INTERNATIONAL JOURNAL OF BASIC EDUCATION RESEARCH FOR INNOVATION, SUSTAINABILITY AND EXCELLENCE (IJBRISE)
https://risejournals.org/index.php/ijberise
Online ISSN: 3028-032X | Print ISSN: 3028-0370

Volume 1, Issue no. 10 (2024)

Effectiveness of Online Distance Learning Delivery Modality among High School Learners in Mathematics 9

DOI 10.5281/zenodo.14011775

Mayo D. Mercado
Colegio de Dagupan
Gadsden County HS, Gadsden County Public School District Quincy, Florida USA

Abstract:

This study examines the effectiveness of Online Distance Learning (ODL) in enhancing the academic performance of Grade 9 learners in Mathematics at Gadsden County High School, Florida, USA, during the 3rd quarter of the 2020–2021 school year. With the shift from traditional learning to online modalities due to the COVID-19 pandemic, this research evaluates how ODL impacts students' mastery of mathematical concepts, focusing on linear equations, systems of linear equations, and exponential functions. A pre-post experimental research design was employed, with 13 purposively selected learners participating in the study. The learners were given a 35-item pre-test before exposure to the ODL modality and a post-test after completing the instructional period. The results showed a significant improvement in mean test scores, increasing from 7.23 (20.66%) in the pre-test to 22.38 (63.94%) in the post-test, with a computed t-value of 16.37, indicating statistical significance. These findings highlight the potential of ODL to enhance mathematical skills through interactive online materials and collaborative learning approaches. The study affirms that the use of digital tools fosters student engagement and improves performance, particularly for students who may struggle in traditional classroom settings. This research underscores the importance of leveraging technology to create a flexible and inclusive learning environment. The results suggest that ODL can be an effective alternative for teaching mathematics, ensuring continuous learning amidst physical restrictions. Recommendations for further studies include expanding the sample size and exploring other subjects to assess the broader impact of ODL on academic performance.

Keywords: Online Distance Learning (ODL), academic performance, Mathematics education, Grade 9 learners, pre-post experimental design, COVID-19 pandemic

Introduction:

Teaching is a dynamic human activity centered on the interaction between the teacher and the learner. Through teaching, learners not only gain knowledge but also become familiar with societal values and behaviors (Malik, 2012). Teaching applies scientific principles to design environments that facilitate learning, requiring teachers to make thoughtful decisions to support each learner's educational journey. Research shows that a conducive learning environment promotes better outcomes, as an effective teacher not only challenges learners intellectually but also supports their understanding (Malik, 2012).

The Department of Education (2020) defines *Distance Learning* as a delivery modality where instruction occurs between teachers and learners who are geographically separated. The three primary forms of distance learning include Modular Distance Learning (MDL), Online Distance Learning (ODL), and TV/Radio-Based Instruction. Greville (2013) and UNESCO (2002), as cited by Ramos (2019), highlight that distance education serves as a formal solution to educational access issues caused by geographical and socio-economic constraints.

In response to the COVID-19 pandemic, traditional teaching approaches shifted to distance learning to ensure continuity of education while safeguarding health and safety. MDL uses self-learning modules (SLMs) in print or digital formats, tailored to individual learners' needs, while ODL leverages internet-based platforms like Microsoft Teams and Google Classroom to facilitate learning. ODL offers both synchronous and asynchronous modes, allowing real-time discussions and self-paced learning. It emphasizes active participation through digital tools, requiring stable internet access for meaningful interactions (Baby & Kannammal, 2020).

E-learning, according to Baby and Kannammal (2020), involves using ICTs to deliver education online. Wan and Niu (2020) emphasize that e-learning provides flexible learning opportunities for a wide range of people. Wladis et al. (2015) further argue that technological advancements have made online education viable, especially for professionals and stay-at-home parents. Driscoll et al. (2012) noted that online platforms encourage participation from students who may be hesitant in face-to-face settings, promoting inclusivity and higher performance.

Mathematics education, however, presents unique challenges. Many students struggle with engagement and view mathematics as difficult, requiring teachers to adopt innovative strategies (Williamson, 2018). Mathematics promotes logical thinking, problem-solving, and analytical skills, which are essential in understanding complex phenomena (Carvajalino, 2018). Despite these benefits, poor performance in mathematics remains a common issue, prompting the need for remedial programs to address learning gaps.

Several studies demonstrate that e-learning methods can enhance students' mathematical skills. The MCIEC model, which emphasizes motivation, context, interactivity, evaluation, and connectivity, promotes student involvement and mastery of content (Ahn & Edwin, 2018). Albano and Dello (2019) found that using platforms like Moodle integrated with GeoGebra improves assessment and engagement. Similarly, Lapisboro (2017) concluded that online enrichment activities significantly enhanced Grade 7 students' performance, while Magat Jr. (2016) reported improved scores among Grade 9 learners using interactive online materials.

In Gadsden County High School, Florida, where this study is situated, previous efforts to improve students' mathematics performance have emphasized collaborative teaching strategies. This study focuses on the effectiveness of ODL in enhancing the academic performance of Grade 9 learners in mathematics. Collaborative learning, which involves teamwork and mutual accountability, will be integrated into the online modality. This approach aims to improve students' mean percentage scores by fostering peer-to-peer learning and active engagement.

The researcher aims to contribute to the improvement of students' mathematics performance through ODL, ensuring continuous learning despite physical limitations. By adopting a collaborative approach, the study hopes to provide insights into how online instruction can effectively support mathematics education in challenging circumstances.

Methodology:

Research Design
The researcher made use of pre-post experimental research design. According to Creswell (2012), pre-post experimental research design involves the only experimental group which is selected through non-randomization procedures. The single group or experimental group is given pre-test at the beginning of the study and post-test at the end of the study. Taner (2018) noted that experimental research is undertaken when a researcher wishes to trace cause-and-effect relationships between defined variables.

In light of the research, the pre-post experimental design was employed since the study made use of single group. The learner-respondents were exposed to online learning modality in learning the 3rd quarter competencies in Mathematics 9 for school year 2020 – 2021, to determine the effectiveness of online distance learning delivery modality among high school learners in Mathematics in Gadsden County High School, Florida, USA.

Meanwhile, to obtain the data and information needed in the study, validated pre-test and post-test research-made questionnaire and online instructional materials for 3rd quarter Mathematics 9 competencies were utilized. From the consolidated data, the respondents of the study were informed; administration of the pre-test and post-test; and implementation of the module was administered.

Moreover, the following steps were undertaken in the conduct of the study. Prior to the distribution of the instruments, endorsement from the school head and department head was sought. Upon approval, parental consent was sent to the parents of the respondents to adhere the ethical and data privacy. Administration of the pre-test to the respondents a week before the start of the 3rd quarter. Implementation of the study which were undertaken and the post-test was given after the exposure to the respondents.

Sources of Data
This study utilized purposive sampling procedure in selecting the respondents. Purposive sampling is based on selecting the individuals as samples according to the purpose of the research study. An individual is selected as part of the sample due to good evidence that he/she is a representative of the total population. (Calmorin, 2006).

In lieu to the population of the research study, thirteen (13) Grade 9 learners of Gadsden County High School, Florida, USA were the respondent of the study in determining the effectiveness of the online learning modality in mastering the Mathematics 9 competencies for 3rd quarter of the school year 2020 – 2021.

The 13 respondents of the research study are currently enrolled in Mathematics 9 through online learning modality of County High School, Florida, USA.

Gadsden County High School, known as East Gadsden High School (EGHS) until 2016, is a public high school in unincorporated Gadsden County, Florida, operated by Gadsden County School District. It is between Havana and

Quincy and it has a "Havana, Florida" postal address. Starting in fall 2017, it is the zoned high school of all of Gadsden County.

Instrumentation and Data Collection
The teacher-made pre-test and post-test questionnaire were used in the study to determine the effectiveness of the online learning modality. It is composed of 40-item test which measures the mastery on the competencies about linear equations, system of linear equations, and exponent and exponential functions in Mathematics 9 for 3rd quarter. The pre-test and post-test was given 1 point for correct answer.

Likewise, face validation by language experts were made to establish the validity of the teacher-made pre-test and post-test. In addition, content validation was employed to measure the alignment of the items to the competencies in Mathematics 9 for 3rd quarter by Mathematics experts.

Furthermore, split-half reliability was administered to non-respondents of the study who are currently Grade 10 enrolled in the same school to determine the internal consistency of the test items.

Meanwhile, in administering the research, it requires not only diligence and expertise, but also integrity and honesty. This research paper strictly observed the ethical standards in writing requirements. To render the study ethical, the rights to anonymity, confidentiality, and informed consent was observed. This was done to recognize and protect the privacy of the respondent. The ethical principle of self-determination was maintained. Respondents were treated as autonomous agents by informing them about the study and allowing them to voluntarily choose to participate or not. Respondents were informed about the purpose of the study, the procedures were used to collect the data, and assured that there was no potential risks or costs involved.

In conducting the research, this research paper was facilitated through collaboration with the experts. Signed by the school principal and department head with parental consent, the letter of intent was given to the respondents. The questionnaire was drafted in a very clear and concise manner to prevent conflicts among respondents.

Tools for Data Analysis
In light of the research paper, the following statistical tools were used in the interpretation of the results. Arithmetic mean scores were used to determine the performance of respondents as to mastery of the competencies in Mathematics 9 for 3rd quarter before and after the exposure of the respondents in the online learning modality. T-test of dependent means was used to test if there is significant difference between the scores obtained before and after exposure of respondents in the online learning modality. In addition, textual and tabular presentations were employed to present the data and findings of the study.

For problems no. 1 and 2, arithmetic mean was used to analyze the test scores of Grade 9 learners before and after the start of online distance learning delivery modality in 3rd quarter Mathematics 9

Where:
x = scores
n = number of respondents

For problem no. 3, t-test for dependent means was used to find out the difference in the test scores of Grade 9 before and after the start of online distance learning delivery modality in 3rd quarter Mathematics 9

$$t = \frac{\Sigma D}{\sqrt{\frac{n\Sigma D^2 - (\Sigma D)^2}{n-1}}}$$

Where
☐D = sum of the difference between the paired observation
☐D^2 = sum of the squared differences n = no. of paired observation

Results:

A. Test Scores of Grade 9 Learners Before the Start of Online Distance Learning Delivery Modality in 3rd Quarter Mathematics 9

Table 3.1 presents the test scores obtained by Grade 9 learners before the start of online distance learning delivery modality in 3rd quarter Mathematics 9.

Table 3.1 Test Scores of Grade 9 Learners Before the Start of Online Distance Learning Delivery Modality in 3rd Quarter Mathematics 9

Test	Mean	SD	Mean Percentage
Before	7.23	1.88	20.66

*35-items

It can be noticed that the test scores of the Grade 9 obtained a mean score of 7.23 from a 35-item examination with a standard deviation of 1.88. This implies that about 20.66 mean percentage of the total competencies were presumed knowledge of the learners before the online distance learning on the intended 3rd quarter Mathematics 9 competencies.

With the result presented, Williamson (2018) reiterated that mathematics in the field of social sciences is considered a necessary instrument to be able to decipher the closest environment and represent various facts that occur in today's world. Likewise, Carvajalino (2018) supported that mathematics facilitates the understanding of various phenomena, which leads to a general suggestion that teachers should be adaptive and creative in teaching to make the curriculum responds, conforms, reflects, and be flexible to the needs of the learners. Hence, delivery of instruction in the mathematics should be given a high priority especially if the performance of the learners were found to be lower than the expected target. Moreover, educational actions in which e-learning has been developed as a teaching method in the field of mathematics. One of the ideas is that applied in the MCIEC model which entails greater student involvement. This model permits the student to enhance his or her ability to make an effort to understand mathematical content, thanks to increased interest, motivation and adaptation to the context (Ahn and Edwin 2018).

B. Test Scores of Grade 9 Learners After the Start of Online Distance Learning Delivery Modality in 3rd Quarter Mathematics 9

Table 3.2 presents the test scores obtained by Grade 9 learners after the start of online distance learning delivery modality in 3rd quarter Mathematics 9.

Table 3.2 Test Scores of Grade 9 Learners After the Start of Online Distance Learning Delivery Modality in 3rd Quarter Mathematics 9

Test	Mean	SD	Mean Percentage
After	22.38	3.33	63.94

*35-items

As reflected, the test scores obtained by the learners after using the online distance learning in the delivery of the 3rd quarter competencies were 22.38 with a mean percentage of 63.94 from the 35-item examination with a standard deviation of 3.33. This implies that there was a positive increase in the scores of the learners after exposure to the online distance learning as compare from the before test scores obtained in the mastering the intended competencies in Mathematics 9.

The result was supported by the literatures that through online distance learning, teacher as facilitator, engaged learners' active participation through the use of various technologies accessed through the internet while they are geographically remote from each other during instruction. It is more interactive than the other types of distance learning and the responses are real-time. Hence, learners may download materials from the internet, complete and submit assignments online, and attend virtual classes. Wan and Niu (2020) stated that e-learning method becomes a pedagogical tool that facilitates access to learning for the whole of society. Likewise, Driscoll et al., (2012) stressed that with online teaching, students who usually do not participate in class may now voice their opinions and concerns. Not being in a classroom setting, quieter students may feel more comfortable partaking in class dialogue without being recognized or judged. This, in turn, may increase average class scores. Moreover, according to India Education (2020), online education is electronically supported learning that comes an almost infinite number of ways to teach and learn outside of traditional classrooms and away from school campuses. It is a rich learning environment with much more flexibility than a traditional classroom. When used to its full potential, online education has been shown to be more effective than pure face-to-face instruction. It can be engaging, fun and tailored to fit almost anyone's schedule.

C. Difference in the Test Scores of Grade 9 Before and After the Use of Online Distance Learning Delivery Modality in 3rd Quarter Mathematics 9

Table 3.3 presents the significant difference in the test scores of Grade 9 before and after the use of online distance learning delivery modality in 3rd quarter Mathematics 9.

Table 3.3 Test of Difference in the Test Scores of Grade 9 Before and After the Use of Online Distance Learning Delivery Modality in 3rd Quarter Mathematics 9

Test	Mean	SD	t-value	Decision	Verbal Description
Before	7.23	1.88	16.37	Reject Ho	Significant
After	22.38	3.33			

$t_{.05}$ at df of 12 = *2.18 (two-tailed); **1.78 (one-tailed)

As reflected, the mean test scores before and after the use of online distance learning resulted a t-test computed value of 16.37 which was greater than the critical values of 2.18 (two-tailed) and 1.78 (one-tailed) at 5 percent level of significance with df = 12. Hence, the no significance between the mean test scores before and after used of online distance learning was rejected. This implies that the 3rd quarter Mathematics 9 intended competencies were significantly mastered as revealed in the positive increase of mean test score after the use of online distance learning.

Affirmed by the study conducted by Lapisboro (2017) on the use of online interactive enrichment activities in Mathematics 7 concluded that that the performance in mathematics of Grade 7 learners exposed to online interactive enrichment activities were improved and moving towards mastery. It was also noted that learners positively engaged themselves in the online enrichment. Likewise, Magat Jr. (2016) on an interactive online instructional material in Mathematics 9 revealed the interactive online instructional material significantly improved the performance of the Grade 9 learners in mathematics. Hence, online education is electronically supported learning that comes an almost infinite number of ways to teach and learn outside of traditional classrooms and away from school campuses. It is a rich learning environment with much more flexibility than a traditional classroom. When used to its full potential, online education has been shown to be more effective than pure face-to-face instruction. It can be engaging, fun and tailored to fit almost anyone's schedule. (India Education, 2020)

Discussion:

The study explored the effectiveness of the online distance learning (ODL) modality in improving the academic performance of Grade 9 learners in Mathematics. The findings demonstrated that the learners exhibited a significant improvement in their test scores after engaging in ODL, with mean scores rising from 7.23 in the pre-test (20.66%) to 22.38 in the post-test (63.94%). This marked improvement suggests that ODL, when implemented thoughtfully and supported with appropriate instructional materials, can effectively facilitate students' mastery of complex mathematical concepts, even in remote learning contexts.

The study's findings align with existing research that highlights the benefits of ODL in promoting better learning outcomes. The significant increase in the learners' performance reflects how online modalities, particularly through synchronous and asynchronous activities, can offer interactive and flexible learning experiences (Baby & Kannammal, 2020). The use of internet-based platforms, such as Microsoft Teams and Google Classroom, likely provided opportunities for students to engage more actively with the content, fostering deeper comprehension of mathematical concepts.

This positive shift in performance is consistent with studies such as those by Lapisboro (2017) and Magat Jr. (2016), which found that online enrichment activities and interactive instructional materials significantly improved student engagement and mathematical proficiency. Additionally, the flexibility and accessibility of ODL platforms enable students to learn at their own pace, review materials as needed, and participate without the social pressures of traditional classrooms (Driscoll et al., 2012).

Despite the improvements, teaching mathematics in an online setting poses unique challenges. Mathematics, being a subject that requires logical reasoning and problem-solving skills (Williamson, 2018), demands consistent practice and timely feedback, which may be difficult to provide remotely. However, the study demonstrates that incorporating collaborative learning strategies within ODL can mitigate these challenges by promoting peer interaction and cooperative learning. This aligns with the MCIEC model (Ahn & Edwin, 2018), which emphasizes the role of motivation, interactivity, and context in improving students' mathematical understanding.

Moreover, the findings underscore the importance of adapting teaching strategies to suit the online environment. Teachers who act as facilitators in ODL can engage students through digital tools, quizzes, and online discussions, thus enhancing participation and motivation (Wan & Niu, 2020). This highlights how ODL offers not only educational continuity during challenging times, such as the COVID-19 pandemic, but also serves as a platform for innovative teaching practices that could be sustained even beyond the crisis.

The results revealed a statistically significant difference between the pre-test and post-test scores, with a t-value of 16.37, which exceeded the critical value at a 5% significance level. This finding confirms that the observed improvement in the students' performance was not due to chance but a direct result of their engagement with the ODL modality. This aligns with studies that argue that well-designed online learning environments can achieve, and in some cases exceed, the effectiveness of traditional classroom settings (India Education, 2020).

The study also emphasizes the importance of integrating content validation and reliability testing into the instructional design process. The use of a validated 40-item test covering key competencies such as linear equations, systems of equations, and exponential functions ensured that the assessment accurately measured the learners' understanding. This rigorous approach to assessment further strengthens the validity of the findings and provides actionable insights for educators looking to implement ODL effectively.

The results of this study offer valuable insights for educators and school administrators in Gadsden County High School and beyond. First, the success of ODL in improving students' performance suggests that schools should invest in robust digital infrastructure and professional development for teachers to enhance their capacity to deliver online instruction. Additionally, integrating collaborative learning strategies and interactive online activities can foster student engagement and make learning mathematics more accessible and enjoyable.

The study also highlights the importance of ensuring equity in online education. While ODL offers flexibility and convenience, it requires stable internet access and appropriate devices, which may not be available to all students. Schools must therefore explore ways to provide technological support to learners, particularly those from disadvantaged backgrounds, to ensure that all students can benefit from online learning opportunities.

Conclusion:

In conclusion, the study revealed the positive effect of online distance learning delivery modality in teaching competencies for 3rd quarter in Mathematics 9. The test scores of the Grade 9 obtained implies that about 20.66 mean percentage of the total competencies were presumed knowledge of the learners before the online distance learning on the intended 3rd quarter Mathematics 9 competencies. Moreover, the learners performed better after exposure as revealed in the mean test score after. As reflected, the test scores obtained by the learners after using the online distance learning in the delivery of the 3rd quarter competencies were 22.38 with a mean percentage of 63.94. There is a significant difference in the test scores of Grade 9 before and after the start of online distance learning delivery modality in 3rd quarter Mathematics 9. Increment was evident on the before and after mean test scores. In totality, the knowledge and skills performance of the learners exposed in the online distance learning were improved.

References:

Ahn, J.Y.; Edwin, A. An e-Learning Model for Teaching Mathematics on an Open Source Learning Platform. Int. Rev. Res. Open Distrib. Learn. 2018, 19, 255–267.

Albano, G.; Dello, U. GeoGebra in e-learning environments: A possible integration in mathematics and beyond. J. Ambient Intell. Humaniz. Comput. 2019, 10, 4331–4343.

Baby, A.; Kannammal, A. Network Path Analysis for developing an enhanced TAM model: A user-centric e-learning perspective. Comput. Hum. Behav. 2020, 107, 1–7.

Carvajalino, J. Edwin Bidwell Wilson and Mathematics as Language. ISIS 2018, 109, 494–514.
Driscoll, A., Jicha, K., Hunt, A. N., Tichavsky, L., and Thompson, G. (2012). Can online courses deliver in-class results? A comparison of student performance and satisfaction in an online versus a face-to-face introductory sociology course. *Am. Sociol. Assoc*. 40, 312–313. doi: 10.1177/0092055X12446624

Tanner K.(2018), in Research Methods (Second Edition) https://www.sciencedirect.com/topics/social-sciences/experimental-research

Wan, S.; Niu, Z. A Hybrid E-Learning Recommendation Approach Based on Learners' Influence Propagation. IEEE Trans. Knowl. Data Eng. 2020, 32, 827–840.

Williamson, T. Alternative logics and applied mathematics. Philos. Issues 2018, 28, 399–424.
Wladis, C., Conway, K. M., and Hachey, A. C. (2015). The online STEM classroom-who succeeds? An exploration of the impact of ethnicity, gender, and non-traditional student characteristics in the community college context. *Commun. Coll. Rev.* 43, 142–164. doi: 10.1177/0091552115571729