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The Use of an Online Learning Management System to Assess the Performance of the Students in Trigonometry

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ABSTRACT

Learning Management Systems were widely used in education, and studies have demonstrated that they boost student achievement. This study's goal was to confirm the findings of the related studies in the context of the school's online learning program. Piaget's Constructivism Learning Theory, Siemens' Connectivism Theory, and Engestrom's Activity Theory backups the process of the group of students who used the LMS and students who were exposed to modular learning. The study examined the effectiveness of incorporating a learning management system in assessing students' performance. Fifty students from a private institution in Cebu, Philippines, were the subjects of a pretest-posttest explanatory sequential mixed method. The mean, median, standard deviation, t-test for independent samples, paired t-test, and Spearman rho were used to test the null hypothesis at 0.05 level of significance. The study's findings show that the respondents did not perform well on the pretest, but they did exceptionally well on the posttest. Additionally, the study discovered that while there is no significant difference between group 1 pretest and posttest results and those of group 2, there is a significant difference between group 1's pretest and posttest results but there was no significant difference in the mean improvement of the student's scores. Respondents' attitudes toward the use of learning management systems in the classrooms were positive but there was no significant relationship between the attitude of the students towards LMS and their performance. Based on these findings, it is recommended that schools develop programs in upgrading their teachers' skills in manipulating the features of the LMS; among others, teachers should intensify efforts in the use of LMS tools in teaching Trigonometry; and that students should be provided with avenue wherein they can enhance their skills in technology and be engaged in the learning process.

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1. THE PROBLEM AND ITS SCOPE

Rationale

The pandemic has prompted the majority of educational institutions around the world to switch from traditional face-to-face learning to online distance learning as a result of COVID-19. To close the gap in the learning process, this circumstance has given institutions the chance to invest in and renew the usage of various online learning platforms and technologies. The benefits of creative thinking have allowed educational activities to expand to new heights thanks to educational technologies (Cetin and Saygili, 2021). An instrument used to provide actively remote education activities is a learning management system (LMS).

For years, most schools have used LMS to integrate educational technology and enhance communication in the learning process. LMS is typically utilized in a wide range of courses, such as those in higher education. Since then, there has been a growth in LMS utilization (Garcia et. al., 2021). In addition, the COVID-19 pandemic has led to the widespread use of the internet in schools due to the popular practice of distance learning. Some institutions still do not adopt this trend in their teaching practices because they prefer the modular learning technique, even though online technology is becoming more popular. Majority of the universities usually use online

modular learning or offline modular learning. However, no research has been done to determine the effectivity of the aforementioned LMS in assessing students' performance compared to the modular learning students use, particularly in the department where the data for this research will be gathered.

Trigonometry is a topic to be taught in the last quarter of the grade 9 curriculum. Extra-curricular activities interrupt with most of the schools' schedule and hinder teachers to finish the target topic. Due to time restrictions, some schools have not included the teaching of Trigonometry and in the case of where the research was conducted, administrators opted to move the said topic to grade 10. The delay in teaching of important concepts will greatly impact students' acquisition of the fundamentals because of the spiral progression curriculum. Hence, there will be non-inclusion of some topics to be taught in grade 10.

This study was developed to look more closely the function/s of LMS in the learning process, notably in Mathematics. When the use of online modular learning modality is contrasted with the use of LMS (Garcia et. al., 2021), the result could provide a possible standpoint to determine if the use of LMS can offer students platforms that demonstrate an active learning environment where they can participate and collaborate with their peers and teachers without being in a classroom. This is in contrast to conventional, offline modular education.

Statement of the Problem

The purpose of this study was to evaluate and compare the performance of the students using LMS as an educational tool in Trigonometry to students who were using modular distance learning, and determine student perceptions on the incorporation of LMS in teaching Trigonometry. Specifically, it aimed to answer the following questions:

1. What is the pretest and posttest performance in Trigonometry of the students:

1.1. who attended synchronous sessions with paper-pencil exams and;

1.2. who attended synchronous sessions with the customized style of the exam?

2. Is there a significant mean gain in the performance in Mathematics from the pretest to the posttest of the students:

2.1. who attended synchronous sessions with paper-pencil exams and;

2.2. who attended synchronous sessions with the customized style of the exam?

3. Is there a significant difference in the mean gain in Mathematics performance between the respondents who attended synchronous sessions with paper-pencil assessments and those who attended synchronous sessions with the customized style of assessments?

4. What is the attitude level of the respondents who attended synchronous sessions with the customized style of the exam towards the use of LMS?

5. Is there a correlation between the attitudes towards the use of and the performance in trigonometry of the respondents?

6. What is the feedback about learning trigonometry from the students:

6.1. who attended synchronous sessions with a customized style of the exam and;

6.2. who attended synchronous sessions with paper-pencil exams?

Hypotheses of the Study

The following null hypotheses were investigated to establish support for the claims made in finding solutions to the problems of the study:

H_{0_1}: There is no significant difference between the hypothetical mean and actual mean of the pretest and posttest results of students:

1.1. who attended synchronous sessions with paper-pencil exams and

1.2. who attended synchronous sessions with a customized style of the exam.

H_{0_2}: There is no significant mean gained in the mathematics performance from the pretest to the posttest of students:

2.1. who attended synchronous sessions with paper-pencil exams and

2.2. who attended synchronous sessions with a customized style of the exam.

H_{0_3}: There is no significant difference in the mean gain of the Mathematics performance between the groups of students who attended synchronous sessions with paper-pencil exams and students who attended synchronous sessions with a customized style of the exam.

H_{0_4}: There is no significant correlation between the attitudes towards the use of LMS and the performance in trigonometry of the respondents.

Theoretical Background

This study was anchored on John Piaget's Constructivism Theory, George Siemen's Connectivism Theory, and Yrjo Engostrom's Activity Theory.

Related Theories

Learning Theory of Constructivism. Constructivism theory of Piaget states that a young individual that participates in designated tasks as part of his learning experiences will be able to develop connections actively towards certain concepts and apply them to his personal life experiences (Piaget, 1971).

The learning theory of constructivism has altered the process of teaching and learning (Vintere, 2018). Constructivist justifications from psychologists like Piaget gave us a full grasp of how people learn. Before the twenty-first century, the teacher was the focal point of education. For professors, students were like blank canvases ready to be painted. Constructivism theory has helped turn a passive classroom into an activity-based one. Students fail to learn. Neither individually nor in groups do we learn. Teaching occurs after learning what the students already know (Obi et al., 2019 and Ștefan, 2017). The function of a teacher has evolved from that of a knowledge transmitter to that of a knowledge and concept facilitator. Students take an active role in their learning processes and experiences help students build knowledge (Kurt, 2021). As new ideas are introduced, each student evaluates his own experience and applies it to what he already knows. Constructivism provides students independence in many areas, and it frequently comes with a variety of resources that are offered to them.

Despite the situation, it is notable to point out that the current distance learning setup in the context of Constructivist learning does not have dissimilarity from Constructivism in traditional learning (Janelli, 2018). In distance learning, students express their opinions and ideas about a concept just as much as they do in traditional face-to-face learning. Both offer students to create actively their knowledge through experience, present data from a range of views, involve the facilitation of a mentor or expert, and access opportunities and time to get involved or master a certain skill.

Learning Theory of Connectivism. Connectivism is a learning philosophy in which several aspects are used to meet the needs of online learning (Siemens, 2008). As much as learning is concerned, it is now impossible for teachers to reach these pupils using a blackboard and chalk to impart knowledge (Boyraz and Ocak, 2021) due to the current prevailing issues brought upon by the pandemic. So, technology has been utilized to address the continuous demand for education. The use of technology has brought acknowledgment to a theory of learning appropriate for the digitally saturated world in which we live must explicitly acknowledge connections—among people, institutions, and technology (Janelli, 2018). The idea of Connectivism or distributed learning is then put out as a better theory for the digital age, where action without individual learning and the use of information outside of our field of expertise are required (Mattar, 2018).

Epistemologically, Connectivism is built on interactions between networks in the brain and the outside environment (Boyraz and Ocak, 2021). A perspective on the dynamics of networks, ecosystems, and ecologies that promotes a continuous learning process is offered by Connectivism as a learning theory. According to Connectivism, the use of an online learning program encourages critical thinking and various activities that promote and guide problem-solving substantial information. Constructivism and Connectivism assert that learning is no longer a process that is solely controlled by the individual, an internal individualistic activity. Instead, it is also outside of ourselves, within other people, an organization, or a database, and these external connections that potentiate what we can learn are more important than our current level of knowledge. This is because students are frequently exposed to technology which gives them resources to learn on their own. Quite often, these two theories support the development of distance learning which is attributed to their commonalities in nature.

Activity Learning Theory. Engestrom's Activity Theory explores the information exchange between humans and computers using the many technologies accessible during the learning process (Engestrom, 2008). In conjunction with this idea, LMS usage relies on communication between students and computers. You must have internet access to utilize the LMS properly.

As students continue to involve themselves in educational technology, this can be attributed to computer and human interaction. Educational technology enables users to copy, reproduce, and trade information from countless sources, as well as, to delete, criticize, and reject inaccurate, pointless, or unreliable information straight from the information links. Students are required to participate actively in the development of these actions since there is a relationship between the technologies utilized to gather this information. Since educational technology requires a variety of digital environments to function while still necessitating hands-on interaction between the computer and the user, the ensuing event is particularly true for teaching LMSs. Engestrom's Activity Theory investigates how humans and computers share information while using the many

technologies available during the educational process (2008). In conjunction with this notion, LMS usage depends on computer-to-student communication. So far Activity theory is significant as it highlights this mediating role that technologies can play when students attempt to achieve desired learning outcomes within the social learning context (Bower, 2019). In this context, technology is seen as a tool (computer) used by students in achieving desired learning outcomes as well as involving themselves in the process.

Related Literature

When compared to earlier or more conventional ways, modern teaching techniques take a radically different approach. The traditional approach to teaching combines exercises with strong teacher direction. A more teacher-centered approach has historically been recommended to instructors as more useful (Mapesos, 2017). Learning is a notion and the instructor is the main controller in the classroom. Most of the time, students are inactive listeners who do not contribute to the discussion. Teachers who put their students' needs first prefer heavily textbook-based lessons. It should be taken into account because teaching from books limits pupils' capacity for problem-solving and decision-making (Seirin, 2018). One's capacity to communicate how one feels about a certain course of action is constrained by his incapacity to do so (Garcia et al., 2021). By participating in discussion-based activities and building a respectable community for differing views and beliefs, students may deal with a variety of difficulties.

The authoritarianism in the classroom and the failure to foster an atmosphere where students are encouraged to engage in critical thinking and problem-solving have led to criticism of traditional approaches. As a result of the negative feedback, the approach of teaching was changed from being teacher-centered to being student-centered (Seirin, 2018). Although adopting a student-centered approach in the classroom has lately gained popularity, teachers still play a crucial role in ensuring that student learning is effective and efficient. Students' growth and performance are more likely to succeed in a classroom atmosphere that fosters active participation in the process.

Online learning and traditional face-to-face learning are two separate formats that call for different techniques. However, a teacher must still take care to engage pupils' interest or help them become motivated learners. Both learning methods depend heavily on motivation, which encompasses the students' desire to learn new things. Students are encouraged to use the LMS for broad instruction using self-learning resources that are inherently accessible and readily available (Handayanto et al., 2018). Many activities in the conventional learning platform were on the verge of being finished, but thanks to the Learning Management System (LMS), things were able to get back on track.

When implementing any potential embedded activity, the classroom's readiness and focus are greatly anticipated. LMS is a great tool for monitoring student involvement in synchronous learning in addition to being used to implement distance learning activities (Handayanto et. al., 2018). The aforementioned LMS features give teachers adequate information to give students quick feedback on their performance or participation, especially those who are in desperate need of attention and assistance (Kehrwald and Parker, 2019).

LMS has emerged as a preferred method for acquiring ICT-based information that is currently employed extensively in the field of education (Rabiman et. al., 2020). As a result of significant changes brought about by the existence of e-learning, particularly during the COVID-19 pandemic, LMS became one of the top learning systems established by institutions at every level of education. When creating the LMS, a "classroom" was referred to as a gathering place for teachers and students. LMS underwent a significant transformation to become a defined virtual learning environment with a variety of components. Some education experts believed that this phenomenon would eventually lead to the transformation of the Industrial Revolution into the Information Age (or Digital Age) in the twenty-first century (Kehrwald and Parker, 2019). In this light, the LMS's communication capabilities can be viewed as infrastructures that combine human collaboration and cooperation in the digital world to lower the cost of education. Additionally, the adaptability and affordability of the online learning system are motivating factors for enhancing students' cognitive understanding, particularly in light of the difficulties presented by the COVID-19 pandemic at the moment. (Hu and Spiro, 2021).

From a larger standpoint, the COVID-19 pandemic has led to a rise in LMS usage with different feature compositions. In choosing an LMS, educational institutions should consider numerous factors especially in addressing the school's objective and the appropriateness of the features to the setting. LMS is divided into three categories: learning skill tools, productivity tools, and communication tools (Kraleva et. al., 2019). The LMS's role in facilitating interactions between teachers and students through

chat, discussion fora, and email is the emphasis of communication tools. The second category, productivity tools, is the functionalization of software offered by the LMS system. Examples include the ability for teachers and students to download and upload data, an evaluation platform for measuring student learning achievement and security measures for LMS user data. Last but not least, the LMS's learning skill tools predominate in online instruction and learning activities including task columns, video presentations, connections to uploading resources, and quiz columns (Mundir and Umiarso, 2022).

Even though online learning with the use of platforms is mostly observed especially in urban areas, there are still remote areas in the country that are still incapable of utilizing such due to lack of resources and materials to be used in the learning procedure got worse when COVID-19 came. Fortunately, leaders from the education sector were able to improvise an approach that could, at the very least, respond to the demand for distance learning. Modular Distance Learning was implemented (Bacomo et. al, 2022) with the aid of Self-Learning Modules. The Department of Education was able to address one of the biggest problems brought upon by the pandemic. Although, there were questions about the integrity among learners (Bautista and Pentang, 2022), MDL encourages the students to perform the desired outcomes with the use of SLM, which enjoins independent and self-regulated learning.

The modernization of teaching techniques that incorporate various forms of technology goes hand in hand with the evolution of various learning approaches in instruction to meet the demands of students. Technology has an impact on nearly every area of our life, including our towns, cities, and homes. When it comes to integrating technology into their teaching methods, most schools lag far behind. Many individuals are only now starting to recognize technology's intrinsic worth in education and learning (Rathore et al., 2015). Technology can assist students in developing the skills necessary to succeed in a challenging, increasingly sophisticated knowledge-based economy. The expanding technology in education needs to be implemented fast and sufficiently to keep up with the times. By incorporating LMS into diverse activities, learning, and self-regulation are enhanced (Al-Fraihat et al., 2020). The flexibility, personalization, and adaptation of technology offer a positive prospect for practitioners' productivity. Many innovative thinkers in the field of online education are advocating the use of LMS to enable student-centered online learning environments that include a variety of applications and virtual communication technologies, as well as the freedom of the students to choose their preferred online learning resources with the proper guidelines and modulation (Bradley, 2020). Both students and teachers can benefit from the advancement of new information technologies to enhance their educational experiences (Ghavifekr and Rosdy, 2015). Due to technology's complicated multidimensional process, which involves dynamics and manipulation of systems and structures, integrating technology into the learning process may take longer than expected. However, the outcome of incorporating such might be able to address specific problems in teaching and learning processes (Akcil et al., 2021). It was discovered that using technology in the classroom offers several advantages for both teachers and pupils. Among the advantages of technology are the integration raised student motivation, engagement, teamwork, and opportunity for hands-on learning. Additionally, it enables learning at all educational levels; raises students' self-confidence and technical proficiency (Costly, 2014). Teachers have also been able to adapt their methods in teaching their lessons, particularly for those who have registered or joined professional development whose topics are centered on the use of different types of educational technology in the learning process. When it comes to delivery and education, teachers were able to advance in their profession (Garcia et al., 2021). The creation of an online classroom that fosters a positive learning environment can be done by teachers and students using LMS (Bradley, 2020). To improve learning for both teachers and students, LMS is utilized in online classrooms. The LMS is a fantastic tool for learning because it has numerous features and is straightforward to use from an architectural perspective (Handayanto et. al., 2018).

It is suitable to set up an internet system or portal to meet the students' academic needs in the rapidly changing nature of today's society. This is due to the fact that most students conduct majority of their daily activities online. Through the online portal, students must be able to confidently look for and obtain information about their subject while ensuring that the content is correct and trustworthy (Bradley 2021). Learners can use an LMS for communication, interaction, and uploading assignments. Currently, LMS users generally use it to submit work and receive handouts (Jung and Huh, 2019). The use of LMSs provides students with a forum to share and track their progress. To build online lessons that analyze learning results based on certain criteria, teachers may make use of LMS technology tools (Bradley 2021). Their intrinsic grasp of all the concepts presented to them will be improved by

connecting items or issues that are generally linked with reality. Students' ability to develop and modify their interpretations can be used by teachers who promote their participation in online forums.

Related Studies

The following relevant studies were reviewed to give more substance to the study.

LMS and other video conferencing programs have become popular tools among creative teachers to employ in the classroom. This was the result of the decision made by the education sector's leaders, which the majority of institutions have been putting into practice because of the epidemic. Since then, several LMS, including Google Classroom, Edmodo, and a plethora of other e-learning platforms for academic institutions, have become widely used. The most popular webcam-integrated conferencing tools in the online classroom setting include Zoom, Jitsi, Big Blue Button, and others (Garcia et al., 2021). Different rules apply to the usage and accessibility of these platforms. Amid a pandemic, learning online through multiple platforms seems to be the most practical option, and since it is very flexible, anyone can access it with the necessary qualifications without specifying a preferred location or time (Taha et al., 2020). Researchers who have studied the effects of using LMS discovered that it has enhanced educational quality by expanding access, reducing costs, and cutting prices. This allow schools and institutions to admit more students. Due to LMS's benefits, higher education sectors have started to adopt it more frequently (Bervell and Umar, 2017).

In the study of Mohammed (2021), it was found that students who were taught with the use of LMS performed better compared to those who the conventional learning. Mohammed concluded that LMS is effective in teaching Financial Accounting and possibly be utilized to muster a better performance of the students. The same conclusions were reached by Oguguo et al. (2020), who found that students who were taught using an LMS (Moodle) outperformed those who were exposed to the different computer-assisted instruction packages Phoenix Aralinks specially employed the study LMS to customize the exam format for the experimental group. Digital learning provider Phoenix Aralinks offers a collaborative learning environment. It makes use of a system built on moodle that can advance your school. The LMS that the school has been using for a good while is called Phoenix Aralinks-LMS.

On the other hand, the modular learning modality is an additional strategy for tackling the problem of one of the overall effects of the abrupt change to distance learning. In Toach locations without reliable internet, parents pick up the printed learning modules from schools and return them after a week. Anzaldo (2002). SLMs provide all the components required for self-paced learning, including diagnostics, exploration, practice, and application (Castroverde and Acala, 2021). Because students can complete their modules at their own pace, modular learning is much more successful at delivering courses than traditional teaching methods (Ambayon, 2020). Practice tasks receive a lot of attention through reinforcement or comment in this process, which is unconstrained and self-paced, motivating students and igniting their interest (Castroverde and Acala, 2021). The facts that raise doubt about the modular learning modality demonstrate the significance of the learning modality and kind of learning environment in supporting a student-centered learning environment.

According to Dargo and Dimas(2021), there a positive and negative impact of impacts under positive impact was being able to bond with their family; enjoy asynchronous learning; the cost of education was a lesson in the sense that transportation and other allowance are not necessary as learning is done most in at the comfort of their home. Consequently, it has a negative impact since most of the students stay at home most of the time. Students have limited interaction with the teacher through the use of messenger or email applications. Since parents are also in the house, they will be given new workload, as they monitor their child's activity; no exposure to significant school activities; too many activities to attend to their modules; lack of socialization with other children; and last was the errors found from the modules due to short period preparation. In the same literature, the authors found that the students' academic performance in Modular Distance Learning decreased after the implementation. It simply indicates that the most crucial aspect of physical learning—face-to-face interaction—was more advantageous and productive for students' learning. This is inconsistent with the findings of the study of Bacomo et. al. (2022), which says that students manifested satisfactory performance in their SLMs. It was also indicated in their study that students who are enthusiastic about answering SLMs are most likely to improve their performance.

more effective in terms of children's learning

However, many private institutions have the option to update their modular learning programs to include online modules. Since it is online, this modality enables students to engage with their lecturers and submit their work via email or instant messaging while working on their assignments at their leisure.

This delivery method was developed to help some students who struggle to join synchronous classes or to spend the entire course period online.

Theoretical-Conceptual Framework

The theoretical-conceptual framework of the study is presented below.

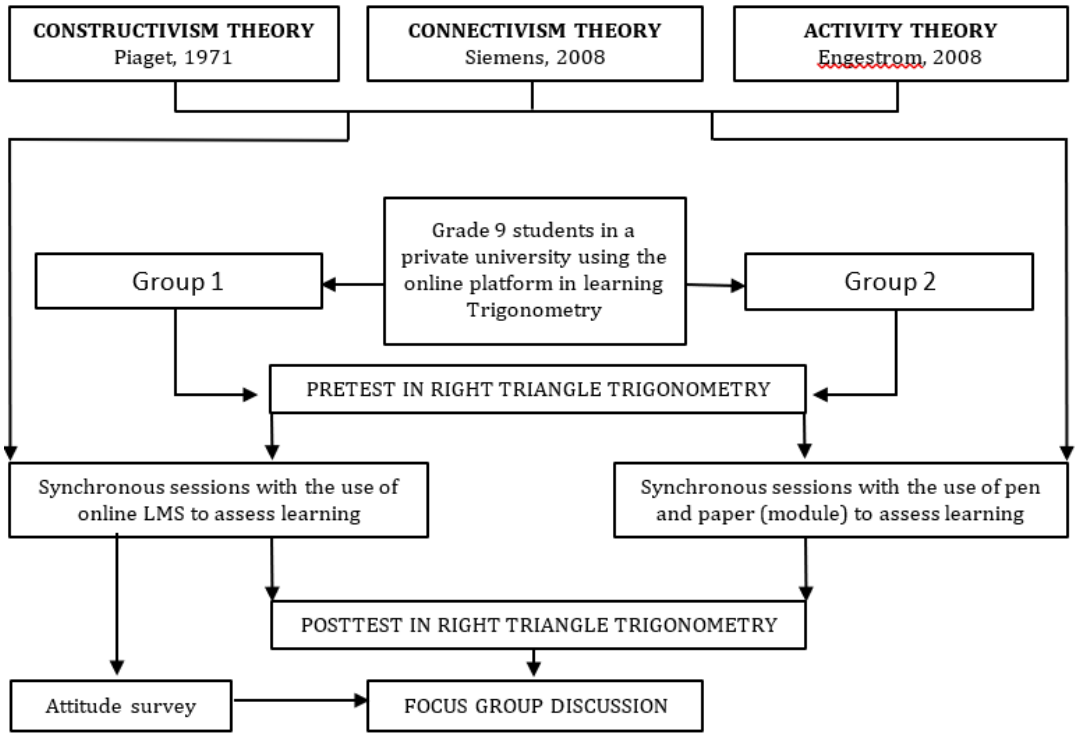

Figure 1 Theoretical-Conceptual Framework of the Study

The three learning theories—Connectivism Theory, Constructivism Theory, and Activity Theory—were used to support this study. According to Piaget's constructivism hypothesis, a person who engages in an activity that he views as a chance for a fresh experience, will build an active relationship with it and apply the lessons he has relearned from those experiences to their daily life (Piaget, 1971). Constructivism is evident in online learning since students focus mostly on self-paced modules or exercises after an online lecture and use primarily their newly acquired knowledge in subsequent exams.

Students in the process were provided with synchronous discussions that… Individually, after the discussions, students are to be provided with formative assessments in which they construct and apply their understanding of the concept taught to them online. Whether it is synchronous sessions or asynchronous sessions, relevant activities were provided to the students to connect their learning experiences and understanding of the concept taught to them to their individual real-life experiences.

Constructivism is evident in online learning because students focus primarily on self-paced modules or activities and apply the majority of what they've learned in the subsequent assessments.

As students continue to apply their understanding of the concept in which they have to communicate and connect the ideas provided to them, they were also provided several materials as supplementary discussions. Students connect their understanding of the concept by gathering more information about the said concepts and collating it with what was given to them. With that significant activities were implemented to address the idea of Activity theory. As they construct and connect meaning understanding to their real-life experiences, they are provided with activities that assess their understanding of the concepts.

Constructivism and Connectivism are two theories that are interrelated because they are student-centered and link mostly the past experiences to the present knowledge. However, Connectivism focuses on the connection of networks and the significance of technology in the learning process (Brown, 2021). The learning process in the current setting requires a connection among information sources. The relationship between the two theories is based on how they link the past experiences or information sources to their own time learning experience. And to be continuously engaged, computers and human connection are usually observed in the learning process in which Activity theory comes in (Engestrom, 2008).

The theories cited above support the use of online learning. Two groups of Grade 9 students participated

in the study. One group had synchronous sessions with the paper and pen to assess their learning which they had to submit in messenger or emails. While the other group had synchronous sessions with the use of LMS in assessing their learning of the lesson. Students participate in online activities, engage in communication, and attend classes using a variety of platforms. After the Pretest and Posttest examination, the students who attended synchronous sessions with the use of LMS had an attitude survey. Furthermore, a limited number of participants from each group were subjected to a focus group discussion.

Significance of the Study

The implications of the study would benefit the following:

the **teachers** could be provided with the option to use blended learning and enhance skills in manipulating the complex threads in the system to maximize learning;

the **school administrators** could be provided with the results as serve as bases for improving school programs not just for their students but also for the continuing professional growth of their teachers. The provision of enough resources to utilized fully the learning instructions with the integration of technology is one to be looked upon;

the **students** could be aided in overcoming their difficulties in understanding the concepts of Trigonometry by using LMS in the process. The result of the study could be utilized in achieving desired learning outcomes;

the **LMS providers** could maximize learning as they provide alternatives to the education sector by improving and by upgrading their features in the interface based on students' suggestions with proper mediation and consideration from administrators; and,

the **future researchers** could acquire knowledge that enables them to use the study's conclusions to produce additional research on the impact of the LMS on the teaching procedure. Additionally, this study will inform them of the areas that need to be improved to enhance students' learning of trigonometry.

Scope and Delimitation of the Study

The study was focused on the effects of the usage of the LMS Phoenix Aralinks, as an aid in Trigonometry to grade 9 students. The results of the pretest and posttest examination given to the students were used as a basis for exploring the implications of using LMS on their performance in Trigonometry

The study only covered the Right Triangle Trigonometry topics. Furthermore, respondents were grade 9 students in a private university in Cebu City. Students' pretest and posttest scores following synchronous sessions with pen and paper to assess their learning and the use of LMS was compared using a statistical method to see if there is a significant difference.

The attitude level of the students towards the use of LMS in online learning was determined through the use of an attitude survey. The survey is a standardized test adopted from a study conducted on college students.

Definition of Terms

The following terms were defined according to their use in the study:

Attitude. Perceived usefulness of the LMS in learning Trigonometry online. Students' favorable and unfavorable evaluation of the use of LMS in learning Trigonometry. This was measured by the use of an attitude survey adapted from a similar study conducted on college students.

Learning Management System. A web-based technology developed to be used as a tool in the development and engagement of students in an online learning environment. A system in which students are to engage in learning and where learning is also assessed. Specifically, the LMS used in this study is the Aralinks.

Modular Learning. A learning modality in which students have to answer everything manually without the aid of any devices. Modality in which learning is done by the students on their own with Self-Learning Modules hardcopy.

Online Learning. A learning modality in students' use of internet-based platforms in engaging with their classmates and teachers. Students have synchronous classes in the morning and asynchronous in the afternoon.

Online-Modular learning. A learning modality in which students had to attend synchronous sessions and answer the prescribed activities from Self-Learning Modules but has to submit their works through messenger or emails. Assessments were embedded in the Self-Learning Modules and has to be answered and submitted in a specified number of days.

Performance. Measurable progress was made by the student, both before and after the having the synchronous sessions with the Modules and with the use of LMS.

2. RESEARCH METHODOLOGY

This chapter presents the study's research methodology, including research design, the research

environment, the research subjects, the data-gathering procedure/research procedures, research instruments and statistical treatment of data.

Research Design

This study utilized an explanatory-sequential mixed-method design. To analyze the performance of the students in Trigonometry, a quantitative approach was used in the process of the pretest-posttest design of two groups; group 1 and group 2

Figure 2. Experimental Design Diagram

G_1	O_1	X_1	O_2
G_2	O_3	X_2	O_4

where: G_1 is the group exposed to synchronous session with the use of LMS,

G_2 is the group exposed to synchronous sessions and modular learning approaches,

O_1 *and* O_3 are pretest,

O_2 *and* O_4 are posttest,

X_1 is the use of online LMS to assess learning, and

X_2 is the use of pen and paper (module) to assess learning

In order to determine the attitude of the respondents towards the usage of the LMS and their perceptions of their learning modality, a qualitative thematic analysis approach was utilized. Group 1 took the attitude test and selected respondents from both groups who were enjoined to participate in the focus group discussion (interview about how they felt about their learning format).

Data was gathered through pretest and posttest assessments. The pretest was done before having the synchronous sessions and the respective use of modules and LMS. Group 1 was provided with the module which was also embedded in the LMS and their assessments were time bounded, in which they had to submit their outputs within the time set. Meanwhile, the control group was able to enjoy the synchronous sessions but their outputs (formative assessments) were submitted a day before the next meeting.

The pretest-posttest was time bounded. Wherein group 1 was required to submit their output within the time set in the LMS while group 2 was required to submit on or before noon the next day. Group 2 was required to submit their answers via messenger or email while group 1 had to attempt the quiz in LMS. Posttest was conducted after the synchronous sessions with the use of modules and LMS. Group 1 had synchronous sessions with the use of the LMS for their assessment, pretest, and posttest.

After the conduct of the research, the data was gathered and analyzed through a statistical tool. The resulting data were interpreted and discussed.

Research Environment

The study was conducted in one of the private universities in Cebu City, Cebu. The university offers students basic education, undergraduate, graduate studies and post-graduate studies. Grade 9 took part in this study. The department's population is not less than 1,164 students.

Research Respondents

The respondents of this research were the randomly selected Grade 9 students from a private university in Cebu City. Both groups participated with 25 students. The control group has undergone an intervention with their mode of instruction being online but they have to answer their modules manually and the experimental group used the digital Phoenix Aralinks-LMS with the customized format of the formative exams. These 50 students were 15% of the total Grade 9 population from the junior high school department of the university.

Data Gathering Procedure

The data were gathered using pretest and posttest assessments. Before the start of the synchronous sessions, respondents answered a pretest with 20 items.

A synchronous session with different styles of exams was done for the two groups of students. Group 2 underwent synchronous sessions with their formative assessment answered manually (paper pencil). The experimental group used the Phoenix Aralinks-LMS in both pretest-posttest exams and formative assessments.

After the series of synchronous sessions and formative assessments in a different style (different quiz formats were available among the features in the Aralinks LMS), a posttest with the same number of items was given. An attitude survey test from the study conducted by Garcia et. al (see Appendix I), was provided to the students, and some students were enjoined to participate in FGD. Results were statistically treated and analyzed.

Pedagogical Approach

The respondents were composed of two groups. Each group received the same set of questions from the pretest examination, formative assessment (activities), and posttest examination. Each group of respondents was instructed to submit their outputs in the LMS for the ones using the Aralinks and email or messenger for the ones having modular learning.

Group one is composed of respondents who had synchronous sessions with the use of LMS to assess

their learning. Students in this group were able to interact with the teacher in the synchronous sessions. Each synchronous discussion has a corresponding formative assessment that each student has to answer in the LMS which has an indicated number of minutes to finish, and what time the activity will be open and closed. The video link of some related discussions was also provided to the students if ever they need to review the discussion after the scheduled synchronous discussion. The pretest was given to the students at the start of the lesson and for more than three weeks, students were given the posttest. The students were also asked to answer an attitude survey towards the use of LMS and some were invited to be part of the focus group discussion to determine their feedback on the use of LMS in assessing their learning in Trigonometry.

Respondents in group two participated in synchronous sessions with modules to assess their level of learning. In the synchronous sessions, this group's students had the opportunity to communicate with the teacher. Students were provided with a module after the pretest of the lesson. After discussion, students were asked to answer specific activity in the module within a certain timeframe. They need to submit through email or messenger. Similarly, the module also contained the set of formative assessments provided to group 1. The video links of some related discussions were also provided to the students if ever they missed the discussion. After more than three weeks, students were given the posttest. Some students were also invited to be part of the focus group discussion to determine their feedback on having modular learning to assess their learning in Trigonometry.

Research Instrument

The study assessed the performance in Trigonometry those of students who attended synchronous sessions with paper and pen assessments and who students who use LMS in their assessments, with the use of a researcher-made questionnaire. A pretest-posttest examination (see Appendix H) with 20 items was implemented before and after the series of synchronous sessions and the use of the modules and LMS to measure students' performance. The questionnaire covers Right Triangle Trigonometry. The instrument for the pretest-posttest examination was validated by experts (see Appendix C). The questionnaire had a Table of Specifications (see Appendix G) and was pilot tested (see Appendix J) and the result was analyzed through an item analysis (see Appendix K).

The other instrument was provided to the students to evaluate their attitudes toward the usage of the LMS and how students feel about their style of learning Trigonometry. The attitude survey test was an adopted instrument from the study of Garcia, et. al. entitled "Integration of Learning Management System as an Aid in Teaching: An Assessment" (see Appendix I).

The students who attended synchronous sessions with the LMS specifically used the Phoenix Aralinks CLE. It is a collaborative learning environment provided by digital learning provider Phoenix Aralinks. It makes use of a moodle-based system that can help your school. The school has been utilizing Phoenix Aralinks-LMS as its LMS for 5 years. It has featured many features about quiz styles and other functions (See Appendix M).

Research Ethics and Data Management Plan

The study was carried out with the agreement of the chosen school's administrator via a request letter (see Appendix A) written before the study's conduct. In doing the research, the researcher will adhere to the school's norms, good behavior, and ethics.

The parents or guardians of the students were informed and were requested of their consent, following the school's policies and research ethics (see Appendix F). Only students with parental or guardian consent were allowed to participate in the study. The study's procedures were explained to the participants' parents and children before they signed the consent form.

The information gathered during the research was kept private and was provided to the students as feedback. A statistician tested and evaluated the pupils' test results with the strictest confidence. The research preserved the pupils' raw test scores even though the data had already been cleaned up for verification purposes.

The study's conclusions were shared with the school, parents, and kids. By the Data Privacy Act, the respondent's information would remain private, and no data obtained from the study would be disclosed to parties not involved in the proceedings. The only data collected was the respondents' scores.

Statistical Treatment of Data

The study employed the following statistical tools:

1. the mean was used to determine the respondents' performance in their pretest and posttest examination.

Formula:

$$\bar{x} = \frac{\sum x}{n}$$

where: $\bar{x}$ = is the mean,

$\sum x$ = is the total of all values, and

n = is the number of samples.

2. a paired t-test was used to compare the posttest scores of group 1 and group 2.

Formula:

$$t = \frac{\sum d}{\sqrt{\frac{n(\sum d^2) - (\sum d)^2}{n-1}}}$$

where: t = computed t-test

d = difference per paired value, and

n = number of samples.

3. an independent sample t-test was utilized to test whether there is a significant difference between the mean of the pretest and posttest scores of each group.

Formula:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}}}$$

where: t = independent sample t-test,

$\bar{x}_1$ = mean of the group 1,

$\bar{x}_2$ = mean of the group 1,

s_1 = standard deviation of group 2,

s_2 = standard deviation of group 1,

n_1 = sample size of group 2, and

n_2 = sample size of group 1.

4. a Spearman Rho correlation would be utilized to test the relationship between the attitude of the students towards the usage of LMS and their performance in Trigonometry.

Formula:

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)}$$

where: d = difference in marks,

n = number of pairs of data,

$\sum d^2$ = sum of the squares of the difference in marks,

r_s = Spearman's Rank Correlation Coefficient,

5. Median was used to determine the attitude level of the students towards the use of LMS.

Formula:

$$\tilde{x} = \frac{n+1}{2}$$

where: $\tilde{x}$ = computed position of the median score,

n = is the number of samples.

All tests were conducted at 5% level of significance.

3. PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

This chapter presents the results, analysis, and interpretations of data on the performance of the two groups of Grade 9 students in learning Trigonometry in synchronous sessions with paper and pencil assessments modules and with the online Learning Management System (LMS).

The Performance Level of the Grade 9 Students in Trigonometry

Table 1 reveals the pretest and posttest performance levels of Grade 9 students in Trigonometry

Table 1 Pretest Performance Level in Mathematics

	N	*HM*	Pretest Mean	*SD*	*p-value*	Qualitative Description
Group 1	25	12	8.68	3.46	< 0.0001*	**Below Average**
Group 2	25		8.44	2.80	< 0.0001*	

Note. HM = 60% of the total number of items; based on the passing standard of the school; the perfect score is 20, and the 60% is 12

*significant at α = 0.05 (two-tailed test).

The table shows that the actual mean of group 2 is 8.44 (SD=2.80) and the actual mean of group 1 is 8.68 (SD= 3.46). Both group scores in the pretest were lower than the hypothetical mean (HM) = 12. These values were significant and H_{0_1} were rejected. This means that there were significant differences between the hypothetical mean and the actual mean of the pretest scores in groups 1 and 2. Their performance in the pretest was below average. Although, there were quite a few who got a score above the hypothetical mean from both groups generally both were below the hypothetical mean (HM) of 60% which is the passing standard criterion set by the school where the study was conducted. This below below-average performance of both groups could be attributed to the presumption that the topics were unfamiliar to them.

Table 1 shows the small variation in the pretest mean score in Trigonometry of group 1 and group 2, this may be because of the unfamiliarity with the topics. Furthermore, because the test is a pretest, it is normal for the respondents' overall score to be quite low for a 20-item test (Garcia, et. al, 2021).

Following the DepEd curriculum guide, both the pre-pandemic curriculum guide or the recently crafted Most Essential Learning Competencies (MELCS) of 2020 for the distance learning curriculum, learning competencies relating to Right Triangle Trigonometry are only found in Grade 9 learning competencies. Although the basic skills and concepts in solving equations were taught in Algebra, Trigonometry, in general has new terminologies which were found to be new to the students. Hence, as students were introduced to new concepts, based on the result of their pretest, may have below-average scores.

Table 2 presents the posttest performance level of Grade 9 students in Trigonometry.

Table 2 Posttest Performance Level in Mathematics

	N	*HM*	Posttest Mean	*SD*	*p-value*	Qualitative Description
Group 1	25	12	17.44	2.36	0.0000*	**Above Average**
Group 2	25		15.36	3.62	0.0001*	

Note. HM = 60% of the total number of items; based on the passing standard of the school; the perfect score is 20, and the 60% is 12

*significant at α = 0.05 (two-tailed test)

Table 2 reveals that during the posttest group 2 had an actual mean of 15.36 (SD= 3.62), while group 1 had an actual mean of 17.4 (SD= 2.36). H_{0_1} was rejected which means that there were significant differences between the hypothetical and actual means of group 1 and group 2. The performance of the students in the posttest was Above Average. This suggests that the performance of both groups obtained an actual mean which is higher than the hypothetical mean (HM) of 60% which is the passing standard criterion set by the school where the study was conducted. This may imply that students probably have acquired more understanding of the concepts in Trigonometry with the aid of either modular learning or learning management systems through distance learning.

Students were provided with enough instruction and resources before and after their online discussion. If they have confusion or difficulty, they can always revisit the materials. It is where the Constructivism theory works and facilitates their learning. This was also observed in the study of Bacomo, et.al, in which students' performance towards SLMs was satisfactory despite their situation at that time (2021). Modules were deemed to ensure that basic education must be offered in any way possible. Even though schools give pupils these resources, the learners must do all the tasks and activities assigned to learn. This was also demonstrated in the same study by Bacomo et al. (2021), students had shown the desire to study independently, a sense of comfort with their work, confidence in their results, and a willingness to put in extra effort to complete projects and complete necessary materials during a pandemic.

It is important to note that the students who had their learning with the LMS, were able to manage and to utilize the available features. But were limited to the teaching style of the teacher is and the items from of the said activities. The students were able to perform very satisfactorily performance in their intervention and this was a similar result to the findings of Araiza and García Leal (2021). According to them, the use of LMS platforms significantly influences learners' academic performance in a certain course. This might be attributed to the extensive utilization of the different significant features of the tor to address students' willingness to learn more engagingly and innovatively.

Mean Improvement of the Grade 9 Students in Trigonometry from the Pretest to Posttest

Table 3 shows the mean improvements of group 1 and group 2 in their performance in Trigonometry.

Table 3 Mean Improvements of the Control and Experimental Group in Mathematics

	N	Pretest Mean	Posttest Mean	Mean Difference	*p-value*
Group 1	25	8.68	17.44	8.76	< 0.0001*
Group 2	25	8.44	15.36	6.92	< 0.0001*

*Note.**significant at α = 0.05 (two-tailed test).

As indicated in Table 3, group 2 which was exposed to modular distance learning had a mean gain of 6.92. This showed a significant mean improvement from the pretest (M=8.44) to the posttest (M= 15.36). For group 1 which was exposed to the use of LMS to assess their learning, a mean gain of 8.72 was obtained. Significant improvements were shown in the posttest (M=17.4) from the pretest (M=8.68). In both cases, H_{0_2} was rejected.

This means that learning can happen in distance learning whether the students will be assessed using pen-paper and with the use of LMS, the students performed well in the posttest. This would mean that both assessments were effective in enhancing students' performance in Trigonometry

This may imply that students who were taught of the lessons without integration of LMS still acquired an understanding of the concepts of Right Triangle Trigonometry because they were still provided with the same sources and materials used during the discussion. Respondents in group 2 were still able to exhibit improvement in their posttest performance despite the situation. This was seen in the research by Bacomo et al. et al. (2022), in which the respondents could meet the minimum requirements established by their lecturers but were unable to achieve great performance.

Meanwhile, the respondents from the experimental group were able to perform well in their posttest. This can be attributed to the features provided to them by the LMS (Garcia, et. al., 2021). The students were privileged enough to utilize relevant features and functions of the LMS. These provided them enough engagement and motivation to learn things distant towards one another and from their teacher as well (Kassim, 2021).

Comparison of the Mean Gains in Trigonometry of the Group 1 and Group 2.

The mean gains in Trigonometry of the experimental and control groups are shown in Table 4.

Table 4 Mean Difference of the Posttest Scores of the Control and Experimental Group in Mathematics

	N	Pretest Mean	Posttest Mean	Absolute Mean Difference	*SD*	*p-value*
Group 1	25	8.68	17.44	8.76	3.62	0.0908
Group 2	25	8.44	15.36	6.92	3.75	

As shown in Table 4, a mean difference of 1.84 was obtained in favor of group 1. However, the result was not significant which p = 0.0908. This fails to reject the H_{0_3} which means that there is no significant mean gain in Trigonometry performance existed in the group 1 and group 2. Both groups had improvements in their performance however group 1 did make a greater difference. Looking closely in assessing students' learning through the use of LMS and pen-paper, many students were encouraged to join a synchronous discussion. It was still undeniable that there were still few areas capable of stable signal reception for those students who were in group 2. Meanwhile, group 1 was able to join most of the discussion. There may be some who were not able to manage their connection but were able to catch up with the discussion. These findings of group 2 were backed up by the study of Bacomo, et. al. (2022), in which students' average performance towards SLMs was satisfactory. Most of the respondents in their study have a performance from 80 to 84 out of 100 percent. Similar findings were found in Pentang (2021) when students working individually on their courses encountered issues as reported by their teachers. While SLMs promote independent learning, the biggest obstacle in today's educational environment is the learners' infrequent connection and communication with their teachers, which negatively impacts the learners' performance over time.

Meanwhile, group 1 was able to outperform the students from group 2 by a slight mean average difference. Despite outperforming the other group, there is still no significance between respondents' performance. It is inconsistent with the claims of the researchers beforehand. Magno (2017) discovered that when LMS is used to teach mathematics to pupils in Grades 10 and 11, the performance of those students who utilized the LMS was much greater than that of those who did not. In a study Ahmed and Mesonovich (2019) did apply LMS to students in the teaching of mathematics, and they discovered that the student's overall course grades increased when LMS was used to them.

Levels of Attitude of the Experimental Group Towards the of Use Aralinks LMS in Learning Trigonometry

Table 5 Attitude of the Experimental Group Towards the Use Aralinks LMS

Table 5 Relationship Between the Attitude Towards LMS and Mathematics Performance

	N	Attitude Level	Qualitative Description	Posttest Mean	*r value*	*p value*
Group 1	25	4.00	Positive	17.44	0.3933	0.0517

With a median score of 4, which has a qualitative interpretation of Positive, Table 5 displays the respondents' opinions toward the integration of the learning management system in learning trigonometry. It's also vital to note that the respondents firmly concurred that an LMS is a crucial tool for making it simple to access their lectures or other content. However, because the LMS has the lowest mean value of 3.84, respondents felt that it had fewer possibilities for group work and quick communication (see Appendix L). This pertains to the consideration that both groups are on time discussion. But, one group couldn't entirely participate in group activities because internet resources were limited on

their end. The LMS offers other meeting conferences that could be utilized at that time. But, due to the situation, the instructions were limited to interactive discussions and the like.

The study's findings, as shown in Table 5, indicate that respondents have favorable opinions about using the Aralinks LMS or including technology in the instruction of mathematics. The results, however, also showed that students occasionally had trouble working and talking with one another. This can be as a result of the respondents' comfort level with face-to-face interaction. The results are in line with earlier studies on learners' perceptions of educational technology, including LMS (Ajijola et. al., 2021). It was revealed in his study that students find it beneficial in their learning process and prefer to learn with as it is convenient for them to locate resources and information of the lesson. The same procedure was done in the delivery of lesson when the intervention was done to those students who used the LMS during the process. This was further demonstrated by Kassim's (2021) study, which discovered that students thought LMS was very simple to use, with this element having the highest mean. They also said that the LMS was very helpful because it increased their productivity, provided them convenience to access materials and complete assignments, and allowed them to communicate with the professor, and other students. Furthermore, it is also important to note that gaining a positive attitude towards the LMS is not the end of the ensuring the efficacy of the utilization of the technology, might as well consider the value of the technology on the students' and teachers' end (Ajijola et. al., 2021).

Relationship Between the Attitude Towards LMS and Mathematics Performance

Table 5 reveals the relationship between the attitude towards the use of learning management system and students' performance in trigonometry. The correlation r value is at 0.3339. This, therefore, means that the null hypothesis was not rejected because the significant value (.3339) was greater than the 0.05 alpha level. By implication, the null hypothesis was established thus, no significant difference existed between students' performance in Trigonometry and students' attitudes towards the use of LMS. Despite the significant improvement in the performance of the students in Trigonometry from group 1, as well as the positive qualitative interpretation of their attitude level towards the integration of LMS in the learning delivery, the correlation between the attitude towards LMS usage and the performance in trigonometry of the respondents has no significance at all.

This finding is consistent with a similar study of Daryazadeh et al, (2022) in which they studied the relationship of attitude towards e-learning and the respondents' academic performance. They found out that attitude towards e-learning had no significant correlation with the student's academic achievement. Although there were outdated studies whose findings do not coincide with this finding like Deryakulu (2009) and Keshavarz (2013), perhaps, the inconsistency can be attributed with the environment and demographics of the respondents.

Respondents' feedback in terms of using LMS and Modules to assess their learning in Trigonometry.

The integration of LMS in the learning process especially in the online distance learning has provided different views to students pertaining to their usage of such. Different perspectives provide individualized experiences which may hinder or improve their performance. Despite the platform's complex systems and multidimensional functions, navigation is not a question to their capabilities as most of these learners are exposed to the internet (Handayanto et al, 2018). On the other hand, there were some who commented about the other issues like internet and system error for some time in their navigation. These were supported by the following statements from the focus group discussion.

> Learner 3: *"Sometimes it's annoying due to technical problems and Wi-Fi but sometimes it's mostly okay."*
>
> Learner 9: *"It's good, but it gets very laggy and loading."*
>
> Learner 14: *"Sometimes the internet connection is a bit off but I can follow through."*

The most practical option during pandemic is learning online through multiple platforms because it is very flexible. Anyone can access it with the necessary qualifications without specifying their preferred location or time (Taha et al, 2020). However, the technical and geographical issues, may affect learner' performance.

To add up, unscheduled system updates are also demanding on the side of the learners as there are new panels added in their navigation, some students were confused at first in the navigation of the new interface but eventually, with the help of the teacher, they caught up. These were the comments of the learners when it comes to the unannounced system updates.

> Learner 5: *"There are times that there have been problems in terms of logging in to my account in Aralinks since the new version of it came."*

Learner 17: *"Aralinks overall is fine and nice but it would be better if they got rid of the login pels before you go in aralinks. Because for me, I deem it as unnecessary considering we have to log in to this to go to that and then click and finally open Aralinks. It's just doesn't make things faster."*

Fortunately, one of the roles of the learning management system (LMS) is to offer a place where the students may engage, communicate, and upload assignments. Currently, LMS users generally use it to submit work and receive handouts (Jung and Huh, 2019). Such are just few functions which enable the learners to track their submissions and even revisit the necessary resources they have missed when technicalities occur (Branch, 2015). These were backed up by the response/s of the students during the group discussion.

Learner 3: *"It was convenient to locate resources as we do not have to log in into or search for the website, you just have to click the links or open the said activity and resources are already provided."*

Learner 5: "*Video links of discussion about the topics can be easily navigated; it notifies you with new activities and its submission dues; it's easier taking activities and quizzes using the LMS."*

Learner 6: *"also easy because of the videos and sources provided in the LMS for me to see and learn about the topic."*

Learner 12: *"it's convenient for me because there are files about trigonometry provided by my teacher and i can re-read or re watch whenever I'm stuck."*

Moreover, the LMS's key objective is to enhance students' performance and engagement in learning both by themselves or with the teacher. Developing such innovations has provided enough positive learning experience when it comes to their performance. This was discovered by Costly's (2014) study, which indicated that using technology in the classroom had various advantages for both teachers and students. Among the advantages of technology integration are raised student motivation, engagement, teamwork, and opportunity for hands-on learning. Additionally, it improves education at all levels and boosts students' self-assurance and technical proficiency.

Learner 1: *"I'm happy because I learned about trigonometry even though we are in a virtual classroom setting. It was difficult at first, but after our teacher discussed it and with the resources provided, I learned about it and know about it."*

Learner 8: *"I believe the use of LMS in learning mathematics can help the students greatly especially in learning the concepts."*

Learner 10: *"The use of LMS is helpful in learning trigonometry because it can give links to sources that further explains the topic."*

Learner 13: *"It was really hard. I admit I had a hard time understanding Trigonometry especially using LMS. But in many ways, Aralinks has helped me understand but I still had a hard time to do so."*

These learning experiences are backed up with Connectivism theory and Activity Theory. The interaction between a machine or computer and a human provides a variety of networks in which learning can happen. Positively done, learners will be able to enhance their performance as they can exchange and communicate with the provision of the LMS. To put into consideration, the additional inputs of the teacher can provide different perspectives in learning the concept.

Meanwhile, the group 2 was still able to manage and prove its performance given the circumstances. These learners were the ones who opted to have modular learning as there were times that they couldn't use the internet and couldn't perform tasks online. Browsing through the LMS requires strong bandwidth of connection. And it was quite known that Odette has made a lot of damage and one area is the service area provider's line. Taking into consideration has provided options to the learners in order for them to continue their learning despite the situation.

The format provides them modules as these modules were provided to them online, the can just download and revisit it as many times over. As restriction were still strictly observed that time, hard copy of the modules cannot be provided to the students. Despite the situation, the learning development on their end was still obvious. It is an indication that these learners were still able to perform and achieve the learning goals in each resources provided to them and these can be seen in their statements below.

Learner 20: "Yes as it helped learn new things in a new perspective and new ways in life."

Learner 22: It helped me in my studies since it can help me source out more sources and can study much easier."

Learner 17: "The modular-online learning was a conducive type of long distance

education because even in the midst of the problem we were still able to continue to learn and answer activities despite the internet problems. It helps in my studies, that just like I said I was still able to continue to learn the subject even though there are times that the internet would slow down."

Learner 19: "It was also difficult to keep up with the lecture since many networking links, particularly LAN, were not set up ahead of time. Having modular learning as an alternative to traditional learning or schooling is partly beneficial, albeit it was first difficult to adjust to the new things and we were unfamiliar with all of the requirements. Reaching out to kids in the virus we confront to pursue education, I can state that this modular learning was better than imagined, even if learning was difficult."

These experiences are just one way of strengthening the claims from the Constructivism theory of Jean Piaget. According to Piaget's constructivism theory, if a person engages in an activity that he views as a chance for a fresh experience, they will build an active relationship with it and apply the lessons they have learnt from those experiences to their daily lives (Piaget, 1971). Constructivism is evident in online learning since students focus mostly on self-paced modules or exercises after an online lecture and use primarily their newly acquired knowledge in the subsequent exams.

Furthermore, Dargo and Dimas were able to identify impacts of learning through MDL, that goes around its positive and negative impact on student learning (2022). One of the interesting impact was about the number of activities provided to the students. It is not a question of whether DepEd remains committed in molding and producing notable individuals to the country (Bacomo et. al. 2022), but it would be really take a tool on the student's end to work on numerous task considering their learning environment. Fortunately, the university provided enough learning materials and activities to answer. This to lessen their burden with the consideration of targeting the same skill and learning competency.

4. SUMMARY, CONCLUSION, AND RECOMMENDATION

This chapter presents the summary, findings, conclusions, and recommendations of the study.

Summary

This study employed the quasi-experimental method with the use of a pretest-posttest control group design that aimed to determine the effects of using the Aralinks LMS on the performance of the respondents in the Trigonometry. Specifically, this study sought to answer the following questions:

1. What is the pretest and posttest performance in Trigonometry of the students:
   1.1. who attended synchronous sessions with paper-pencil exams and;
   1.2. who attended synchronous sessions with customized style of the exam?
2. Is there a significant mean gain in the performance in Mathematics from the pretest to the posttest of the students:
   2.1. who attended synchronous sessions with paper-pencil exams and;
   2.2. who attended synchronous sessions with customized style of the exam?
3. Is there a significant difference in the mean gain in Mathematics performance between the respondents who attended synchronous sessions with paper-pencil assessments and to those who attended synchronous sessions with customized style of the assessments?
4. What is the attitude level of the respondents who attended online lecture with customized style of the exam towards LMS?
5. Is there a correlation between the attitude towards LMS usage and the performance in trigonometry of the respondents?
6. What are the feedback about learning trigonometry of the students:
   6.1. who attended synchronous sessions with customized style of the exam and;
   6.2. who attended synchronous sessions with paper-pencil exams?

Findings of the Study

After the analyses of the data, this study obtained the following results:

1. Both groups of students who had LMS and Modules to assess their learning in Trigonometry manifested **below average** performance in the pretest examination.
2. Both groups of students who had LMS and Modules to assess their learning in Trigonometry manifested **above average** performance in the posttest examination.
3. There was significant mean improvement in the students' performance in Trigonometry in both experimental and control groups.
4. There was no significant difference in the mean improvement in Trigonometry between the group 1 and group 2.

5. The students from group 1 exhibited a median score of 4 with a qualitative interpretation of "Positive" attitude towards the use of Aralinks LMS in Trigonometry.
6. There was no significant relationship established between the attitude of the students towards the use of Aralinks LMS and their performance in Trigonometry.
7. Students' response in their views on their perspective intervention varies on their situation. The ones using the LMS had positive and negative outlook on the usage of the LMS, depending on the availability and accessibility of the learning resource they were provided. Although they experienced varied learning experiences during the process, they still claim that the use of LMS has been a convenient in general since all the things they needed is place in one place. Meanwhile, the other group also appreciated their intervention as it provided them control on their time and be able to continue their learning process even with the current situation they had that time.

Conclusion

The transition of instruction from face to face to blended learning requires innovation to target specifically necessary skills students should acquire. The innovations that has certainly progressed students' involvement and performance based on the literatures identified is LMS.

According to the results, respondents still demonstrated a considerable improvement in trigonometry as seen by their equivalent performance with or without the inclusion of LMS. The results of the study demonstrate the improvement of the students' performance as they did poorly on the pretest, but they performed remarkably well on the posttest. Though, group 1 outperformed group 2 in both pretest and posttest mean scores, the gap of scores was minimal. So, based on the statistical treatment, researcher found no significant difference of mean improvement of the two groups. Positive responses were received from respondents on the use of learning management systems in the classroom. But, there was no connection found between students' attitudes and performance and the use of LMS. Based on this finding, it is recommended among others that teachers should intensify efforts in the use of LMS tool in teaching Trigonometry.

The theories of Constructivism Learning Theory by Jean Piaget which states that the individual is at the center of the knowledge generation and acquisition process, and that humans develop knowledge by interacting with their experiences and ideas; Connectivism by Siemens and Activity theory by Engestrom which stand on the belief that innovations require network of communication and connection provided by computer they faced on a daily basis were confirmed by the findings of this study.

Recommendation

Based on the results of the study, the following are the suggested recommendations:

1. the schools continue to upgrade the skills of their teachers by conducting more extensive trainings or workshops and giving them incentives like certificates and cash/allowance in attending trainings to support them to face the continuing demand in addressing students' engagement and participation in the learning process. School administrators would provide devices necessary in implementing and maximizing the use of LMS;
2. the teachers be open to the idea that classroom practices can also be mediated with teaching innovations to assess learners in academic proficiency and to lessen the gap between the development of teaching approaches and the applications of technology to intensify efforts in the use of LMS in teaching;
3. the students be given the opportunity to be able to develop more their skills in a non-linear way. They may enjoy in the learning process through effective teaching approaches to overcome the difficulty in Mathematics; and,
4. the future researchers conduct similar study in the face-to-face modality but not limited to the teaching of Trigonometry.

REFERENCES

[1] Adzharuddin, N. A., & Ling, L. H. (2018). Learning Management System (LMS) among University Students: Does It Work? *Learning Management System (LMS) among University Students: Does It Work?*, *3*(2).

[2] Ahmed, K., & Mesonovich, M. (2019). Learning Management Systems and Student Performance. *International Journal for E-Learning Security*, *8*(1), 582–591. https://doi.org/10.20533/ijels.2046.4568.2019.0073

[3] Ajijola, E. M., Ogunlade, O. O., & G.A., A. (2021). The attitude of Distance Learners towards the Utilization of Learning Management System (A case study of National Open University of Nigeria). *Indonesian Journal of Teaching in Science*, *1*(1).

[4] Akcil, U., Uzunboylu, H., & Kinik, E. (2021). Integration of Technology to Learning-Teaching Processes and Google Workspace Tools: A Literature Review. *Sustainability*, *13*(9), 5018. https://doi.org/10.3390/su13095018

[5] Al-Fraihat, D., Joy, M., Masa'deh, R., & Sinclair, J. (2020). Evaluating E-learning systems success: An empirical study. *Computers in Human Behavior*, *102*, 67–86. https://doi.org/10.1016/j.chb.2019.08.004

[6] Alkhasawnh, S., & Alqahtani, M. (2019). Fostering Students' Self-Regulated Learning Through using a Learning Management System to Enhance Academic Outcomes at the University of Bisha. *Fostering Students' Self-Regulated Learning Through Using a Learning Management System to Enhance Academic Outcomes at the University of Bish*, *8*(2), 662–669. https://doi.org/10.18421/TEM82-47

[7] Ambayon, C. M. (2020). Modular-Based Approach and Students' Achievement in Literature. *International Journal of Education and Literacy Studies*, *8*(3), 32. https://doi.org/10.7575/aiac.ijels.v.8n.3p.32

[8] Anzaldo, G. D. (2021). Modular Distance Learning in the New Normal Education amidst Covid-19. *International Journal Of Scientific Advances*, *2*(3). https://doi.org/10.51542/ijscia.v2i3.6

[9] Araiza, M., & García Leal, M. (2021). Impact of an LMS Platform on the Academic Performance of Postgraduate Students: A Study from Data Analytics. *The International Journal of Technologies in Learning*, *28*(1), 75–91. https://doi.org/10.18848/2327-0144/cgp/v28i01/75-91

[10] Bacomo,C., A. C., P. Daculap, L., O. Ocampo, M. G., D. Paguia, C., T. Pentang, J., & M. Bautista, R. (2022). Modular Learning Efficiency: Learner's Attitude and Performance Towards Self-Learning Modules. *International Multidisciplinary Research Journal*, *4*(2), 60–72. https://doi.org/10.54476/s149512

[11] Barhoumi, C. (2015). The Effectiveness of WhatsApp Mobile Learning Activities Guided by Activty Theory on Students' Knowldege Management. *Contemporary Educational Technology*, *6*(3). https://doi.org/10.30935/cedtech/6151

[12] Barth-Cohen, L. A., Smith, M. K., Capps, D. K., Lewin, J. D., Shemwell, J. T., & Stetzer, M. R. (2015). What are Middle School Students Talking About During Clicker Questions? Characterizing Small-Group Conversations Mediated by Classroom Response Systems. *Journal of Science Education and Technology*, *25*(1), 50–61. https://doi.org/10.1007/s10956-015-9576-2

[13] Bautista, R. M., & Pentang, J. T. (2022). Ctrl C + Ctrl V: Plagiarism and Knowledge on Referencing and Citation among Pre-service Teachers. *International Journal of Multidisciplinary: Applied Business and Education Research*, *3*(2), 245–257. https://doi.org/10.11594/ijmaber.03.02.10

[14] Bernard, M., Sumarna, A., Rolina, R., & Akbar, P. (2019). Development of high school student work sheets using VBA for microsoft word trigonometry materials. *Journal of Physics: Conference Series*, *1315*(1), 012031. https://doi.org/10.1088/1742-6596/1315/1/012031

[15] Bervell, B., & Umar, I. N. (2017). Validation of the UTAUT Model: Re-Considering Non-Linear Relationships of Exogeneous Variables in Higher Education Technology Acceptance Research. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(10). https://doi.org/10.12973/ejmste/78076

[16] Bower, M. (2019). Technology-mediated learning theory. *British Journal of Educational Technology*, *50*(3), 1035–1048. https://doi.org/10.1111/bjet.12771

[17] Boyraz, S., & Ocak, G. (2021). Connectivism: A Literature Review for the New Pathway of Pandemic Driven Education. *International Journal of Innovative Science and Research Technology*, *6*(3).

[18] Bradley, V. M. (2020). Learning Management System (LMS) Use with Online Instruction. *International Journal of Technology in Education*, *4*(1), 68. https://doi.org/10.46328/ijte.36

[19] Branch, L. J. (2014). The Impact of Project-Based Learning and Technology on Student Achievement in Mathematics. *New Media, Knowledge Practices and Multiliteracies*, 259–268. https://doi.org/10.1007/978-981-287-209-8_24

[20] Brown, G. (2021, September 29). *The Connectivism and Constructivism*. Difference Between. http://www.differencebetween.net/miscellaneou

s/the-difference-between-connectivism-and-constructivism/

[21] Brush, K. (2019, December 30). *learning management system (LMS)*. SearchCIO. https://www.techtarget.com/searchcio/definition/learning-management-system

[22] Castroverde, F., & Acala, M. (2021). Modular distance learning modality: Challenges of teachers in teaching amid the Covid-19 pandemic. *International Journal of Research Studies in Education*, *10*(8). https://doi.org/10.5861/ijrse.2021.602

[23] Costly, K. C. (2014). The Positive Effects of Technology on Teaching and Student Learning. *The Positive Effects of Technology on Teaching and Student Learning*.

[24] Daryazadeh, S., Yavari, M., Madani, S. R., Taghavi-Ardakani, A., Azadchahr, M. J., & Shayeghi, F. (2022). Correlation Between the E-learning Attitude and Academic Achievement of Medical Students in Clinical Levels. *Educational Research in Medical Sciences*, *10*(2). https://doi.org/10.5812/erms.120391

[25] Deniz Deryakulu, & Şener Büyüköztürk Hüseyin Özçınar. (2009a). Predictors of Academic Achievement of Student ICT Teachers with Different Learning Styles. *CERN European Organization for Nuclear Research - Zenodo*. https://doi.org/10.5281/zenodo.1332732

[26] Dinah, A. (2018). Causes Of Poor Performance In Mathematics In Universal Secondary Education Schools In Kakiri Sub-County, Wakiso District. *Kampala International University*.

[27] Duffy, T., & Cunningham, D. (1996). Constructivism: Implications for the design and delivery of instruction. *Constructivism: Implications for the Design and Delivery of Instruction*.

[28] E., R., M., A., & V., N. (2021). Integration of Learning Management System as an Aid in Teaching: An Assessment. *European Journal of Educational Research*, *10*(4), 1907–1918. https://doi.org/10.12973/eu-jer.10.4.1907

[29] Engestrom, Y. (2000). Activity theory as a framework for analyzing and redesigning work. *Ergonomics*, *43*(7), 960–974. https://doi.org/10.1080/001401300409143

[30] Ford, K., & Lott, L. (2011). The impact of technology on constructivist pedagogies. Boise State University. *The Impact of Technology on Constructivist Pedagogies. Boise State University*.

[31] Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and Learning with Technology: Effectiveness of ICT Integration in Schools. *International Journal of Research in Education and Science*, *1*(2), 175. https://doi.org/10.21890/ijres.23596

[32] Gunawan, G., Suranti, N. M. Y., & Fathoroni, F. (2020). Variations of models and learning platforms for prospective teachers during the COVID-19 pandemic period. Indonesian Journal of Teacher Education. *Variations of Models and Learning Platforms for Prospective Teachers during the COVID-19 Pandemic Period. Indonesian Journal of Teacher Education*, *1*(2), 61–70.

[33] Hallberg, K., Cook, T. D., Steiner, P. M., & Clark, M. H. (2016). Pretest Measures of the Study Outcome and the Elimination of Selection Bias: Evidence from Three Within Study Comparisons. *Prevention Science*, *19*(3), 274–283. https://doi.org/10.1007/s11121-016-0732-6

[34] Handayanto, A., Supandi, S., & Ariyanto, L. (2018). Teaching using moodle in mathematics education. *Journal of Physics: Conference Series*, *1013*, 012128. https://doi.org/10.1088/1742-6596/1013/1/012128

[35] Hero, J. L. (2019). The Impact of Technology Integration in Teaching Performance. *The Impact of Technology Integration in Teaching Performance*, *48*(1), 101–114.

[36] Hu, Y., & Spiro, R. J. (2021). Design for now, but with the future in mind: a "cognitive flexibility theory" perspective on online learning through the lens of MOOCs. *Educational Technology Research and Development*, *69*(1), 373–378. https://doi.org/10.1007/s11423-020-09920-z

[37] Электронное обучение в теории, практике и исследованиях. (2018). *Voprosy Obrazovaniya / Educational Studies Moscow*, *4*, 81–98. https://doi.org/10.17323/1814-9545-2018-4-81-98

[38] Jung, S., & Huh, J. H. (2019). An Efficient LMS Platform and Its Test Bed. *Electronics*,

8(2), 154. https://doi.org/10.3390/electronics8020154

[39] Kathleen Dunaway, M. (2011). Connectivism. *Reference Services Review*, *39*(4), 675–685. https://doi.org/10.1108/00907321111186686

[40] Kassim, W. Z. W. (2021). Google Classroom: Malaysian University Students' Attitudes towards Its Use as Learning Management System. *Proceedings of the First International Conference on Science, Technology, Engineering and Industrial Revolution (ICSTEIR 2020)*. https://doi.org/10.2991/assehr.k.210312.072

[41] Kehrwald, B. A., & Parker, B. (2019). Editorial - Implementing online learning: Stories from the field. *Journal of University Teaching and Learning Practice*, *16*(1), 2–7. https://doi.org/10.53761/1.16.1.1

[42] Keshavarz, M., Rahimi, M., & Esmaeili, Z. (2013). The effect of e-learning on the academic development of university students. *Journal of Torbat Heydariyeh University of Medical Sciences*, *1*(2).

[43] Kraleva, R., Kralev, V., & Kostadinova, D. (2019). A Methodology for the Analysis of Block-Based Programming Languages Appropriate for Children. *Journal of Computing Science and Engineering*, *13*(1), 1–10. https://doi.org/10.5626/jcse.2019.13.1.1

[44] Kurt, S. (2021, February 21). *Constructivist Learning Theory. Education Technology*. Https://Educationaltechnology.Net/. Retrieved February 26, 2022, from https://educationaltechnology.net/constructivist-learning-theory/#:~:text=The%20constructivist%20theory%20is%20based,ideas%20with%20their%20prior%20knowledge

[45] Magno, C. (2017). Facilitating student learning in schools through a learning management system: An action research. *The International Journal of Research and Review*, *12*.

[46] Mapesos, R. M. L. (2017). Traditional Approach. *Traditional Approach*.

[47] Mattar, J. (2018). Constructivism and connectivism in education technology: Active, situated, authentic, experiential, and anchored learning. *RIED. Revista Iberoamericana De Educación a Distancia*, *21*(2), 201. https://doi.org/10.5944/ried.21.2.20055

[48] Mohammed, U. A. (2021, January 4). *GRIN - Effect of using learning Management System on academic Performance of Students in financial Accounting in Secondary School in Bauchi State*. https://www.grin.com/document/983916

[49] Mundir, M., & Umiarso, U. (2022). Students' Attitudes Toward Learning Management System (Lms) During Covid-19 Pandemic: A Case Study. *Lentera Pendidikan : Jurnal Ilmu Tarbiyah Dan Keguruan*, *25*(1), 68–81. https://doi.org/10.24252/lp.2022v25n1i6

[50] Piaget, J. (1971). Psychology and epistemology: Towards a theory of knowledge. Grossman. *Psychology and Epistemology: Towards a Theory of Knowledge. Grossman*.

[51] Obi, N. C., Ukpepi, C., & Ndifon, R. A. (2019). Constructivists' Theory and Science Education Classroom. *European Journal of Scientific Research*, *154*(4).

[52] Oguguo, B. C. E., Nannim, F. A., Agah, J. J., Ugwuanyi, C. S., Ene, C. U., & Nzeadibe, A. C. (2020). Effect of learning management system on Student's performance in educational measurement and evaluation. *Education and Information Technologies*, *26*(2), 1471–1483. https://doi.org/10.1007/s10639-020-10318-w

[53] Pentang, J. (2021). Impact Assessment and Clients' Feedback towards MATHEMATICS Project Implementation. *International Journal of Educational Management and Development Studies*, *1*(1), 90–103. https://doi.org/10.53378/346107

[54] Pourhosein Gilakjani, A., Mei Leong, L., & Nizam Ismail, H. (2013). Teachers' Use of Technology and Constructivism. *International Journal of Modern Education and Computer Science*, *5*(4), 49–63. https://doi.org/10.5815/ijmecs.2013.04.07

[55] Kelly, M. (2019, November 19). Pretests. ThoughtCo. https://www.thoughtco.com/importance-and-uses-of-pretests-7674

[56] Rabiman,R., Muhammad Nurtanto, & Nur Kholifah. (2020). Design And Development E-Learning System By Learning Management System (LMS) In Vocational Education. *International Journal of Scientific & Technology Research*, *9*(1), 1059–1063.

[57] Rahman, M., Daud, M. Y., & Ensimau, N. K. (2019). Learning Management System (LMS) in Teaching and Learning. *International*

Journal of Academic Research in Business and Social Sciences, *9*(11). https://doi.org/10.6007/ijarbss/v9-i11/6717

[58] Rathore, M. K., & Sonawat, R. (2015). Integration of technology in education and its impact on learning of students. *Integration of Technology in Education and Its Impact on Learning of Students.*, *2*(7 & 8), 235–246.

[59] Regoniel, P. (2021, December 14). *Modular Learning: 8 Tips for Effective Teaching*. Research-Based Articles. https://simplyeducate.me/2021/06/22/modular-learning/#:%7E:text=Modular%20learning%2C%20as%20the%20word,the%20aid%20of%20curriculum%20developers.

[60] Saygili, H., & Çetin, H. (2021). The Effects of Learning Management Systems (LMS) on Mathematics Achievement: A Meta-Analysis Study. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi*. https://doi.org/10.17522/balikesirnef.1026534

[61] Serin, H. (2018). A Comparison of Teacher-Centered and Student-Centered Approaches in Educational Settings. *International Journal of Social Sciences & Educational Studies*, *5*(1). https://doi.org/10.23918/ijsses.v5i1p164

[62] Siemens, G. (2008). Learning and knowing in networks: Changing roles for educators and designers. *Learning and Knowing in Networks: Changing Roles for Educators and Designers.*

[63] Ștefan, M. A. (2017). Using Constructivist Theory In E-Learning Effectively. *ELearning & Software for Education*, *1*.

[64] Sulisworo, D., Rohmadheny, P. S., Fatimah, N., & Arif, D. B. (2020). Learning analytics to predict student achievement in online learning during COVID- 19 mitigation. International Journal of Psychosocial Rehabilitation. *Learning Analytics to Predict Student Achievement in Online Learning during COVID- 19 Mitigation. International Journal of Psychosocial Rehabilitation*, *24*(10), 1844–1861.

[65] Taha, M. H., Abdalla, M. E., Wadi, M., & Khalafalla, H. (2020). Curriculum delivery in Medical Education during an emergency: A guide based on the responses to the COVID-19 pandemic. *MedEdPublish*, *9*, 69. https://doi.org/10.15694/mep.2020.000069.1

[66] Vintere, Anne (2018). A Constructivist Approach to the Teaching of Mathematics to Boost Competences Needed for Sustainable Development. RURAL SUSTAINABILITY RESEARCH 39(334), 2018 ISSN – 2256-0939. DOI:10.2478/plua-2018-0001

[67] *What is Online Learning?* (2022, March 6). Practical Adult Insights. https://www.practicaladultinsights.com/what-is-online-learning.html