

Synchronous, Asynchronous and Modular Distance Learning: Effects on Students' Mathematics Performance

ABSTRACT

Aims: This study was conducted to determine the significance of Synchronous Online Learning, Asynchronous Online Learning, and Modular Distance Learning on the students' performance in mathematics School Year 2021-2022.

Study design: Quasi-Experimental Design

Place and Duration of Study: The study was conducted at one of the public schools in the division of Misamis Oriental during the school year: 2021 - 2022.

Methodology: Respondents were that intact classes of students ($n=90$) fitted for synchronous and asynchronous learning (experimental groups) and modular learning (controlled group). The researcher made pretest and posttest questionnaires were validated and tested by the schools' statistician and validators for its adequacy in getting the data for the study. The data were analyzed using descriptive statistics like frequency, mean, percentage, standard deviation, and Analysis of Covariance (ANCOVA).

Results: Results showed that students have outstanding performance under synchronous online learning while very satisfactory for asynchronous online learning and modular distance learning. Furthermore, significant difference was also disclosed proving that the three (3) learning strategies were the reasons on students' improved Mathematics performance. Finally, it was recommended that use of various learning strategies must be employed on teaching and learning process to help and better the performance of students.

Conclusion: It was concluded that Students performed better under Asynchronous Online Learning compared to the other two (2) learning strategies utilized in this study. Thus, teaching and learning process can be more effective and productive with the implementation of various teaching strategies specially in providing remedial activities to the learners. Students' Mathematics Performance specifically at Synchronous Online Learning Strategy was described as outstanding level and interpreted as Very High Mathematics Performance. Moreover, students also achieved High Mathematics Performance on the other two (2) learning strategies. Thus, providing remedial activities can enhance students' performance in mathematics. The data revealed a significant difference; thus, the null hypothesis was rejected. In addition, the improvement of students' Mathematics Performance was brought about by the impact of the three learning strategies employed during the conduct of the study.

Keywords: synchronous online learning, asynchronous online learning, modular distance learning, mathematics performance, factoring

1. INTRODUCTION

Concepts or topics in Mathematics is one of the most important subject that a student should learn as part of preparation for the future. Although it has been stigmatized as difficult and boring subject, its importance and

use in basic daily living is undeniable. When the pandemic hit us in the latter part of the year 2019 up to the present the mode of learning delivery has suddenly shifted to a different manner.

Face to face classes was canceled and distance learning was implemented. Math teachers have to find ways and means to assist the students as they were not use to the new normal in education setting. Some students are still not fully developed as independent learners making themselves subject to getting low Mathematics performance. Thus, teachers resorts to exploring the advantages of distance learning via synchronous, asynchronous, modular distance learning mode. The Department of Education specifically the Division of Misamis Oriental wherein Alubijid National Comprehensive High School (ANCHS) and Alubijid East District is located was no exception. Distance Learning refers to a learning delivery modality, where learning takes place between the teacher and the learners who are geographically remote from each other during instruction. The strategies being tested of its impact on students' Mathematics performance are synchronous and asynchronous learning (experimental) and modular distance learning (controlled).

Synchronous Online Learning happens in real time basis. Wherein teacher and students interact in a specific virtual place at a set time. In these cases, teachers commonly take attendance and include video conferencing, teleconferencing, live chatting, and live-streamed lectures that must be viewed in real time (Staff, 2020).

Asynchronous Online Learning happens on the schedule and non-real time basis (Staff, 2020). In this environment, the teachers prepare the digital copy of the learning materials, weekly study guides and other resources for the said mode of learning. Parents supervised their child's interaction with the materials and communication with the teacher. Furthermore, students must accomplish the module activities, complete the individual learning plan, connect with the teacher for feedback through text, messenger, or any form of communication (Codamon, 2020).

Modular Distance Learning happens on the sole use of printed self-learning modules (Vacalares, 2022). In this environment, the teachers prepare the learning materials and other resources for the modular distance learning. Parents can still supervise their child's interaction with the materials. Furthermore, students must accomplish the module activities, complete the individual learning plan, connect with the teacher for feedback through text, messenger, or any form of communication (Codamon, 2020). Thus, outputs of the learners will be evaluated as basis for Mathematics performance.

Mathematics performance is the measurement of student achievement Math. As noted, teachers and education officials typically measure achievement using student activities like performance task, written works, portfolio and results from standardized tests like the pretest and post-test. Academic performance is the barometer in measuring what the students learn in a unit, quarter and even in a grade level. It does not only define about passing mark but about retention and mastery.

Research studies were also considered in choosing the type of learning modality as it gives ideas on its effectiveness and its efficiency as well as its flaws. Anzaldo (2021) confirmed that in the Philippines modular distance learning is the most common tool used in the delivery of education specially in the cities that enjoy modern living. Students in this area have much better internet access and gadgets to use as aid in studying.

Meanwhile, the study of Sumaoang (2020) revealed that the main challenges include: lack of school funds delivery of modules to students living at far flung areas, learners have difficulty adjusting to self-learning mode, and parents or guardians lack of knowledge or time to guide or assist their learners. This was affirmed by Alcala (2021) citing further those stakeholders should help and assist the school specially the teachers in planning for various alternatives to combat issues and challenges in the implementation of distance learning. Thus, success can be achieved if all sectors of society unite in supporting school programs and activities.

Moreover, Aksan (2021) revealed that students have positive perceptions towards modular distance learning in mathematics and posted positive academic (Very Satisfactory) performance. Thus, distance learning is an effective modality in the absence of face to face learning. Fidalgo (2020) stated that many students are interested in distance education but has concerns in terms of Time Management and English Language Skills.

In search of finding innovations and practices that made contributions to the learners' Mathematics performance, the teacher-researcher utilized the synchronous, asynchronous, and modular distance

learning delivery to ensure that learning and acquisition of knowledge and skills were still at high level. Thus, distance learning was utilized as the alternative learning delivery in giving assistance to the learners.

This study is anchored on the theories of Pavlov on behaviorism. Behaviorism focuses on how people behave. In the field of education, behaviorism examines how students behave through learning. More specifically, behaviorism focuses on observing how students respond to certain stimuli that, when repeated, can be evaluated, quantified, and eventually controlled for everyone.

The emphasis in behaviorism is on that which is observable and not on the mind or cognitive processes. In sum, if you cannot observe it, it cannot be studied. The development of behaviorism is frequently associated with Ivan Pavlov, famous for his experiments with dogs, food, and audible stimuli, such as a bell. In his experiments, dogs learned to associate food or feeding time with the sound of the bell and began to salivate. Pavlov conducted his experiments in the early 1900s and they were replicated by many other researchers throughout the 20th century (McLeod, 2017).

John B. Watson, among the first Americans to follow Pavlov's work, saw it as a branch of natural science. Watson became a major proponent of Pavlov and is generally credited with coining the term behaviorism. He argued that mind and consciousness are unimportant in the learning process and that everything can be studied in terms of stimulus and response.

Other major figures associated with behaviorism are B.F. Skinner and Edward Thorndike. Skinner is particularly well known, primarily because he introduced what he referred to as operant conditioning which emphasized the use of both positive and negative reinforcement to help individuals learn new behaviors.

This was quite different from Pavlov, who relied on simple reflexive responses to specific stimuli although both Pavlov and Skinner promoted repetitive behavior that leads to habit formation. These proponents have significant impact on various educators on the development of modular distance learning approaches. The delivery of the instructional model of this research were patterned on these theories and educators and realigned with the current state or level of understanding and learning capacity of learners under this study.

The studies of Cox and Weegar as cited by Calam (2022) revealed that behaviorism is still significant in today's teaching and learning process however it must be aligned with the current learning needs and styles of learners. Thus, using a theory in the teaching and learning process needs enhancements and modifications to make it more useful and effective. This was seen on the study of Reese (2013) revealed that behaviorism plays a vital role in the child development. To make it more effective it must be accompanied with the use of technologies available that can make learning aligned with the current trend in education.

Moreover, Budiman (2017) revealed that behaviorism plays vital role in the teaching and learning process. As time goes by teachers incorporate behaviorism with other theories to make learning more effective. Thus, according to Kaplan (2018) teachers must continue in using behaviorism theories in making best learning plan and activities for the learners. Indeed, Behaviorism is still functional and useful even at this time where technology advancement is at its higher level and that so many evolutions happened in the field of education.

This research study uses the Independent Variable (IV) and Dependent Variable (DV) Model. Independent Variable (synchronous, asynchronous, and modular) is defined as the variable/s that the researcher manipulates with the assumption that it has direct effect towards the assigned dependent variable/s. Meanwhile, Dependent Variable (students' mathematics performance) is defined as the variable being tested and measured by the researcher in the study or experiment. Another variable in this study is the covariate variable wherein in this study is the pretest as it is being considered to have effect on the dependent variable which is the students' mathematics performance. McLeod (2019) revealed that this model provided significant impact on decision making process. Meanwhile, Subiyakto (2016) study solidifies it with the same results. This provides clear view on the status of a current situation wherein it allows person or group of individuals concerned to have proper guidance and idea on what possible actions or set of innovations will be implemented to have better performance results.

According to Parra as cited by Vacalares (2022), IV-DV model plays an important role in various research sectors in our society like in the economic sector wherein it can assist flow of shadow prices of the hours worked and the extension of the use of technology. On the other hand, Deng as cited by Calam (2022) revealed that implementation of this model in a system or industry can provide better and clear analysis vital

to determining shortcomings of an industry or sector. Thus, IV-DV model is an effective tool in assisting and evaluating situations and cases. Moreover, Staff (2020) study revealed that this model provides a systematic method for better understanding and stressed that this was useful in different sector of our society in terms of diagnostics, assessments and evaluations.

The independent variables of this study were taken from the pretest scores of the targeted respondents from synchronous online learning, asynchronous online learning, and modular distance learning using the two sets of researcher made questionnaires. During the implementation aspect on this research, asynchronous online learning used self-learning modules in digital copy (word or pdf file) saved in a tablet gadget and can visit or surf the internet at their convenient time. Modular distance learning used plain printed or hard copy of the of the self-learning modules and the cannot or not allowed to access the internet while synchronous online learning utilized the google meet platform for the online class sessions.

The study attempted to compare student's Mathematics performance. Specifically, it seek to find answers to the following:

1. What is the level of Mathematics performance of students based on indicator scores through pretest and posttest scores as exposed to: a. synchronous online learning, b. asynchronous online learning, and c. modular distance learning?
2. What is the level of Mathematics performance of students based on overall scores through pretest and posttest scores as exposed to: a. synchronous online learning, b. asynchronous online learning, and c. modular distance learning?
3. Is there a significant difference of the students' pretest and post-test scores as Mathematics performance as exposed to: synchronous online learning, asynchronous online learning, and modular distance learning?

2. MATERIAL AND METHODS

2.1 Design

This study used quantitative research utilizing the descriptive correlation design because it involves respondents, The researcher utilized the quasi-experimental method in conducting the study. Quasi-experimental research design aimed to demonstrate the cause-and-effect correspondence between the identified independent and dependent variables (Thomas, 2022). It did not employ random sampling method as it utilized intact classes for the identified groups in this study namely: synchronous online learning and asynchronous online learning for the experimental groups and modular distance learning for the controlled group.

The primary purpose of this research was to find the impact of synchronous online learning, asynchronous online learning, and modular distance learning on the student's mathematics performance. Moreover, it would also provide data on the implementation of DepEd digital program and its effects on student's learning.

The conduct of the research run for a month. Set of researcher-made questionnaires of multiple-choice type for pretest and post-test were utilized to measure the Mathematics performance of students. Likewise, it would measure the effectiveness of the synchronous online learning, asynchronous online learning, modular distance learning. Finally, this research design was used to investigate if the three (3) learning strategies were the reason or the contributing factors on the status of students' mathematics performance.

2.2 Respondents and Sampling Procedure

The selection of the participants of this research study was based on the following criteria. A. The respondent is a recipient of DepEd Pilot test for Digital Program wherein he/she was able to get the chance to use or borrow a tablet provided by DepEd which can use for asynchronous online learning. B. The respondent belongs to the students with gadgets/appliances at home like Television, Personal Computer, Cellphone or Laptop with stable internet connection that is suitable and ideal for synchronous online learning. C. The respondent can only avail on the use of self-learning modules and cannot access synchronous or asynchronous online learning strategies.

Based on the criteria, ninety (90) students qualified for conduct of the study wherein they were assigned under these conditions: A. The 30 students that are recipients of DepEd Digital program wherein each of

them was able to borrow tablet use for educational activities purposes only were under the synchronous online learning. B. Another set of 30 students will be under the asynchronous online learning. C. The final 30 set of students were utilized under modular distance learning. Moreover, no sampling procedure was done as the total universal population or intact classes of the targeted participants were utilized.

The participants of this study were asked to join voluntarily and that they were informed about the whole content of the research as well as the purpose and contents of the study. The researcher assured the participants that data gathered, and details taken from them were held with utmost confidentiality for privacy, safety, and ethics concerns. Since the students' participation in this research study was voluntary therefore, they can choose to participate or not. The respondents were also be assured that participation or non-participation in this activity will not in any way affect their mathematics performance as a student. However, if the student decides to participate and then decide to avail "stop participation in the latter part of the study like the conduct of the unstructured interview it will not be permitted but the students can request that the information provided by them will not be used as part in the research study. Since the respondents' participation in this research is study is voluntary therefore anyone from them can choose or have the right to refuse or withdraw. Respondents were also given an assurance that participation or non-participation in this activity will not in any way affect their mathematics performance as a student. If the respondents chose to participate in this research endeavor, they will still have the opportunity to review their responses and remarks in individual interviews and erase part or all of the recording or note.

Finally, the student-participants on this study were still at junior high school level. Thus, they are considered minors. Therefore, consent letter to be signed by the parents or legal guardian were sent and secured before conducting the pilot and actual conduct of the study to avoid legal violations. In accepting the signed parent/guardian consent form the following have been met:

On the parent/guardian's part 1) They have read the foregoing information about the research and its questionnaires, or it has been read to them. They have had the opportunity to ask questions about it and any questions they have been asked to have been answered, explained, and cleared to their satisfaction. They consent voluntarily their child to be a participant in this research study that will serve as thesis requirement of the investigator.

On the investigator's part 2) He confirmed that the parent/guardian of the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered and explained correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

2.3 Instrument

The instruments used to gather the data and information of this study composed of two sets. The first set of the questionnaire in multiple choice type was the pre-test wherein it covered the factoring lessons. The second set of the questionnaire in multiple choice type was the post-test. Both pretest and post-test questionnaires contain 50 items multiple choice test wherein each correct answer was worth 2 points.

The researcher conducted a pilot study of the questionnaires in one of the junior high schools in Alubijid East District in Misamis Oriental. After conducting the pilot test, the data gathered were subjected to Cronbach's Alpha test to determine the reliability and validity of the pretest and posttest questionnaires. The researcher-made questionnaires underwent validation, which was graded by licensed English and Math teachers. After obtaining permission from the validators, they rated the researcher-made questionnaire, and the researcher gathered the rating data for calculation. The overall mean of the ratings was 4.58. The result of 4.58 belongs to a scale of 5 which is Very Highly Valid. This means that the questionnaire was valid and could provide unbiased data for the study, allowing 0-5% margin of error.

3. RESULTS AND DISCUSSION

3.1 Students' Performance on Synchronous Online Learning (SOL)

The data revealed an overall mean of 56.02 (SD=4.04) for pretest equivalent to Did Not Meet Expectations Level. The posttest overall Mean was 91.24 (SD=2.52) equivalent to Outstanding Level. This implied that the students under the synchronous online learning group have improved their Mathematics Performance when pretest and posttest scores were considered.

For the pretest, fifty (50) out of fifty (50) or 100% of the indicators were at did not meet expectations level. The highest rated indicators were: 4. Special forms of algebraic expressions whose product are readily seen with the mean of 70 (SD=4.32), 5. Which of the following is NOT a special product? With the mean of 70 (SD=4.39) and 12. Which of the following is a special product? With the mean of 70 (SD=4.10). All of which belongs to did not meet expectations level. These three (3) indicators belong to the learning objective: Define Special Product. The lowest rated indicators were: 18. Determine the factor of this polynomial ($m^2 - 9$)? with the mean of 45 (SD=4.15), 23. Factor ($x^2 - 36$) with the mean of 45 (SD=4.57) and 36. Find the missing term to make the polynomial a perfect square trinomial: $m^2 + 4m + \underline{\quad}$? With the mean of 45 (SD=3.93). All of which belongs to did not meet expectations level. These three (3) indicators belong to the learning objective: Factor the Difference of Two Squares.

This data implied that the respondents scores under Synchronous Online Learning Strategy was at Did Not Meet Expectations Level. This further indicates that remedial activities or enhancements must be implemented as the level of performance of students in mathematics is at lowest levels. Mastery on the concepts of mathematics is essential in the development of a student therefore situations like this should be given attention and actions. Students revealed that there were topics in Mathematics that require more time to get mastered and factoring was definitely one of them (Namocatcat, 2022). Jamis (2022) agreed and further stressed that the topic factoring requires ample time to be fully mastered and learned by the students.

For the posttest, thirty-six (36) out of fifty (50) or 72% of the indicators were at did not meet expectations level, eleven (11) out of fifty (50) or 22% were at very satisfactory level, three (3) out of fifty (50) or 6% were at satisfactory level and non for fairly satisfactory and did not meet expectations level respectively. The highest rated indicators were: 4. Special forms of algebraic expressions whose product are readily seen with the mean of 96 (SD=2.02), 5. Which of the ff. is NOT a special product? With the mean of 96 (SD=2.14) and 12. Which of the following is a special product? With the mean of 96 (SD=2.52). All of which belongs to outstanding level. These three (3) indicators belong to the learning objective: Define Special Product. The lowest rated indicators were: 18. Determine the factor of this polynomial ($m^2 - 9$)? with the mean of 84 (SD=2.71), 23. Factor ($x^2 - 36$) with the mean of 84 (SD=2.63) and 36. Find the missing term to make the polynomial a perfect square trinomial: $m^2 + 4m + \underline{\quad}$? With the mean of 84 (SD=2.77). All of which belongs to did not meet expectations level. These three (3) indicators belong to the learning objective: Factor the Difference of Two Squares.

This data implied that the respondents under Synchronous Online Learning Strategy is at Outstanding Level. This further indicates that the remedial activities or enhancements conducted made changes on the level of performance of students in mathematics wherein it was at the lowest level during the pretest and move up to the highest level of performance when posttest was conducted. Thus, mastery on the concepts of mathematics were achieved. Per interview, the students admitted that they like the learning strategy as it was closer to face to face teaching and learning. This finding aligned with the study of Ampo (2022) who found out that students under synchronous learning environment performs better in Mathematics and were comfortable with it. This was also confirmed by the study of Cuadra (2022) revealing the same results.

According to Lin (2017), synchronous learning provided positive impact on students' performance and also their motivation towards the subject Mathematics. Synchronous learning allowed the students to feel the presence of face-to-face learning in a virtual manner making them feel comfortable and at ease. This was affirmed by the study of Guerero (2020) adding that synchronous learning has positive impact on student participation in the learning process and outcome. Furthermore, the study of Dhawan (2020) revealed that student's exposure to synchronous learning made them more resilient in facing the subject mathematics as they have more ways and means to learn the subject.

3.2 Students' Performance on Asynchronous Online Learning (AOL)

The data revealed an overall mean of 69.80 (SD=3.40) for pretest equivalent to Did Not Meet Expectations Level. The posttest overall Mean was 89.22 (SD=2.50) equivalent to Very Satisfactory Level. This implied that the students under the asynchronous online learning group have improved their Mathematics Performance when pretest and posttest scores were considered.

For the pretest, forty-seven (47) out of fifty (50) or 94% of the indicators were at did not meet expectations level while three (3) out of fifty (50) or 6% of the indicators were at fairly satisfactory level. The highest rated indicators were: 15. Which of the following gives the product of $(3x + y)^2$? With the mean of 77 (SD=3.48)

equivalent to fairly satisfactory level. This indicator belongs to the learning objective: Identify trinomials that is a product of square of binomial. The lowest rated indicators was: 8. Find an expression that when placed in the blank makes the statement Correct: $(x + 1)(x - y + 1) = x^2 - xy + \underline{\hspace{1cm}} - y + 1$? With the mean of 61 (SD=3.74) equivalent to did not meet expectations level. This indicator belongs to the learning objective: Find the product of Binomial and Trinomial.

This data implied that the respondents scores under Asynchronous Online Learning Strategy was at Did Not Meet Expectations Level. This further indicates that remedial activities or enhancements must be implemented as the level of performance of students in mathematics is at lowest levels. Mastery on the concepts of mathematics is essential in the development of a student therefore situations like this should be given attention and actions.

For the posttest, twenty-nine (29) out of fifty (50) or 58% of the indicators were outstanding level, eight (8) out of fifty (50) or 16% were at very satisfactory level, thirteen (13) out of fifty (50) or 26% were at satisfactory level and non for fairly satisfactory and did not meet expectations level respectively. The highest rated indicators were: 3. Which of the following gives the product of $(s + 4)^2$? With the mean of 96 (SD=2.18), 6. Find the missing term to complete: $(x + 5)(x + 5) = x^2 + \underline{\hspace{1cm}} + 25$ with the mean of 96 (SD=2.06), and 15. Which of the following gives the product of $(3x + y)^2$? With the mean of 96 (SD=2.73) all at outstanding level. These three (3) indicators belong to the learning objective: Identify trinomials that is a product of square of a binomial. The lowest rated indicators were: 19. Evaluate $(x^3 - 1)$ with the mean of 80 (SD=2.63) and 24. Factor $(x^3 + 8)$ with the mean of 80 (SD=2.87) all belong to satisfactory level. These two (2) indicators belong to the learning objective: Factor sum and difference of two cubes.

This data implied that the respondents under Asynchronous Online Learning Strategy was at Very Satisfactory Level. This further indicated that the remedial activities or enhancements conducted made changes the level of performance of students in mathematics wherein it was at the lowest level during the pretest and move up to the second highest level of performance when posttest was conducted. Thus, mastery on the concepts of mathematics were achieved. Per interview, the students admitted that they like the learning strategy as it allowed them to study their lessons at their own phasing and convenient time.

Gayrama (2022) disclosed that there were growing number of learners that prefers to study and make their assignments at their convenient time to avoid stress and fatigue. Learners tend to motivate themselves first before indulging to studying and making assigned tasks and assignments. Villastique (2022) further stressed that even in conducting remedial activities the students have to be given the mindset or motivation to learn and improve themselves for better performance and outcomes.

3.3 Students' Performance on Modular Distance Learning (MDL)

The data revealed an overall mean of 69.86 (SD=3.57) for pretest equivalent to Did Not Meet Expectations Level. The posttest overall Mean was 89.04 (SD=2.49) equivalent to Very Satisfactory Level. This implied that the students under the modular distance learning group have improved their Mathematics Performance when pretest and posttest scores were considered.

For the pretest, forty-seven (47) out of fifty (50) or 94% of the indicators were at did not meet expectations level while three (3) out of fifty (50) or 6% of the indicators were at fairly satisfactory level. The highest rated indicators were: 3. Which of the following gives the product of $(s + 4)^2$? With the mean of 76 (SD=3.80) and 15. Which of the following gives the product of $(3x + y)^2$? With the mean of 76 (SD=3.80) equivalent to fairly satisfactory level. These indicators belong to the learning objective: Identify trinomials that is a product of square of binomial. The lowest rated indicators were: 1. Find the missing term of $a^2 - 81 = (a + \underline{\hspace{1cm}})(a - \underline{\hspace{1cm}})$ with the mean of 61 (SD=3.00) and 26. The product of the sum and difference of two terms is $\underline{\hspace{1cm}}$ with the mean of 61 (SD=3.92) both equivalent to did not meet expectations level. This indicator belongs to the learning objective: Identify factors of difference of two squares.

This data implied that the respondents scores under Modular Distance Learning Strategy was at Did Not Meet Expectations Level. This further indicated that remedial activities or enhancements must be implemented as the level of performance of students in mathematics is at lowest levels. Mastery on the concepts of mathematics is essential in the development of a student therefore situations like this should be given attention and actions. Per interview, students revealed that there were topics in Mathematics that require more time to get mastered and factoring was definitely one of them.

For the posttest, thirty-five (35) out of fifty (50) or 70% of the indicators were outstanding level, three (3) out of fifty (50) or 6% were at very satisfactory level, twelve (12) out of fifty (50) or 24% were at satisfactory level and non for fairly satisfactory and did not meet expectations level respectively. The highest rated indicators were: 3. Which of the following gives the product of $(s + 4)^2$? With the mean of 96 (SD=2.44) and 15. Which of the following gives the product of $(3x + y)^2$? With the mean of 96 (SD=2.12) all at outstanding level. These two (2) indicators belong to the learning objective: Identify trinomials that is a product of square of a binomial. The lowest rated indicators were: 49. The number that will make the equation $y^2 - 14y + \underline{\hspace{1cm}}$ correct with the mean of 80 (SD=2.27) and 50. The product of $(x+3)(x+3)$ with the mean of 80 (SD=2.42) all belong to satisfactory level. These two (2) indicators belong to the learning objective: Factor sum and difference of two cubes.

This data implied that the respondents under Modular Distance Learning Strategy is at Very Satisfactory Level. This further indicates that the remedial activities or enhancements conducted made changes the level of performance of students in mathematics wherein it was at the lowest level during the pretest and move up to the second highest level of performance when posttest was conducted. Thus, mastery on the concepts of mathematics were achieved.

Factoring is one of the concepts in Mathematics that have complex subtopics and were only given minimal time allotment during the teaching and learning process. That is why its level of mastery is oftentimes low. However, with the advent of providing additional activities and assistance like tutorials or worksheets its level of learning would definitely improve Villastique (2022). Finally, Vacalares (2022) admitted that giving remedial classes and activities specifically in factoring provides positive gains on both teacher and students wherein the students gain more knowledge and skills while the teachers achieved satisfaction and fulfillment in giving assistance to students in need and in achieving higher performance as well.

3.4 Comparative Students' Performance on SOL, AOL, and MDL

The data revealed that students under Synchronous Online Learning have much better results than the students under Asynchronous Online Learning and Modular Distance Learning strategies as it recorded Did Not Meet Expectations Level with interpretation of Very Low Mathematics Performance during the pretest and Outstanding Level with interpretation of Very High Mathematics Performance after the conduct of the study based on the posttest. Meanwhile AOL and MDL results were at Very Satisfactory Level with interpretation of High Mathematics Performance respectively.

This implied that in all three (3) learning areas, the efforts by both teachers and students were not wasted as improvements were seen and observed with students belonging to synchronous online learning group registering the best results. According to Mustaq (2013), students that makes more efforts in studying mathematics often gain much higher performance. Parent's support, self-confidence and interest in math are also key factors in determining math performance. That's why assistance must be provided as much as possible to ensure positive notion towards mathematics.

3.5 Test Significance on Students' Performance on SOL, AOL, and MDL

The highlighted results (method) showed an ANCOVA (F-test) results of 5.662 (P-value=0.005) which is lower than the 0.05 level significance. This implies that posttest scores of each method or strategy have significant effects on the students' level of performance. Thus, the null hypothesis is rejected.

This further indicates that the strategies utilized in this study have significantly impacted the performance of the students. Moreover, the non-significant value of pretest signifies that it has no impact on the posttest scores of the students. Therefore, the final scores of the students were affected by the three (3) learning strategies employed in the study.

Moreover, research results of Ullah (2018) and Armenta (2019) concluded that aiding students' needs enhanced the academic achievement of students in the experimental group significantly, hence, it was an effective method of instruction for teaching at secondary level. They further suggested other teaching methodologies must be incorporated in the teaching and learning process, and it may be given due consideration in all teacher education practices. This can lead to better study habit and performance among students.

Duncan as cited by Calam (2022) stressed that asynchronous learning is significant to learners' performance as it allowed them to have ample time to prepare and study before taking the exams. Independent learning ability is also a key factor in achieving better performance in asynchronous learning. Meanwhile, Gayrama (2022) revealed that students under asynchronous learning achieved high learning levels and had positive perceptions towards the mode of learning.

Meanwhile, Vacalares (2022) revealed that modular learning showed significant differences on students learning experiences and performance. The researcher further stressed that students began to adjust to this new normal setting in order to cope up with the timeline and submission of needed outputs.

Furthermore, Jaudian (2022) and Janubas (2022) both claimed that modular distance learning can be one of the most effective alternatives of learning delivery as it is advantageous to minors that are not allowed to freely go out of their homes and also to working students that needs to balance their time for work and study.

Finally, although all three (3) strategies have significant effects on the students' performance, it can be observed that students performed better under synchronous online learning compared to asynchronous modular learning and modular distance learning respectively. Therefore, students are still not fully developed as independent learners and that guidance and assistance of teachers are still required.

4. CONCLUSION

Based on the findings of this study, the following are concluded: Students performed better under Asynchronous Online Learning compared to the other two (2) learning strategies utilized in this study. Thus, teaching and learning process can be more effective and productive with the implementation of various teaching strategies specially in providing remedial activities to the learners. Students' Mathematics Performance specifically at Synchronous Online Learning Strategy was described as outstanding level and interpreted as Very High Mathematics Performance. Moreover, students also achieved High Mathematics Performance on the other two (2) learning strategies. Thus, providing remedial activities can enhance students' performance in mathematics. The data revealed a significant difference; thus, the null hypothesis was rejected. In addition, the improvement of students' Mathematics Performance was brought about by the impact of the three learning strategies employed during the conduct of the study.

REFERENCES

1. Abdul, M. (2021). Comparison of Students' Academic Performance in Mathematics Course with Synchronous and Asynchronous Online Learning Environments during Covid-19 Crisis. *HMARS*, 10(2): 492-501. <http://dx.doi.org/10.6007/IJARPED/v10-i2/10131>
2. Agarwal, A. (2019). How Modular Education is Revolutionizing the Way we Learn and Work. *IJSR*, 9(1). <https://smartech.gatech.edu>
3. Aksan, J. (2021). Effect of Modular Distance Learning Approach to Academic Performance in Mathematics of Students in Mindanao State University-Sulu Senior High School Amidst Covid-19 Pandemic. *Open Access Indonesia Journal of Social Sciences*, 4(4), 386-409. <https://doi.org/10.37275/oaijss.v4i2.64>
4. Alcalá, M. (2021). Modular Distance Learning Modality: Challenges of Teachers in Teaching Amid the Covid-19 Pandemic. *International Journal of Scientific Research in Education*, 10(3). <https://doi.org/10.5861/ijrse.2021.602>
5. Amiti, F. (2020). Synchronous and Asynchronous E-learning. *European Journal of Education and E-Learning Studies*, 5(2). <https://oapub.org/edu>
6. Ampo, J. (2022). Learned Competencies In English, Mathematics, Filipino And Araling Panlipunan Areas Of Pupils In Sta. Ana Elementary School, District Of Tagoloan. Cagayan de Oro College. Carmen, Cagayan de Oro City, Philippines
7. Anzaldo, G. (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>

8. Arcilla, J. (2020). DepEd: Most Parents Prefer Modular Learning. Manila, Philippines. <https://www.manilatimes.net/2020/07/31/news/national/depd-most-parents-prefer-modular-learning/748207/>
9. Arinto, P. (2013). Teaching at a distance in a digital age: Perspectives from the philippines. *Researchgate Publications*, Retrieved from <https://discovery.ucl.ac.uk>
10. Armenta, Z. (2019). The effect of the presence tutorials in the academic performance of the administration students of a university of the north of mexico. *GSJ Publication*.
11. Aque, A. (2021). Asynchronous Learning: Its effects on Academic Performance and Students' Motivation. *Thabiea: Journal of Natural Science Teaching* 4(1). <http://journal.iainkudus.ac.id/index.php/Thabiea>
12. Berry, S. (2017). Educational Outcomes of Synchronous and Asynchronous High School Students: A Quantitative Causal-Comparative Study of Online Algebra. *ERIC Publications*. <https://eric.ed.gov/?id=ED579952>
13. Bondoc, B. (2014). Action Research Made Easy. *First Edition* page 180-210. Lorimar Publishing. Manila Philippine
14. Broto, A. (2010). Statistics Made Simple. *Second publication* page 50-90. National Bookstore. Manila, Philippines
15. Calam, W. (2022). Exploring the Advantages and Disadvantages of Modular Distance Learning. Basic Research. DepEd Division Misamis Oriental, Philippines
16. Calmorin, L. (2010). Research @nd Statistics with Computer. *Third Edition* page 90-130. Rex Bookstore. Manila, Philippines
17. Cherry, K. (2019). Freud's Id, Ego, and Superego. *VWM Publications*, 9(1). <https://www.verywellmind.com/the-id-ego-and-superego-2795951>
18. Cherry, K. (2020). A Guide to the 5 Levels of Maslow's Hierarchy of Needs. <https://www.masterclass.com/articles/a-guide-to-the-5-levels-of-maslows-hierarchy-of-needs>
19. Codamon, D. (2020). Understanding the Distance Learning Modalities. *DPublications*, 9(3). <https://pia.gov.ph/news/articles/104927>
20. Coogle, C. (2015). Synchronous and Asynchronous Learning Environments of Rural Graduate Early Childhood Special Educators Utilizing Wimba and Ecampus. *MERLOT Journal of Online Learning and Teaching*, 11(2):1-15. <https://jolt.merlot.org>
21. Cox, M. (2011). Advancing the Diagnostic Analysis of Environmental Problems. *International Journal of the Commons*, 5(2), 346–363. <http://doi.org/10.18352/ijc.273>
22. Cuadra, E. (2021). Students' Academic Performance in SAT-Aided Modular Learning: Basis on Providing Interventions for Learners in Mathematics. A Basic Research Study. Alubijid, Misamis Oriental, Philippines.
23. Deng, W. (2017). A Comparison of the Climates of the Medieval Climate Anomaly, Little Ice Age, and Current Warm Period Reconstructed using coral Records from the Northern South China Sea. *Agupublications*, 10(1). <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016JC01245>
24. Dhawan, S. (2020). Online Learning: A Panacea in the Time of Covid-19 Crisis. *International Journal of Engineering Technologies and Management Research*, 8(10), 16-32. <https://doi.org/10.1177/0047239520934018>
25. Duncan, K. (2012). The Effect of Synchronous and Asynchronous Participation on Students' Performance in Online Accounting Courses. *Researchgate Publication*, 21(4):1-19. <https://doi.org/10.1080/09639284.2012.673387>
26. Enriquez, R. (2020). The Use of MELCs in the Normal and its impact on learning of the learned competencies in core subjects. Unpublished Thesis. Cagayan de Oro College. Carmen, Cagayan de Oro City, Philippines
27. Fabriz, S. (2021). Impact of Synchronous and Asynchronous Settings of Online Teaching and Learning in Higher Education on Students' Learning Experience during Covid-19. *Front. Psychol.* 12:733554. <https://doi.org/10.3389/fpsyg.2021.733554>
28. Fan, S. (2010). Covariate. In N. J. Salkind (Ed.), *Encyclopedia of Research Design* (pp. 285-287). SAGE Publications, Inc., <https://dx.doi.org/10.4135/9781412961288.n85>

29. Fidalgo, P. (2020). Students' Perceptions on Distance Education: A Multinational Study. *Researchgate Publications*. <https://www.researchgate.net/publication>
30. Fowler, R. (2019). The Effects of Synchronous Online Course Orientation on Student Attrition. (Doctoral dissertation). Retrieved from <https://scholarcommons.sc.edu/etd/5346>
31. French, S. (2015). The Benefits and Challenges of Modular Education Curricula. *Melbourne Publications*. <https://melbourne-cshe.unimelb.edu.au>
32. Gayrama, J. (2022). Learned Competencies in the Learning Areas of Junior High School. Unpublished Thesis. Cagayan de Oro College. Carmen, Cagayan de Oro City, Philippines
33. Gimodo, A. (2022). Learned Competencies in 7 Learning Areas of Junior High Schools in Tagoloan District. Unpublished Thesis. Cagayan de Oro College. Carmen, Cagayan de Oro City, Philippines
34. Guerrero, A. (2020). E-learning in the Teaching of Mathematics: An Educational Experience in Adult High School. *Researchgate Publications*, 10. <https://doi.org/10.3390/math8050840>
35. Guinocor, M. (2020). Mathematics Performance of Students in a Philippine State University. *IJME*, 15(3). <https://doi.org/10.29333/iejme/7859>
36. Han, Y. (2016). An In-Depth Study of Undergraduate Tutorial System Based on Education and Teaching Integration Reform. *IJSR Publications*, 10(3). <https://www.shs-conferences.org>
37. <https://www.youtube.com/watch?v=idCEA0MHRW4>
38. <https://www.youtube.com/watch?v=0rGevuktP64>
39. Janubas, I. (2022). The Impact of Modular Distance Learning Approaches on Students' Academic Achievement. Research Paper. DepEd Division of Lanao del Norte, Philippines
40. Jameel, H. (2013). Causes of Poor Performance in Mathematics from the Perspective of Students, Teachers, and Parents. *ASRJETS*, 2313-4410. [https://www.ijhssi.org/papers/vol9\(6\)/Series-1/C0906011018.pdf](https://www.ijhssi.org/papers/vol9(6)/Series-1/C0906011018.pdf)
41. Jamis, Matela S. (2022). Impact of Pocket Tutorial on the Academic Performance of Grade 9 Students in Mathematics. A Research Study. Misamis Oriental, Philippines
42. Jaudian, C. (2022). Students' Performance under Synchronous and Asynchronous Mode of Learning: An investigation. Basic Research. DepEd Division of Misamis Oriental, Philippines
43. Jena, A. (2019). Effects of Asynchronous Intervention on Learning Performance in Relation to Thinking Skills, Executive Functions and Attention Benefits of Indian Students. *The Online Journal of Distance Education and e-Learning*, 7(3). <https://www.tojdel.net/journals/tojdel/articles/v07i03/v07i03-01.pdf>
44. Kaplan, D. (2018). Behaviorism in Online Teacher tTaining. *Scientific Publications*, 9(4): 570-577. <https://doi.org/10.4236/psych.2018.9403>
45. Kolkorov, A. (2020). Advantages and Disadvantages of Distance Learning on Students' and Teachers of the Physical Culture Faculty Opinion. *MSRU Publications*, 9(3). <https://eztalks.co>
46. Kuijk, A. (2018). Herzberg Two Factor Theory of Motivation. *TH Publications*, 8(3). <https://www.toolshero.com>
47. Lector, L. (2020). Tutorials Teaching: Advantages and Disadvantages. *SLN Journals*, 8(2). <http://studylecturenates.com>
48. Lee, J. (2018). The Effectiveness of Online Curriculum on the Academic Achievement of Students with Cognitive, Emotional, and Behavioral Disabilities. *CPSE Journals*, 9(1). <https://repository.stcloudstate.edu>
49. LeShea, A. (2013). The Effects of Asynchronous Class Sessions on Students' Academic Achievement and Levels of Satisfaction. *VCDC Journal Publications*, 8(1). <https://digitalcommons.liberty.edu/doctoral/769/>
50. Lin, Y. (2017). The Effect of Blended Learning in Mathematics Course. *EURASIA Journal of Mathematics Science and Technology Education*, 13(3). <https://doi.org/10.12973/eurasia.2017.00641a>
51. Malik, M. (2017) E-learning: Students' Perspectives About Asynchronous and Synchronous Resources. *Bulletin of Education and Research*, 39(2): 183-195. <https://files.eric.ed.gov/fulltext/EJ1210223.pdf>

52. Malkin, A. (2016). An Investigation of the Efficacy of Asynchronous Discussion on Students' Performance in an Online Research Method Course. *Behav Anal Pract.*, 11(3): 274–278. <https://doi.org/10.1007/s40617-016-0157-5>
53. Martin, F. (2021). A Meta-Analysis on the Effects of Synchronous Online Learning on Cognitive and Affective Educational Outcomes. *IRRODL*, 22(3). <https://doi.org/10.19173/irrodl.v22i3.5263>
54. Martinez, E. (2012). Thesis and Dissertation – Preparation Made Easy. First edition. Page 205-235. *Buksu Publishing*. Bukidnon, Philippines
55. McKay, T. (2016). Assessing the Impact of Tutors on First Year Academic Performance at a South African University. South Africa. *Researchgate Publications* (9). <https://www.researchgate.net>
56. McLeod, Saul. (2019). What are Independent and Dependent Variables? <https://www.simplypsychology.org/variables.html>
57. Mcleod, S. (2017). Behaviorist Approach. *SP Journal Publications*, (10). Retrieved from <https://www.simplypsychology.org>
58. Means, B. (2013). The Effectiveness of Online and Blended Learning: A Meta-Analysis of the Empirical Literature. *Teachers College Records*, 115:1-47. <http://www.learnonline.ecampusontario.ca>
59. Milicic, G. (2021). Distance Learning in Mathematics Education: Synchronous and Asynchronous Learning with Mathematics @home. *MCM Journal Publications*, 9(1). <https://doi.org/10.21125/edulearn.2021.2101>
60. Moallem, M. (2015). The Impact of Synchronous and Asynchronous Communication Tools on Learner Self-Regulation, Social Presence, Immediacy, Intimacy and Satisfaction in Collaborative Online Learning. *The Online Journal of Distance Education and e-Learning*, 3(3):1-23. <http://www.tojdel.net/>
61. Mori, I. (2015). The Effects of Supplementary Tutoring on students' Mathematics Achievement. *ISSDP Publications*, 7(2). <https://www.iss.u-tokyo.ac>
62. Murphy, E. (2011). Asynchronous and Synchronous Teaching and Learning in High-School Distance Education. *Education Faculty Publications*, 7(10). <https://doi.org/10.1111/j.1467-8535.2010.01112>
63. Mustaq, F. (2013). Mathematics Achievements among High School sStudents. *DP Journals*, (8)(9). <http://www.diva-portal.org>
64. Namocatcat, Angie O. (2021). Parallel and Non-Parallel Sessions (PNPS): Reinforcing MDL in Providing Much Better Learning Environment for Mathematics. A Research Study. Misamis Oriental, Philippines
65. Odutayo, A. (2017). Effect of Peer Tutoring on Students' Academic Performance in Ilorin South, Nigeria. *Journal of Peer Learning*, 10(1). <https://files.eric.ed.gov/fulltext/EJ1147960.pdf>
66. Ogbonna, C. (2019). Synchronous versus Asynchronous E-learning in Teaching Word Processing: An Experimental Approach. *AJOL*, 39(2). <https://www.ajol.info/>
67. Parra, S. (2016). Use of Student Created Video Podcasts to Promote Foreign Language Grammar Acquisition in Middle School. *NSU Works Publications*, 7(1). https://nsuworks.nova.edu/gscis_etd/971/
68. Pavitt, C. (2014). An Interactive Input–Process–Output Model of Social Influence in Decision-Making Groups. *Sage Publications*, 9(5). <https://journals.sagepub.com/doi/10.1177/1046496414548353>
69. Peteros, E. (2019). Factors Affecting Mathematics Performance of Junior High School Students. *IEJME*, 15(1). <https://doi.org/10.29333/iejme/593>
70. Perez, J. (2010). Methods of Research, Thesis Writing and Applied Statistics. Second edition. Page 80-100. *National bookstore*. Manila, Philippines
71. Perveen, A. (2016). Synchronous and Asynchronous E-language Learning: A Case Study of Virtual university of Pakistan. *ICODE*, 7(1). <https://files.eric.ed.gov/fulltext/EJ1093436.pdf>
72. Razak, W. (2015). Academic Performance of Students: A Case in a Higher Learning Institution. *KNE Journals*, 3(1). <https://knepublishing.com/index.php/KnE-Social/article/view/4285/8800>
73. Reese, J. (2013). Use of Twitter among Local Health Departments: An Analysis of Information Sharing, Engagement, Action. *Journal of Medical Internet Research*, 15(8). <https://www.jmir.org/2013/8/e177>

74. Reimers, F. (2020). Supporting the Continuation of Teaching and Learning during the Covid-19 Pandemic. *OECD Publications*, 8(2). <https://www.oecd.org/educatio>
75. Rohani, L. (2019). Exclusively Synchronous Online Learning: The Impact on Student Performance and Engagement Outcomes. *Sage Publications*, 10(2). <https://journals.sagepub.com/doi/full/10.1177/027347531881886>
76. Santosa, P. (2015). Student Engagement with Online Tutorial: A Perspective on fFow Theory. *International Journal of Emerging Technologies in Learning (IJET)*, 10(1): 60–67. <https://doi.org/10.3991/ijet.v10i1.4348>
77. Sanz, M. (2017). Exploring Academic Performance: Looking Beyond Numerical Grades. *Universal Journal of Educational Research*, 5(7): 1105-1112. <https://doi.org/10.13189/ujer.2017.050703>
78. Shea, P. (2016). Student Satisfaction with Asynchronous Learning. *OLC Journals*, 9(2). <https://olj.onlinelearningconsortium.org>
79. Sobiyakto, A. (2016). Assessing an Information System Project Success Model using Mixed Methods. *Researchgate Publications* 9. <https://www.researchgate.net>
80. Somaoang, J. (2020) The Implementation of Modular Distance Learning in the Philippine Secondary Public Schools. *Digital Publications*, 7(3). <https://www.dpublication.com/abstract-of-3rd-icate/27-427/>
81. Staff, T. (2020). Synchronous vs. Asynchronous Learning in Online Education. *GSJ Publications*, 8(1). <https://thebestschools.org>
82. Stoesz, B. (2018). Effectiveness of Tutorials for Promoting Education Integrity: A Synthesis Paper. *BMC Journals*, 10(1). <https://edintegrity.biomedcentral.com/articles/10.1007/s40979-018-0030-0>
83. Tagarao, M. (2022). Learned competencies in 7 learning areas of junior high schools of Villanueva district. Unpublished Thesis. Cagayan de Oro College. Carmen, Cagayan de Oro City, Philippines
84. Tansel, A. (2018). Does Private Tutoring Increase Students' Academic Performance. *ITIR Publications*, 5(3). <https://ideas.repec.org>
85. Teng, J. (2017). Effectiveness of Video Aided Approach on Self-Efficacy and Task Performance of Students. *PROC Publications*, 9(2). <https://essay.utwente.nl>
86. Thomas, Lauren. (2022). Quasi-Experimental Design | Definition, Types & Examples <https://www.scribbr.com/methodology/quasi-experimental-design/>
87. Ting, K. (2013). Student Teachers' Reflective Practice on a Tutorial Teaching Approach. *SJUT Journals*, 10(3). <https://files.eric.ed.gov/fulltext/EJ1068571.pdf>
88. Tweedie, F. (2019). Teachers Respond to Impact of Intelligent Mathematics Tutorial on Students' Motivation and Engagement. *UNE Publications*, 9(1). <https://dune.une.edu/theses/272/>
89. Ullah, I. (2018). Effects of Tutoring on the Academic Achievement of Students at Secondary Level. *Researchgate Publications*, 10(2). <https://www.researchgate.net>
90. Uplane, M. (2014). Synchronous and Asynchronous E-learning Styles and Academic Performance. *Researchgate Publications*, 8(2). <https://www.researchgate.net>
91. Vacalares, I. (2022). The Effects of Asynchronous Class Sessions on Students' Academic Achievement and Levels of Satisfaction. A Research. DepEd Division of Misamis Oriental, Philippines
92. Vacalares, Ian Franco S. (2022). Video Lessons and Instructional Sheets: Its Impact on Educational Outcomes in Mathematics. A Research Study. Misamis Oriental, Philippines
93. Vallente, E. (2022). Learned Competencies in 7 Learning Areas of Junior High School in St Mary's Academy of Tagoloan. Unpublished Thesis. Cagayan de Oro College. Carmen, Cagayan de Oro City, Philippines
94. Villastique, Rey N. (2022). Improving Student's Numeracy Skills through Problem Based Learning Module. A Research Study. Misamis Oriental, Philippines
95. Villastique, Rey N. (2022). Level of Problem-Solving Skills of Junior High School Students in Alubijid East and West Districts. A Research Study. Misamis Oriental, Philippines
96. Weegar, M. (2012). A Comparison of Two Theories of Learning - Behaviorism and Constructivism as Applied to Face-to-Face and Online Learning. *NUSD Publications*, 10(2). <https://g-casa.com/conferences/manila/papers/Weegar.pdf>

97. Yeh, C. (2019). Enhancing Achievement and Interest in Mathematics Learning Mthrough math-illand. *RPTEL* 14, 5. <https://doi.org/10.1186/s41039-019-0100-9>
98. Yilmaz, E. (2013). The Perception of Learning in Asynchronous Online Discussions: A Scale Development Study. *Procedia - Social and Behavioral Sciences* 83: 776 – 780. www.sciencedirectassets.com
99. Zhang, J. (2019). The Relationship Between Math Anxiety and Math Performance: A Meta-Analytic Investigation. *Frontiers in Psychology*, 10. <https://doi.org/10.3389/fpsyg.2019.01613>

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