 and above	1	8.33
	Relevant trainings attended	0	1	8.33
		1 to 2	3	25.00
		3 to 5	4	33.33
		6 and above	4	33.33
Students	Sex	Male	53	29.12
		Female	129	70.88
	Grade Level	11	74	40.66
		12	108	59.34
	Track	Academic	160	87.91
		TVL	2	1.10
		Arts and Design	15	8.24
		Sports	5	2.75
	Parent's Monthly Income	₱10,000-below	102	56.04
		₱11,000-₱20,000	34	18.68
		₱21,000-₱30,000	15	8.24
		₱31,000-above	31	17.03
	Parent's Highest Educational Attainment	Elementary level	13	7.14
		Elementary graduate	4	2.20
		High school level	17	9.34
		High school graduate	25	13.74
		Vocational	1	0.55
		College level	30	16.48
		College graduate	89	48.90
		Master's Unit Earner	3	1.65

Demographic information of the teachers consists of sex, age, highest educational attainment, length of teaching experience, and relevant training attended. Most of the respondents were female (67%), and their ages group mostly belonged from 21 to 30 years old (75%). Most of them were master's degree unit earners (41.57%) and bachelor's degree graduates (41.57%). In terms of the number of years in teaching, most of the respondents were newly hired teachers with 0-3 years of experience (75%) further classified as beginning or experienced teachers and attended more than three relevant training in education.

The profile of the students consists of sex, grade level, track/strand, parent's monthly income, and parent educational attainment. Most of the students were females (71%), and most were grade 12 students (59.34%).

There were 160 enrolled in the academic track, 2 in the TVL track, 15 in the arts and design track, and 5 in the sports track. More than half of the students had ₱10,000-below parents' monthly income (56.04%). Regarding the parent's highest educational attainment, most of them were college graduates (48.90%).

The extent of implementation of Blended Learning to SHS Students in Science

The extent of implementation of blended learning to SHS students in science is presented in Table 3. Technology, pedagogy, and assessment were perceived as moderately implemented by the students, and teachers, while content and communication were perceived as highly implemented. Overall, the extent of implementation of blended learning in SHS is moderately implemented as perceived by the students (3.15±0.43) and teachers (3.17±1.06).

Table 3. The extent of Implementation of Blended Learning to SHS Students in Science

Constructs	Students		Teachers	
	MeanSD	QD	MeanSD	QD
Content	3.17±0.46	HI	3.19±1.04	HI
Communication	3.15±0.55	HI	3.18±1.09	HI
Technology	3.13±9.57	MI	3.20±1.13	MI
Pedagogy	3.12±0.50	MI	3.15±1.09	MI
Assessment	3.20±0.49	MI	3.13±1.07	MI
Overall	3.15±0.43	MI	3.17±1.06	MI

Legend: *1-1.75 – Not at all (NA); 1.76-2.5 – Slightly implemented (SI); 2.51-3.25 – Moderately implemented (MI); 3.26-4- Highly implemented (HI)*

The extent of Implementation of Blended Learning when Grouped According to the Respondents' Profile

The significant difference in the extent of implementation of blended learning when grouped according to the respondents' profile variables was evaluated and measured and the results are presented in Table 4 and 7.

As observed from Table 4, based on students' profiles, p-values are higher than 0.05 level of significance across all factors in the implementation of blended learning when grouped by sex, grade level, track, strand, and parents' highest educational attainment. This result implied that there was no statistically significant difference in the extent of implementation of blended learning in SHS in terms of content, communication, technology, pedagogy, and assessment with respect to the respondents' sex, grade level, track, strand, and parents' highest educational attainment. On the contrary, it was found that there was statistically significant difference in the extent of implementation of blended learning in terms of technology when student-respondents were grouped by parents' monthly income.

Table 4. The extent of Implementation of Blended Learning when Grouped According to the Students' Profile

Students' Profile	Dependent Variable	f	p-value	Remarks
Sex	Content	0.23	0.63	Not Significant
	Communication	0.00	0.97	Not Significant
	Technology	0.23	0.64	Not Significant
	Pedagogy	1.11	0.29	Not Significant
	Assessment	3.89	0.07	Not Significant
Grade level	Content	1.03	0.31	Not Significant
	Communication	1.80	0.18	Not Significant
	Technology	0.35	0.55	Not Significant
	Pedagogy	0.95	0.33	Not Significant
	Assessment	0.06	0.81	Not Significant
Track	Content	0.16	0.93	Not Significant
	Communication	0.23	0.88	Not Significant
	Technology	0.67	0.57	Not Significant
	Pedagogy	0.21	0.89	Not Significant
	Assessment	0.03	0.99	Not Significant
Strand	Content	3.09	0.07	Not Significant
	Communication	0.94	0.44	Not Significant
	Technology	2.25	0.07	Not Significant
	Pedagogy	0.31	0.87	Not Significant
	Assessment	1.77	0.14	Not Significant
Parents'	Content	0.64	0.59	Not Significant
Monthly	Communication	2.18	0.09	Not Significant
Income	***Technology***	***2.78***	***0.04***	***Significant***
	Pedagogy	1.69	0.17	Not Significant
	Assessment	2.45	0.07	Not Significant
Parents' Highest Educational Attainment	Content	0.16	0.99	Not Significant
	Communication	0.54	0.80	Not Significant
	Technology	1.32	0.25	Not Significant
	Pedagogy	0.30	0.96	Not Significant
	Assessment	0.34	0.94	Not Significant

Legend: p value < 0.05 Significant

The extent of implementation of blended learning when grouped according to the teachers' profile is presented in Table 5. As observed from the results, p-values under content and assessment are less than 0.05 level of significance. These signify that there was statistically significant relationship between the extent of implementation of blended learning in terms of content and assessment and the academic achievement of the students. The correlation coefficient r=0.45 indicates that the relationship between content and academic achievement is moderately positive. In other words, as the implementation of blended learning in terms of content enhances, the academic achievement of the students increases. Since across all teachers' profiles considered, p-values are all greater than 0.05 level of significance. These inferred that as perceived by the teachers, the extent of implementation of blended learning in terms of content, communication, technology, pedagogy, and assessment did not statistically significantly differ across teachers' profiles.

Table 5. The extent of Implementation of Blended Learning when Grouped According to the Teachers' Profile

Profile	Variables	f	p-value	Remarks
Sex	Content	0.35	0.57	Not Significant
	Communication	0.66	0.44	Not Significant
	Technology	0.74	0.41	Not Significant
	Pedagogy	0.29	0.60	Not Significant
	Assessment	0.23	0.64	Not Significant
Age	Content	0.41	0.54	Not Significant
	Communication	2.56	0.14	Not Significant
	Technology	2.24	0.17	Not Significant
	Pedagogy	1.86	0.20	Not Significant
	Assessment	0.37	0.56	Not Significant
Highest Educational Attainment	Content	0.23	0.87	Not Significant
	Communication	0.40	0.76	Not Significant
	Technology	0.33	0.80	Not Significant
	Pedagogy	0.24	0.86	Not Significant
	Assessment	0.01	1.00	Not Significant
Teaching Experience	Content	0.16	0.85	Not Significant
	Communication	0.41	0.67	Not Significant
	Technology	0.54	0.60	Not Significant
	Pedagogy	0.21	0.81	Not Significant
	Assessment	0.21	0.82	Not Significant
Relevant training	Content	0.44	0.73	Not Significant
	Communication	0.76	0.55	Not Significant
	Technology	0.78	0.54	Not Significant
	Pedagogy	0.80	0.53	Not Significant
	Assessment	1.34	0.33	Not Significant

Legend: p value < 0.05 Significant

Academic Achievement of Senior High School

The academic achievement of the SHS students is shown in Figure 2. It can be gleaned that only 3 students got the grade under 75-80 grades which is fairly satisfactory, 13 students got 81-85 grades which is satisfactory, 39 students got 86-90 which is very satisfactory, 107 students got the grade of 95 which is outstanding, and 20 students got the grade of 96 and above which is outstanding. The majority of the students (n=107) got an "outstanding" rating.

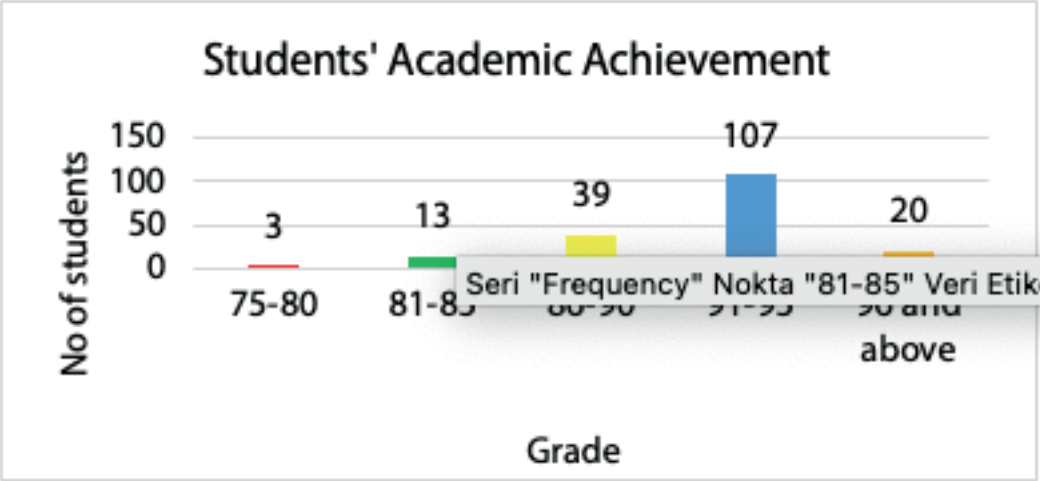

Figure 2. Students' Academic Achievement

The Extent of Implementation of Blended Learning and Students' Academic Achievement

The significant relationship between the extent of implementation of blended learning and the academic achievement of the students is presented in Table 6. Content (*r=0.45, p=0.04*) and assessment (*r=0.13, p=0.04*) was statistically significant towards the academic achievement of the students Communication (*r=0.10, p=0.16*), technology (*r=0.10, p=0.20*), pedagogy (*r=0.11, p=0.14*) was statistically not significant. The results suggest that blended learning in terms of communication, technology, and pedagogy do not affect the academic achievement of the SHS students while blended learning in terms of content and assessment affects their academic achievement. These reveals that improvement must be done to achieve positive implementation of blended learning in SHS students in science.

Table 6. The extent of Implementation of Blended Learning and the Academic Achievement of the Students

Extent of Implementation	correlation coefficient	p-value	Remarks
Content	0.45	0.04	Significant
Communication	0.10	0.16	Not significant
Technology	0.10	0.20	Not significant
Pedagogy	0.11	0.14	Not significant
Assessment	0.13	0.04	Significant

Legend: p value < 0.05 Significant

DISCUSSIONS

The study investigates the extent of implementation of blended learning in SHS science education as to the content, communication, technology, pedagogy, and assessment. It determines the profile of the respondents, students' academic achievement in science after the implementation of blended learning, a significant difference in the extent of implementation of blended learning when grouped according to the respondents' profile, and a significant relationship between the extent of implementation of blended learning to the academic achievement of the students in science.

The quantitative analysis of the overall extent of implementation of blended learning to SHS students in science was perceived as moderately implemented by the students and teachers. Studies revealed challenges in the implementation of blending learning by students (Broadbent, 2017; Prasad et al., 2018) and teachers (Geverola et al., 2022; Medina, 2018; Ocak, 2011). According to Bamoallem & Altarteer (2021), the

teaching, cognitive and social presences constructs are predictors of acceptance of blended learning. With the implementation of blended learning in the new normal, several things should be considered for the extent of implementation.

The extent of implementation of blended learning when grouped according to student's profiles showed no significant difference in the extent of implementation of blended learning in terms of content, communication, technology, pedagogy, and assessment of the respondents' sex, grade level, track, strand, and parents' highest educational attainment. Kintu et al. (2017) listed that one of the significant challenges in blended learning is ensuring students can successfully use technology. System functioning can lead to success or failure, as low technology quality degrades user pleasure while high technology improves satisfaction. The user's continuing navigation through the technology of the learning management system is a measure of blended learning success. Another drawback of blended learning is the overloading of learners (Andrews, 2020) and perceived as more demanding and less appropriate regarding the required investments compared with more traditional learning (Spanjers et al., 2015). On the contrary, it was found that there was a statistically significant difference in the extent of implementation of blended learning in terms of technology when parents' monthly income grouped student-respondents. This finding is supported by the study by Rideout & Katz (2016) that parents feel primarily optimistic about the internet and digital technology. Its use of it helps their children learn essential skills, exposes them to new ideas and information and improves the quality of education.

Findings also showed that the extent of implementation of blended learning when grouped according to teacher's profile p-values was all greater than the 0.05 level of significance. These inferred that, as perceived by the teachers, the extent of implementation of blended learning in terms of content, communication, technology, pedagogy, and assessment did not statistically significantly differ across teachers' profiles. Andrews (2020) stated that teachers must adjust a face-to-face course to blend it with an online component. Some teachers were unsure about modifying their classes for the blended environment (Freeman & Tremblay, 2013). Purposeful design, including working with an instructional designer and transformation of teaching, is supported in research (Capra, 2014; Szeto & Cheng, 2016). Moreover, Koch and McAdory (2012) indicated that sometimes there is resistance to the teaching of blended instruction by teachers who feel classroom presence is what makes a difference in teaching. Thus, teachers need to consider designing and implementing this learning modality.

The implementation of the blended learning resulted in an outstanding rating of the students' academic achievement in science. This result is supported by Bazelais and Doleck's (2018a) study that the blended learning approach leads to more conceptual change, acquisition of more skills, and higher performance. Furthermore, many academics and educators support that blended learning has the potential to make education more appealing, accessible, and effective for students. Blended learning was beneficial to students juggling careers, families, school, and those who reside in rural locations or have special learning requirements. Students benefited from the reduced classroom contact hours provided by online study materials, tests, and coaching (Deschacht & Goeman, 2015; Mutya et al., 2022). A blended learning environment improves students' performance and achievement (Dickfos et al., 2014), elevates the learning experience, creates a conducive learning environment (Azizan, 2010; Wai & Seng, 2014), and allows experiencing a conceptual change Bazelais and Doleck (2018b).

Lastly, a significant relationship between the extent of implementation of blended learning and the students' academic achievement in terms of communication, technology, and pedagogy does not affect the academic achievement of the SHS students. In contrast, in terms of content and assessment, it affects their academic achievement. These reveal that improvement must be made to achieve positive implementation of blended learning in SHS students in science. Bazelais and Doleck (2018a) mentioned that the blended learning approach leads to higher achievement. In terms of assessment, the correlation coefficient r=0.128 signifies a low positive relationship between the extent of implementation of blended learning in terms of assessment and academic achievement. Low positive means that the connection between the said variables is that the improvement in the students' academic achievement is weakly connected to the extent of implementation of blended learning in terms of assessment. This result is supported by Umar (2018), that assessment is quite favorable for the subjects' academic achievement. On the contrary, there was no significant relationship between the extent of implementation of blended learning in terms of communication, technology, and

pedagogy. Khalid (2015) revealed that blended learning was beneficial in students learning endeavors in providing comfort during assessment and facilitating peer discussion. With online and modular assessment, students can balance their workloads and assess at their most convenient time or conducive to learning.

CONCLUSION AND RECOMMENDATION

In summary, this study has been conducted to investigate the extent of implementation of blended learning in SHS science education as to the content, communication, technology, pedagogy, and assessment vis-à-vis students' academic achievement. This study revealed that the extent of implementation of blended learning in SHS science education was perceived as moderately implemented by the students and teachers. As to the students' profiles, there was a significant relationship between the extent of implementation of blended learning in terms of technology to the parent's monthly income. There was no significant difference in the extent of implementation of blended learning across all variables as perceived by the teachers. After implementing blended learning, the student's academic achievement in science was outstanding, and a significant relationship between the extent of implementation of blended learning in terms of content and assessment to their academic achievement. The students successfully acquired the learning competencies in science classes despite the pandemic (Seage & Turegun; 2020; Suma et al., 2020). Several things should be considered in implementing blended learning in the new normal education. Students' and teachers' involvement in the implementation is essential for improving the modality. Researchers may use the results of this study as a springboard for related research works in the future.

In view of the study's findings, the school administrators may consider undertaking specific plans and activities such as the need for teachers to attend training, seminars, and workshops related to blended learning implementation in terms of content, communication, technology, pedagogy, and assessment. Teachers are encouraged to incorporate intervention strategies to meet the needs of each learner. They may enhance their effective teaching strategies and techniques by implementing the blending learning approach. Students may enhance their learning engagement and involvement with the aid of the blended learning modality implemented. Researchers may use the results of this study as a springboard for related research works in the future.

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