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BLENDED LEARNING APPROACH AND THE PERFORMANCE OF SENIOR HIGH SCHOOL STUDENTS IN MATHEMATICS

Madelyn Grace B. Patron

ABSTRACT

In complying to quality standards prescribed in the new normal period, SBINHS-Main will carry out its programs, projects, activities with compassion and understanding. Therefore, the Learning Continuity Plan is crafted to effectively address the needs of all learners employing various innovative strategies. The learning modalities that the school adopt are Modular Distance Learning where learners use self -learning modules in print or electronic copy, and teachers take the responsibility of monitoring the progress of the learners while in online distance learning, learners use various technologies accessed through the internet.As the school continue to confront the issues brought about by the pandemic, San Buenaventura Integrated National High School Main and Annex is addressing challenges through the Learning Continuity Plan. The field of Senior High School is one of the most rapidly evolving fields in education. Newer teaching methods are being evaluated and incorporated in secondary. One of the promising new methods is the blended learning approach that may involve an instructional sequencing, where online instruction precedes the group meeting, allowing for more sophisticated learning through discussion and critical thinking. This descriptive method and quasi-experimental research design were utilized in this study to determine the level of modular distance learning and online distance learning on the performance in mathematics, the level of mathematics performance of the students and the relationship between these challenges and issues in the use of blended learning approach in teaching mathematics and the mathematics performance of the students.

INDEX TERMS: *blended learning, modular distance learning, online distance learning, performance in mathematics*

1. INTRODUCTION

This time of pandemic teachers are finding what is essential in the field of education. Department of Education mandated the different learning platforms that can be used for the Learning Continuity Plan, two of them was Online Distance Learning and Modular Distance Learning. E-materials are part of a new trend, the so-called blended learning, a new teaching method combining physical and virtual sources. Besides the classical presentation of the material, the students have access to electronic material such as videos, presentations, electronic worksheet, and educational software's like Geogebra. These materials can be attained through web-application accessible not only through tablets and smartphones. Now days, almost every student owns smartphones with an internet connection which allowed an individual approach to electronic materials. Teachers can thus exploit the potential of ICT in the teaching of mathematics.

With the administration of K-12 program on the Philippine education system – which aims to "enhance learners' basic skills, produce more competent citizens, and prepare graduates for lifelong learning and employment" (K12 Philippines, 2015) – teaching Mathematics becomes more of a challenge. These days, it is not unusual to find a wide range of abilities in a single classroom – from students struggling to grasp new concepts, to those who are way ahead of their peers from day one (Mathseeds, 2018). Teaching approach plays a valuable role for determining how students learn on such environment.

Mathematics teachers in Grade 11 of San Buenaventura Integrated National High School use various instructional approaches in handling their class. The main and annex branch has only two Mathematics teachers for each of their Garde 11 which makes them shoulder the sole responsibilities of strengthening the students' knowledge in Mathematics for their upcoming Grade 12 class, particularly about Calculus. Knowing how the teachers' instructional approaches affects the students' Mathematics performance and how the students perceive these approaches are the main goals of the study. With that in mind, the teachers must find the most suitable style for the lesson content, but more importantly, a style which will suit all learners and allow them to benefit from the teaching (Essays UK, 2018).

1.1 Objectives of the Study

This study determined the level of online distance learning and modular distance learning in the performance in mathematics Grade 11 students at San Buenaventura Integrated National High School-Main. Specifically, the study sought to determine level of performance in mathematics of the groups of respondents on the Pre-test and Post-test assessment in terms of blended learning approach. Furthermore, the study determined the significant difference between the level of performance pre-test and post-test in mathematics to Blended Learning Appraoch.

2. LITERATURE REVIEW

Traditional education method, also known as conventional education or teacher-centered approach, is still widely used in schools. According to Cambridge Centre for Sixth-form Studies or CCSS (2017), the old-fashioned way of teaching was all about recitation, for example students would sit in silence, while one student after another would take it in turns to recite the lesson, until each one had been called upon. The teacher would listen to each student's recitation, and they were expected to study and memorize the assignments.

In contrary, the modern teaching method is a learner-centered and activity-based teaching method which is used to get learners fully involved (Asaolusam, 2016). This approach recognizes the learner as the primary reason for curriculum planning and teaching. It is called a constructivist approach because it enables the learner to construct her/his knowledge and skills through active participation in the teaching-learning process.

This strategy builds on the more traditional use of blended learning approaches as defined in the literature (Gilboy et al. 2015), by promoting non-linear learning opportunities. In a school where absences are frequent due to extra-curricular activities, the ability for students to catch up on work was considered a benefit. This affordance is significant in mathematics classrooms due to the hierarchical nature of the subject and the misconceptions that can occur if foundational concepts are not understoodAccording to Zapalska and Dabb (2002), cited by Wilson (2012), an understanding of the way students learn improves the selection of teaching strategies best suited to student learning. Choosing what activities to include in a class is not an easy task and teachers tend to include activities based on their teaching styles and sometimes students are not included in these decisions (Samperio, 2017).

Academic performance, as defined by Amasuomo (2014), is the outcome of education; it is the extent to which a student, teacher or institution has achieved their educational goals. Thus, performance is characterized by performance on tests associated with coursework and the performance of students on other types of examinations.

According to (Adams Becker et al. 2017) blended learning designs were one of the short-term forces driving technology adoption in higher education in the next 1-2 years. Also, blended learning is one of the key issues in teaching and learning process.

Teacher will be most interested in the relationship between content, learners and technology. (Richardson et al. 2012). Understanding the of the dynamic and adaptive nature of blended learning system approach allows someone new to blend learning to consider key interacting components at work as they create and offer a blended learning course or program.(Wang et al. 2015, p. 390).

Blended learning forces us to consider the characteristics of digital technology, in general, and information communication technologies (ICTs), more specifically. Floridi (2014) suggest an answer that digital ICTs can process information on their own, in some sense just as humans and other biological life. ICTs can also communicate information to each other, without human intervention, but as linked process designed by humans.

According (Means et.al. 2013) as well as an improvement in students' sense of community when compared to face-to-face courses. Those who have been most successful at blended learning initiatives stress the importance of institutional support for course redesign and planning (Moskal et al. 2013).

Blended learning environments and its relationship to learning effectiveness (Bernard et al. 2014). Each of these studies has found small to moderate positive effect sizes in favour of blended learning when compared to fully online or traditional face-to-face environments.

Many studies have examined online learning from the students' perspective, but less attention has been paid to the experience of the teacher in online learning (Cleveland-Innes & Garrison, 2012). Assumptions have been made about teacher practice in designing and delivering online learning that may not be fully realized (Cleveland-Innes&Garrison).

Digital technologies offer other innovative ways for students to learn and engage with mathematics through their capacity to enable learning anywhere and anytime through blended approaches, as well as the ability to capture, annotate and share multimedia. There are a range of pedagogical opportunities and implications afforded by the use of digital technologies that extend beyond the nature of the tools and software apps utilised, to the learning intentions of the teacher and the ways in which students interact with the technologies and with each other (Calder et al. 2018). Each of these implications creates opportunities to influence the teaching practice in mathematics classrooms. Digital devices provide tools that are dynamic, graphical, and interactive, providing students with opportunities to "explore mathematical objects from different but interlinked perspectives, where the relationships that are key for mathematical understanding are highlighted, made more tangible and manipulable" (Hoyles and Noss 2009, p. 132). Students can make practical use of technology in mathematics for "genuine and productive purposes, rather than for the application of rote-learned formulae and procedures to contrived scenarios" as would be typical in traditional mathematics classrooms (Bray and Tangney 2017, p. 257).Distance learners, synchronous webconferences can reduce impersonality and a sense of isolation (de Freitas & Neumann, 2009) which are not addressed through asynchronous learning (Schullo et.al.,2005). The building of trust, rapport and a sense of personal belonginess in learners (Falloon, 2011;, Jones,&Cheng, 2009)can enhance collaboration and success.

According to (Zickuhr & Raine, 2014). The use of computers, mobile devices, and the Internet is at its highest level to date and expected to continue to increase as technology becomes more accessible, particularly for users in developing countries.

In addition, there is a growing number of people who are smartphones for Internet access rather than more expensive devices such as laptops and tablets. Greater access to and demand for technology has presented unique opportunities and challenges for many industries, some of which have thrived by effectively digitizing their operations and services and other that have struggled to keep up with the pace of technological innovation. (Anderson&Horrigan, 2016).

Organizational barriers to technology adoption are particularly problematics given the growing demands and perceived benefits among students about using teachnology to learn. (Amirault , 2012).

Blended learning approach combines online and face-to-face teaching. Flipped learning is considered by some as a separate approach, yet others consider it as a specific model of blended learning that has a clear delineation between online and face-to-face instruction (Borba et al. 2016; Polly and Casto 2019). At its most basic, the flipped classroom approach is intended to make better use of classroom time. Rather than expose students to new materials within mathematics lessons, students are expected to access pre-prepared materials before their lessons (Gilboy et al. 2015; Lo and Hew 2017). Pre-learning occurs outside the classroom and class time is then used to maximise opportunities for teacher/student interaction, collaboration, provision of remediation, and application of the learning that occurs off-site (Bhagat et al. 2016; Weinhandl et al. 2018). The flipped learning approach includes variations that range from the simple provision of direct instruction via the use of video lectures, through to an approach where learning can be individualised according to student needs (Lai and Hwang 2016). Pre-prepared lesson materials can range from teacher-produced videos and screencasts to the provision of mathematics resources produced with software such as *GeoGebra* and the use of instructional videos created by others such as Khan Academy and WooTube. To date, research on the flipped learning approach has predominantly been conducted within the field of tertiary education (Zainuddin and Halili 2016), and studies that interrogate the pedagogical practices that have emerged from flipped learning in secondary mathematics classrooms and the resulting students' perceptions are limited.

Blended learning approaches such as flipped learning have several benefits that may potentially address some of the significant issues in mathematics education. Firstly, emerging research documents an improvement in student engagement due to the anywhere, anytime affordance of flipped classrooms (Cronhjort et al. 2018; Huang et al. 2018). The approach provides students with greater autonomy in their learning and makes mathematics learning

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accessible for those who may wish to revise challenging or difficult content (Muir and Geiger 2016). Decreasing the need for whole class explicit teaching within every lesson allows the teacher to work more effectively to address the learning needs of individual students. However, as with most approaches, there are disadvantages to the flipped approach. An early study exploring the introduction of iPads in primary mathematics classrooms found the flipped model did not work well in one Grade 3 classroom due to the level of maturity of the students, their self-regulation, and a mismatch between the mathematics content embedded within the flipped approach and the students' levels of conceptual understanding (Attard and Curry 2012). A later review of flipped learning approaches by Abeysekera and Dawson (2015) critiqued the approach across all levels of education, claiming a lack of evidence as to its effectiveness. This issue related to the difficulty in tailoring the information to the individual needs of students and the ability of students to take responsibility for their learning outside the classroom. The success of a flipped approach relies on the willingness of students to actively engage with the materials before attending their classes as well as their ability to comprehend the information presented. Having unprepared students may result in unproductive classroom time.

While flipped and blended learning approaches provide students with the opportunity to access mathematics content outside of school, it could be argued that traditional textbooks do the same. However, the affordances of digital technology can promote higher levels of interaction, a more personalised approach and more detailed feedback (Attard and Holmes 2020a, 2020b). Even so, Polly and Casto (2019) caution "In a blended learning environment where students engage with technology, exposure to cognitively demanding tasks is not guaranteed" (p.286). Polly and Casto also claim there are widely held beliefs that teachers of mathematics tend to use technology to focus on low level skills rather than activities that promote higher-order thinking. The success of blended learning approaches is also heavily reliant on the teacher, his or her pedagogical content knowledge, and the practices and interactions that occur during classroom time, with or without technology. Similarly, the teacher's affinity with digital technology and their technology-infused practices are a critical influence on whether digital technology does improve access, engagement and learning in mathematics (Attard 2018).

In addition, students report that Facebook helps them stay engaged in learning through collaboration and interaction with both peers and instructors. (Bahati, 2015). Which is evident in Facebook posts where students collaborated to study for exams, consulted on technical and theoretical problem solving, discussed course content, exchange learning resources, and expresses opinions as well as academic success and challenges. (Bowman 7 Akcaoglu, 2014).

In terms of emotional engagement, studies suggest that students feel positively about being part of a course-specific Facebook group and that Facebook is useful for expressing feelings about learning and concerns for peers, through features such as the "like" button and emoticons. (Bowman & Akcaoglu, 2014).

In the teaching and learning of mathematics, we encounter problems that are difficult to solve in a face-to-face teaching framework for the beginners. They may lack the interest, motivation and positive attitude, some are not intended to specialize in it, and thus, they pay little or no attention to understanding basic mathematics concepts(Abramovitz, Berezina, Bereman,& Shvartsman, 2012). Therefore, utilizing a blended learning approach can improve learners' interest and positive attitude. Blended learning facilities active learning and interactivity between learners and the mediator in the learning environment. Also, the use of blended learning helps to diversify the instructional delivery in mathematics curriculum, as well as, exploring the benefits of web-based technologies in mathematics education(Awodeyi, Akpan, & Udo, 2014).

Technology use can potentially drive disruption in mathematics education which is imperative given the international concerns about student disengagement and falling enrolments in senior mathematics courses (Thomson et al. 2017). However, for a range of reason, teacher resistance to technologically driven innovation within classroom teaching is not uncommon. Tangney and Bray (2013) suggest that although the affordance of digital mobile technologies align with a social constructivist teaching approach that promotes collaboration, communication, creativity, and problem-solving, technology use overwhelming continues to be restricted to content consumption, resulting in a regression towards a traditional approach of teaching mathematics(Attard 2015; Orlando and Attard 2016).

Integrating digital technologies effectively into mathematics Mathematics is usually taught using non-traditional method, often called as modern approach, and constructivism serves as its basis; this implicates strategies in which the individual is making sense of his

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or her universe (Tularam, 2018). In a modern classroom setting, the student is an active participant, which allows an individual to develop, construct or rediscover knowledge – a major goal that can be very time-consuming process if taken literally for each student.

The finding of the study by Lagura (2016) revealed that activity-based approach in terms of game show, quiz bee, talk show, drama and musikahan are all very satisfactory as perceived by the respondents. Moreover, when respondents are subjected to the activity-based learning strategies, post-test results revealed that many of the students rose to excellent level as evidenced by the increased of total scores from pre-test to post-test.

Integration of technology in instruction seems to be the norm in today's classroom. Computer supported hybrid teaching, according to Zhang and Jiao (2011), was more effective for teaching geometry-related topics. In terms of the students' performance, they found out that medium- and low-performance students benefited more from the computer supported hybrid teaching. The traditional teaching was more Kenney and Newcombe (2011) did their comparison to establish effectiveness in view of grades and found that blended learning had higher score than the non-blended learning environment. Comparison between blended learning environments have been done to establish the disparity between academic achievement, grade dispersion and gender performance differences and no significant differences were found between the groups (Demirkol & Kazu, 2014).

Sehraim & Khlaif (2010) note in their research that 75% of students and 72% of teachers were lacking in skills to utilize ICT based learning components due to insufficient skills and experience in computer and internet applications. And this may lead to failure in e-learning and blended learning. It is therefore pertinent that since the use of blended learning applies high usage of computers, computer competence is necessary.

Technology has become powerful allies of students and teachers in many inclusive classrooms. At equipment can facilitate inclusion of students with disabilities by making previously difficult or impossible tasks feasible. (Dichev & Dicheva, 2017) associated with using a new technology. Finally, many studies lack adequate details about learning activities, raising question about whether poor instructional design may have adversely affected results.

(Kim et al., 2015), which helped student practice applying knowledge. In addition, studies show that students perceive Twitter and Facebook to be primarily for social interaction (Camus et al., 2016; Ross et al., 2015), which may make these technologies viable tools for sharing resources, giving brief opinions about news stories pertaining to course content, or having casual conversations with classmates rather than full-fledged scholarly discourse.

Incentivize students to use technology, either by assigning regular grades or extra credit. The average participation rates in voluntary web-conferencing, Facebook, and Twitter learning activities in studies we reviewed was 52% (Andrew et al., 2015)

Hung (2007), Liu(2010), Wang and Yu (2012), and Wiginton (2013) have found that blended learning method is more effective in terms of academic achievement than traditional methods. The reason may be that in teacher-based learning, students cannot progress at their own pace, and if they become distracted, it is difficult to catch up on what they have missed. When each student has their own computer with access to teaching resources, they can control their learning progress and they need and repeat exercises to understand the content. Online assessment and immediate feedback can help to improve learning effectiveness.

suitable for the high-performance students. The student-centered hybrid learning requested significant more teaching hours to facilitate effective learning results.

In a report by Oxford Group (2013), some learners (16%) had negative attitudes to blended learning while 26% were concerned that learners would not complete study in blended learning. Learners are important partners in any learning process and therefore, their backgrounds and characteristics affect their ability to effectively carry on with learning and being in blended learning, the design tools to be used may impinge on the effectiveness in their learning.

The introduction of blended learning (combination of face-to-face and online teaching and learning) initiatives is part of these innovations but its uptake, especially in the developing world faces challenges for it to be an effective innovation in teaching and learning. Blended Learning effectiveness has quite a number of underying factors that pose challenges. One big challenge is about how users can successfully use the technology and ensuring participants' commitment given the individual learner characteristics and encounters with technology (Hofmann, 2014).

teaching and learning is a complex task requiring the consideration of many elements including pedagogy, content and student learning. Uses of digital technologies in mathematics can be ineffective, distracting, or even dangerous when not integrated into

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the learning process in meaningful ways (Attard 2015; Freeman et al. 2017). Online learning environments provide affordances that could allow mathematics teachers to redefine practices as they currently occur in mathematics classrooms, disrupting traditional methods to mediate meaningful student-student and student-teacher interactions through blended and flipped learning approaches.

Kenney and Newcombe (2011) did their comparison to establish effectiveness in view of grades and found that blended learning had higher average score than the non-blended learning environment. Garrison and Kanuka (2004) examined the transformative potential of blended learning and reported an increase in course completion rates, improved retention and increased student satisfaction. Comparisons between blended learning environments have been done to establish the disparity between academic achievement, grade dispersions and gender performance differences and no significant differences were found between the groups (Demirkol & Kazu, 2014).A study conducted by Balliu and Benshi (2017) found out that 60% of their respondents, which are Albanian teachers, stimulate their students' active learning by using student-centered teaching. On the other hand, teacher-centered teaching is used by about 30% of the teachers. Interactive methods and the methods where the students act as the leader are the most liked ones.

The study by Kintu and Zhu (2016) investigated the possibility of blended learning in a Ugandan University and examined whether student characteristics (such as self-regulation, attitudes towards blended learning, computer competence) and student background (such as family support, social support and management of workload) were significant factors in learner outcomes (such as motivation, satisfaction, knowledge construction and performance). The characteristics and background factors were studied along with blended learning design features such as technology quality, learner interactions, and Moodle with its tools and resources. The findings from that study indicated that learner attitudes towards blended learning were significant factors to learner satisfaction and motivation while workload management was a significant factor to learner satisfaction and knowledge construction. Among the blended learning design features, only learner interaction was a significant factor to learner satisfaction and knowledge construction.

In this paper, we explore the perceptions of teachers and students from a study of four Australian secondary mathematics classrooms conducted prior to the COVID-19 pandemic. Data informing this paper is drawn from a larger multiple case study of 10 Australian mathematics classrooms ranging from pre-school to Year 12 (see Attard and Holmes 2020a; Attard and Holmes 2020b). Results of the study indicated interesting commonalities across the four secondary case study classrooms relating the varied blended learning approaches and uses of learning management systems (LMS). Little research relating to the perceived influence of LMS within mathematics classrooms currently exists yet the use of such systems has now become more common as a result of the forced shift to online learning during the COVID-19 pandemic. This has made it important to understand how blended learning strategies and LMS are being utilised and how teachers and students perceive their influences on the mathematics learning experience.

To this paper, we explore the practices of four secondary mathematics teachers concerning the strategies and effects of blended learning approaches. We investigate how their nuanced pedagogical approaches specifically influenced how mathematics learning resources were made accessible to students and, as a result, how they influenced students' experiences of secondary mathematics education. A clearer understanding of the intricacies involved in blended learning in mathematics and the related perceptions of teachers and students will provide insights for researchers, teachers, and pre-service teacher educators as we begin to understand the evolving educational landscape post COVID-19. These insights may assist educators in developing methods that are helpful in improving students' access to elements of mathematics education such as learning resources, regardless of device or software, and the ways they redefine learning spaces and teaching practice. Further, the insights may provide new and valuable pathways for research in mathematics education.

There are multiple factors related to student underachievement and disengagement in mathematics. One reason for the decline stems from the gaps in knowledge that occur when students fail to learn or understand critical mathematical concepts (Hoyles 2016). One common factor is the fast pace of learning that is typical in secondary schools Hallam and Ireson 2005) which can result in these gaps in conceptual understanding, leading to student disengagement and their failing to continue the study of mathematics beyond the compulsory years, potentially limiting life and career opportunities. Expectations of improved student engagement through the use of digital technologies is widely reported in literature (e.g.,

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Beavis et al. 2015; Bray and Tangney 2015; Pierce and Ball 2009), so it is clear that we need to understand if and how the use of technology-related practices contribute to student engagement with mathematics (Attard and Holmes 2020

Burke (2011) studied about the group work and its use towards effective outcomes. The study discussed about the use of group work setup in higher education. The paper found out that not only prospective employers aim to develop a dynamic teamwork skills specially for fresh graduates,

Students themselves found that participation in a collaborative learning environment provide them generally higher academic marks, and motivating them to continue their study all the way to tertiary level. Thus, collaborative learning can be seen as an influence of academic achievement and academic motivation for secondary school students.

On the elementary learner's level, Bancroft (2010) also stressed the potential benefits of collaborative approach to teaching. In her study focusing on the enhancement of student achievement through cooperative learning, she found out that elementary schools gained good outcomes when they transform their classrooms to a setup that promotes working together in a cohesive education situation.

Sitorus & Surya (2017) conducted a pseudo experiment to assess whether collaborative learning through the use of games tournament can influence students' creativity in learning Mathematics. They found out that more than half of positive progress of students' creativity in the said subject can be accounted through the utilization of games tournament, while the other percentage can be traced to other factors not tested in their study.

In 2009, Goyak analyzed the effects of cooperative learning approach vis-à-vis lecture approach in the classroom. The researcher focused on the students' perception on their learning atmosphereand their higher order thinking skills. The study's results indicated that substantial higher means were achieved in the cooperative learning group, suggesting that cooperative learning approaches have direct benefit in the tertiary-level classrooms.

Zakaria et.al (2014) studied about the effects of collaborative learning styles of high school learners' mathematical performance in Indonesia. Their study focused on determining the perception concerning cooperative learning through pre-test and posttest. The findings revealed that there isimportant and crucial difference among the learners' mathematical achievement which can be accounted to the groups' increased comprehension and self-confidence on the part of the learners.

Sung,et. al. (2017) studied the effects of collaborative learning in mathematics using mobile computer supported activities. The paper examined the scope of using active and collaborative learning and their difference with traditional lecture to promote key skills for learners preparing to become engineers – modeling, problem-solution skills, communication proficiency,and collaborative teamwork participation. The findings indicated that collaborative method is well-backed by statistics and substantial indicators that student learns greater in a collaborative approach and environment. This is evident regardless of other factors being considered in the controlled experiment context.

Russo (2014) compared the effects of a cooperative learning strategy using quantitative research design. The study targeted the perceptions of pre-service teacher that used cooperative learning approach in their classrooms. The post- test results of the experiment unit were remarkably higheras shown by the research findings. This finding came in spite of putting into consideration the individual learner's differences in the way they perceived the lessons.

Tran (2013) studied about collaborative learning outcomes in contrast with the traditional teaching methods in Vietnam. The paper focused on the three theories that supports collaborative learning – social interdependence theory, who have higher academic engagement tend to have higher academic performance in Mathematics. Conversely, the lower mathematical ability is the lower in their academic performance.

Blatchford, Bassett, & Brown, (2011) as cited by Al Munnr Abubakar (2017), their study analyzed those impacts about class measure around classroom engagement instructor's testament pupil cooperation and contrasts On connection to pupil former accomplishment grade also optional schools. It is generally perceived that we need to know more something like the impacts of class extent around classroom association what's more person conduct. Those examine extends eventually tom's perusing thinking about the impact of scholar classroom engagement also an instructor testament learner interaction, also looking at on impacts change toward person accomplishment level. Classroom engagement diminished for bigger classes, but, opposite will expectation, this might have been especially stamped two more levels achieving learner at those optional levels low achieving pupils subsequently, profit from smaller classes at the optional level as far as additional unique consideration also encouraging engagement over learning.

All the reviewed literature and studies explained the concept of gamification and collaborative learning. However, the present study dealt on the use of gamification with exposure to collaborative learning environment in teaching mathematics to essential problem solving skills and motivation of Grade 10 students.

3. METHODOLOGY

Descriptive research and quasi – experimental design will be used in this study. The former will be used to assess the level of acceptability of blended learning approach with Online Distance Learning and Modular Distance Learning while the latter will be used to determine the would-be effect of blended learning approach in the performance of Senior High School students in Mathematics of San Buenaventura Integrated National High School (Main and Annex), S.Y. 2020 – 2021.

Descriptive research is a methodology that seeks to describe the characteristics or behavior of an audience (McNeill, 2018). Its purpose is, of course, to describe, as well as explain, or validate some sort of hypothesis or objective when it comes to a specific group of people. There are three main methods of descriptive research.

This study was implemented to 60 Grade 101 students of San Buenaventura Integrated National High School- Main during the third quarter grading of school year 2020-2021. There were two sections selected in cluster sampling procedure composed of 40 students in each. They were grouped heterogeneously were given pre-test and posttest to determine the level of modular distance learning and online distance learning. A random sampling technique in selecting the two sections under study was used in consideration of the Learner Information System in Department of Education as strictly followed by the school, San Buenaventura Integrated National High School-Main. To gather the relevant data on this study, the research instruments were constructed parallel to the design of the study. Since this research is an descriptive quasi experimental design that focused on the use of of ble blended learning approach in terms of online distance learning and modular distance learning made Daily Lesson logs, a self–made pre-test and posttest in measuring the level of performance in mathematics of the grade 10 students in Mathematics, and self-made survey- questionnaire to know the motivational level of the students in learning Mathematics as to goal setting and task cognitive perspective, and the social learning theory. The research found out that all theories give logical and empirical support in favor of collaborative learning, which provides answers for academic, social, and psychological improvement of the learners. The findings highlight the complementary nature of applied cooperative approach in classroom, supporting reciprocal interaction between learners inside and outside the group structure.

Adams (2013), in his review about cooperative learning in classrooms, noted that the variety of cooperative and collaborative learning approaches will force educators to thoroughly select, plan, and structure suitable for their learners' needs. In addition, the dynamics of teaching must be carefully appropriated from lesson planning to assessment and evaluation. All in all, the paper provides confident conclusion that collaborative approach, if properly and regularly utilized, will result in greater academic outcomes.

Frianto, et. al. (2016), in their study about application of collaborative models of learning, activities that have team games, and their effects on motivation and social learning outcomes, found out that such models, when implemented in an experimental class setting, can have great enhancements on the learners' social learning and motivation.

It depends on many skills and factors which therefore makes it challenge both to learn and to teach. If the instructor understands of the process is limited, difficulties in teaching mathematical problem solving, will arise. Hence the great need to understand these factors and skills if we want to help our students acquire this important process. Basic mathematical skills such as solving equations and inequalities are necessary for mathematical problem solving. Formulating a problem can be very demanding but simplifying and solving the equation obtained, for example, is necessary to answer the question in the problem. Students who cannot manipulate algebraic expressions will definitely have difficulties in problem solving. Critical thinking is needed in all steps of problem solving. Students do not look back critically at the solution of a problem once it is solved. They tend to accept whatever answer they have obtained. Critical thinking is needed when extracting information from the text of the problem, formulating and solving the problem and analyzing the solution obtained.

According to Franciliso (2002), as cited by Ponce (2014), the academic engagement and academic performance of the students go together. It further implied that the studentsaccomplishment. Self-made survey-questionnaire to know the motivational level of the students in learning Mathematics as to goal setting and task accomplishment. Before the implementation of the designed online distance learning and modular distance learning in collaborative set-up, the two groups of students took pre-test to assess the prior knowledge of the students toward Statistics and Probability. In response to the statement of the problems set in the study, different statistical tools were utilized to effectively analyze the results of the study. The mean, standard deviation, frequency percent, cohens D, Mann Whitney and Rank biserial are to be used to measure the pre-test and posttest scores of the respondents to identify the level of proficiency of the students in problem solving. To determine how motivated the students are when exposed to two different learning environments as to online distance learning and modular distance learning on collaborative learning and conventional learning, the study utilized mean, standard deviation and the verbal interpretation referred to its Likert Scale. To determine whether there is significant difference between the pre-test and posttest scores of the respondents in each group, paired t-test was utilized. And to determine whether there is significant difference between pre- test, posttests and motivational level, independent t-test was used.

3. RESULTS AND DISCUSSIONS

On the basis of the data gathered, the following are the results of the study with regards to the pre-test and post test scores of the group exposed to Online Distance Learning and Modular Distance Learning. It refers to the level of proficiency in terms of understanding and assessment as revealed in the following table, which shows the interval of ratings, frequency and percentage of frequency, overall mean, standard deviation, and verbal interpretation.

This chapter is about the discussion on the data about the status of modular and online learning modalities and their effect on the performance of the students on selected topics in mathematics.

Table 1 is about the status of online learning classes. Based on the results, it has an overall mean of 3.36 and a verbal interpretation of sometimes. It appears that students would sometimes prefer online learning because of access to online materials, of the amount of learning that they can have, of the good fit with their schedule and of their learning style which has a better fit with online learning. These are reflected by the statements, "Online learning enables me to attend classes more frequently (*Mean* = 3.57, *SD* = 0.77)," "Online learning works well with my schedule (*Mean* = 3.50, *SD* = 0.94)," and "I prefer online learning than modular distance learning (*Mean* = 3.43, *SD* = 0.90)."

Table 1. Status of Online Learning

	Levels	Mean	SD	Verbal Interpretation
1	In a course with both traditional and online methodologies, I learn better through online learning.	3.33	1.06	Sometimes
2	I prefer online learning courses to traditional courses.	3.31	1.04	Sometimes
3	I believe that I can learn the same amount in an online learning class as in a traditional course.	3.00	1.08	Sometimes
4	I believe that I can learn more or would learn more through online material.	3.37	0.96	Sometimes
5	I prefer online learning than modular distance learning	3.43	0.90	Sometimes
6	Online learning saves me time.	3.37	0.96	Sometimes
7	Online learning works well with my schedule.	3.50	0.94	Sometimes
8	Online learning enables me to attend classes more frequently.	3.57	0.77	Sometimes
	Overall Mean	3.36		Sometimes

Legend: 4.20 – 5.0 = Every time; 3.40 – 4.19 =Almost every time; 2.60 – 3.39 = Sometimes; 1.80 – 2.59 = Rarely; 1.00-1.79 = Almost Never

The least of the indicators which tells that online learning is sometimes preferred by the students is the statement, "I believe that I can learn the same amount in an online learning class as in a traditional course

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(*Mean* = 3.00, *SD* = 1.08)."

The results of the status of modular learning are shown in Table 2. Its status has an overall mean of 3.53 with an interpretation of almost every time. It is clear that based from this result the students would prefer, almost every time, modular learning because of its appropriate physical learning resources, structure, content, objectives and assessment and the feedback. All of these find support from the statements, "I was able to obtain guidance from staff to support my studies when needed (*Mean* = 3.63, *SD* = 0.81)," The aims and learning outcomes of the module were made clear to me (*Mean* = 3.63, *SD* = 0.89)," "I was provided with timely and helpful information and guidance on the assessment requirements and criteria (*Mean* = 3.63, *SD* = 0.93)," and "The module was well organized (*Mean* = 3.63, *SD* = 1.03)." Although the students would prefer modular learning almost every time and they were satisfied with the quality of the module, these had the least impact on their preference on modular learning. This is supported by the statements, "I was provided with timely and helpful information and guidance at the start of the module (*Mean* = 3.30, *SD* = 1.09)" and "Overall, I am satisfied with the quality of the module (*Mean* = 3.30, *SD* = 1.09)."

Table 2. Status of Modular Learning

	Levels	Mean	SD	Verbal Interpretation
1	I was provided with timely and helpful information and guidance at the start of the module.	3.30	1.09	Sometimes
2	The aims and learning outcomes of the module were made clear to me.	3.63	0.89	Almost every time
3	The physical accommodation for the module was appropriate	3.57	1.04	Almost every time
4	The learning activities on the module helped me to learn.	3.50	1.14	Almost every time
5	The teaching on the module helped me to learn.	3.57	0.97	Almost every time
6	The learning materials provided on the module were helpful.	3.50	1.04	Almost every time
7	The module was well organized.	3.63	1.03	Almost every time
8	I was provided with timely and helpful information and guidance on the assessment requirements and criteria.	3.63	0.93	Almost every time
9	I was able to obtain guidance from staff to	3.63	0.81	Almost every time

	support my studies when needed.			
10	The physical learning resources for the module were appropriate.	3.53	0.90	Almost every time
11	The module was intellectually stimulating and stretched me.	3.40	1.00	Almost every time
12	I received timely and helpful feedback on my learning in the module.	3.57	1.14	Almost every time
13	The module helped to develop my personal skills and qualities.	3.30	0.99	Sometimes
14	Overall, I am satisfied with the quality of the module.	3.30	1.09	Sometimes
	Overall Mean	3.53		Almost every time

Legend: 4.20 – 5.0 = Every time; 3.40 – 4.19 =Almost every time; 2.60 – 3.39 = Sometimes; 1.80 – 2.59 = Rarely; 1.00-1.79 = Almost Never

Although it appears that the students would prefer modular learning almost every time and satisfied with the quality of the module, these had the least impact on their preference on modular learning. This is supported by the statements, "I was provided with timely and helpful information and guidance at the start of the module (*Mean* = 3.30, *SD* = 1.09)" and "Overall, I am satisfied with the quality of the module (*Mean* = 3.30, *SD* = 1.09)."

Table 3 is about the level of performance of the students in the pretest and posttest. The level of performance of the students in these tests is Beginning as reflected by the results. The 83% of the students in online learning showed this kind of performance in pretest and 60% of them had this type of performance in the posttest. On the other hand, 100% of students in modular learning showed the same level of performance in the pretest and 83% in the posttest.

Table 3. Level of Performance in Pretest and Posttest

Levels	Online Learning				Modular Learning			
	Pretest		Posttest		Pretest		Posttest	
	f	%	f	%	f	%	f	%
Beginning (74% and below)	25	83.33	18	60.00	30	100	25	83.33
Developing (75 - 79%)	2	6.67	6	20.00	0	0	4	13.33
Approaching Proficiency (80 84%)	1	3.33	3	10.00	0	0	1	3.33
Proficient (85-89%)	1	3.33	1	3.33	0	0	0	0.00
Advanced (90% and above)	1	3.33	2	6.67	0	0	0	0.00
Total	30	100	30	100	30	100	30	100

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On the other hand, 100% of students in modular learning showed the same level of performance in the pretest and 83% in the posttest.

The parametric t - test for significant difference between pretest and posttest is shown in Table 4. It shows that the difference in the mean scores of the tests of students under online learning, *Student's t* = 19.3, *df* = 29, p = < .001, and under modular learning, *Students' t* = 5.49, *df* = 27, *p* = < .001 is significant.

Both differences are positive which suggests that there is a significant improvement in the performance of the students from both learning modalities.

Statistical evidence clearly shows that the modular learning modality has a medium effect on the improved performance of the students in the posttest, *Cohen's d* = 3.53. In the case of online learning modality, it has small effect on the improved posttest mean score of the students.

The results of non-parametric t-test for significant difference in the pretest and posttest of online and modular learning modality are in Table 5. Based on these results, the mean difference between pretests of the two groups, *Mann Whitney U* = 314, *p* = 0.097, does not vary. The positive mean difference between the two pretests does not mean that students from modular learning are better than the students from online learning modality. This means that the students from both groups have the same level of cognitive skills.

The same can be said about the results of the test for significant difference between the two posttests. There is also no significant difference between the posttests of the two groups, *Mann Whitney U* = 366, *p* = 0.216. The learning modality have a small effect on this non-significant difference, *Rank biserial correlation* = 0.187.

Table 4. Difference in the pretest and posttest of online and modular learning modality

		Statistic	p	Mean difference	Rank Biserial Correlation
PRETEST	Mann-Whitney U	314	0.097	1.41	
POSTTEST	Mann-Whitney U	366	0.216	2	0.187

p – value < 0.05 - Significant

The learning modality have a small effect on this non-significant difference, *Rank biserial correlation* = 0.187.

4. RESULTS AND DISCUSSIONS

Based on the data gathered, the following are the results of the study with regards to the pre-test and post test scores of the group exposed to Collaborative Learning with Gamification and the other for Conventional Collaborative Learning Approach. It refers to the level of proficiency in terms of understanding and assessment as revealed in the following table, which shows the interval of ratings, frequency and percentage of frequency, overall mean, standard deviation, and verbal interpretation.

This study was conducted by the research to determine the status of blended learning modality which includes modular and online learning modalities. The researcher wanted to determine if those modalities influence the performance of the students on selected topics in mathematics. The research design for this is descriptive and quasi - experimental research design. Sixty (60) Senior High School students of San Buenaventura Integrated National High School (Main and Annex) were randomly selected for this study.

The status of blended learning modality was assessed using weighted mean and standard deviation. On the other hand, the parametric and non – parametric t – test for dependent and independent samples were used to test for any significant difference between the pretest and posttest of the students from modular and online learning modalities.

FINDINGS

1. **Status of Online Learning**

The students sometimes prefer online learning because of its accessibility, the amount of learning that they can have, and it is a good fit with their schedule and their learning style.

2. **Status of Modular Learning**

The students would like to be under modular learning almost every time because of its appropriate physical learning resources, the structure, content, objectives, assessment of the module and the valuable feedback from their teachers concerning their learning assessments.

3. **Level of performance in the pretest and posttest**

The performance in the pretest and posttest of the majority of the students from the two learning modalities is Beginning, that is, their mark is 74% and below.

4. **Difference between pretest and posttest**

There is a significant difference in the pretest and posttest of students of online learning, and in the pretest and posttest of students of modular learning. There is a significant improvement in the performance of the students from both learning modalities. The modular learning modality has a medium effect on the improved performance of the students in the posttest while online learning modality has a small effect on the improved posttest mean score of the students.

Moreover, there is no significant difference in the pretests and posttests of the two groups. The non-significant difference of the pretests suggests that students from both groups have the same level of cognitive skills. Further, both learning modalities have a small effect on these results.

4. CONCLUSIONS & RECOMMENDATIONS

CONCLUSION

Since, there is a significant difference between the pretest and posttest of the students from modular and online learning modality and there is no significant difference in the pretests and posttests of the students from both groups, then statistical evidence does not completely support the hypothesis of this research. Also, either of the learning modalities can positively influenced the performance of the students in mathematics.

RECOMMENDATIONS

The following are the recommendations based on the above - mentioned findings.

1. Use either modular or online learning modality or both in teaching selected topics in mathematics since the two modalities have a medium and small effect on the performance of the students.
2. Provide students with pieces of information about the two learning modalities. The information must include the specific structure and learning design of the modalities as well as the advantages of each.

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