Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 4, 7936 – 7948

# Mathematics Performance, e-Learning Experiences, and Demographics among the University Students via Distance Education: A Correlational Study

**[1]Yllenie Gabales, [2]Mirasol Sabandal, [3]Josette Filmar Saluta, [4]Daniel Bermudez, [5]Anabella R. Gimeno, [6]Nanet A. Goles**

*[1]Cebu Technological University- Moalboal Campus, Poblacion West, Moalboal, Cebu, yllenie.gabales@ctu.edu.ph*
*[2]Cebu Technological University- Moalboal Campus, Poblacion West, Moalboal, Cebu, mirasol.sabandal@ctu.edu.ph*
*[3]Cebu Technological University- Moalboal Campus, Poblacion West, Moalboal, Cebu, jossette.saluta@ctu.edu.ph*
*[4]Cebu Technological University- Moalboal Campus, Poblacion West, Moalboal, Cebu, daniel.bermudez@ctu.edu.ph*
*[5]Cebu Technological University- Moalboal Campus, Poblacion West, Moalboal, Cebu, Anabella.gimeno@ctu.edu.ph*
*[6]Cebu Technological University- Moalboal Campus, Poblacion West, Moalboal, Cebu, nanet.goles@ctu.edu.ph*

## Abstract

The Covid-19 pandemic made most of the universities in the Philippines shift to distance education, particularly the e-learning mode, as it is a suitable alternative for teaching students amidst the pandemic. This paper investigated the the university students' mathematics performance based on their GPA and their e-learning experiences through distance education and the correlations of such variables including the demographic characteristics. A validated modified survey questionnaire was used to gather data from the 489 randomly selected participants for their demographics and e-learning experiences based on self-efficacy, usefulness, system quality, effectiveness, satisfaction, challenges, benefits, and leisure interest. It also included information on their e-learning access. Data were analyzed using the chi-square and Spearman tests through SPSS software. Findings revealed that students showed good mathematics performance and significantly correlated ($p \leq 0.05$) to their age and fathers' educational background. Moreover, students' level of digital literacy, possession of technology, type of internet connection, and system quality were significantly correlated as well to their GPA. Overall, students have manifested a positive e-learning experience. The results are useful for the school administrators as this may serves as information to improve the implementation of distance education through e-learning mode to ensure quality learning. Moreover, Schools are encouraged to provide students with high-speed internet kits and other facilities for a significantly better e-learning experience.

**Keywords**: COVID-19, e-learning, distance education, higher education, Mathematics Performance, learning experience.

## INTRODUCTION

Due to the COVID-19 pandemic, the Philippine government, like other countries, suspends face-to-face instruction and employs strict quarantine measures to stop the COVID-19 virus from spreading, affecting mainly the 3.5

million Filipino tertiary students (Joaquin et al., 2020). Hence, distance education through e-learning has been adopted by most Philippine universities to ensure the continuation of inclusive and accessible education despite COVID-19. Other than e-learning, as mentioned by Gocotano et al. (2021), terms such as online learning, flexible online learning, and remote education are specified as distance education. E-learning refers to the delivery of the teaching and learning process through the internet and technology. Generally, Mathematical e-learning utilizes the internet and software suitable for the subject to implement mathematics-related instructions in a virtual environment (Kim et al., 2014). Employing e-learning in Mathematics entails active participation that raises students' ability to make an effort to understand mathematical content, improving their mathematics performance consequently (El Mamoun et al., 2018). However, it has been stated that many students are guilty of claiming Mathematics is a complex subject (Gafoor & Kurukkan, 2015). The lack of effort and prerequisites are the significant reasons mathematics is a complex subject for students. They also enumerated other factors such as the difficulty of remembering the content learned in the previous classes, rapid forgetting of the learned material, difficulty understanding mathematics concepts, reluctance to seek help from others, inattention in the classroom, and students' lack of motivation. Such problems happened even with the assistance of the expert, their teacher.

In addition, well-designed Mathematical e-learning differs from a sudden shift in response to the national emergency. It creates difficulties for schools unfamiliar with e-learning, like the Philippines, that suddenly embrace e-learning modality due to the pandemic. The problem is evident in the teaching and learning process because both the students and teachers have been unprepared for the new learning mode, e.g., insufficient knowledge of various educational applications and software (Zaharah & Kirilova, 2020). Moreover, internet connectivity is also a challenge, as it is not accessible to some students from third-world countries because of monetary issues (Adnan & Anwar, 2020). It is stated that without efficient and stable connections, students will have a negative experience in e-learning since they will experience a lack of interest in the subject matter affecting their mathematics performance.

Further research on students' experiences with online learning is essential given that the students experience a sudden shift of learning, which changes the way learning is designed and delivered. Hence, investigating e-learning in virtual math instruction is deemed necessary, particularly on their learning experience and mathematics performance during this pandemic. This paper also aims to present the relationship between their demographics and such variables. This study provides information to the school managers on which students perform better in an e-learning mode and improve e-learning implementation suitable to diverse students' needs.

With the research conducted, the issue on various experiences and adaptation with online learning may be addressed, although not in its fullest domain, hindsight on what online learning has brought to students in the mathematical field especially with the sudden shift of learning, which brought changes to the design and delivery of knowledge to each student.

This research aimed to assess the college students' mathematics performance based on their GPA and its correlation with their e-learning experience and demographic characteristics during a pandemic at a State University in Cebu Province, Philippines.

## METHOD

The research method used was a quantitative correlational with a survey design since the ultimate goal of this study is to establish the relationship between students' demographic characteristics and e-learning experience to their mathematical performance based on their GPA. A correlation study shows whether two or more variables are related (Gogtay & Thatte, 2017), and Creswell (2002) described it as a

statistical test to develop patterns for two variables. Also, Apuke (2017) noted that survey design creates a logical sampling strategy with a planned survey to measure a given population and characteristics using statistical methods.

Participants

This study involved 489 students that were randomly selected from the first year to the third year from different courses: Bachelor in Elementary Education, Bachelor of Secondary Education, Bachelor of Science in Fisheries, Bachelor of Science in Hospitality Management, and Bachelor of Science in Industrial Engineering from a state university in Cebu Philippines during the school year 2020-2021. Most of the participants are female students aged 18-20 years old. Most of their mothers are high school graduates, while their fathers are elementary level and under low-income families. The participants were ensured that their data were handled with the utmost confidentiality.

Data Collection and Analysis

The data were collected through Google forms with the respondents' consent and permission from the Campus Director to survey the selected students of the university. Such primary data collected measured the student's extent in e-learning experiences and demographic profile. The respondents were given one (1) week to answer the survey questionnaire before it was retrieved to provide them with ample time to answer the tool.

This online survey questionnaire has two main parts: questions regarding demographic information are in part one such as age, gender, combined family income, and parents' educational attainment. The second part is about students' perceived e-learning experience measured in two ways. One was based on the information related to the access of e-learning such as Level of Digital Literacy, Possession of Technology, Accessibility to Internet Connection, Type of Internet Connection, Modes of Instruction, and Technology Usage and Skills. Another was based on their perception of the following constructs: self-efficacy, usefulness, system quality, effectiveness, satisfaction, challenges, benefits, and leisure interest anchored from Zabadi & Al-Alawi (2016); Liaw (2008); and Kisanga & Ireson (2016). These parameters were subjected to realiability test using the chronbach alpha and obtained good and acceptable values as follows: 0.871, 0.780, 0.744, 0.850, 0.778, 0.804, 0.860 and 0.706 respectively. The secondary data was the student's GPA, taken from the university Registrar's Office. All the collected data was sorted, tabulated, and analyzed using the SPSS Software.

The Scale

Each parameter in a student's e-learning experience is answerable by a Likert four-point scale with four (4) strongly agree, and one (1) means strongly disagree. The following range of means with its descriptions was used: ≥0.70 (Very strong relationship); 0.40-0.69 (Strong relationship); 0.30-0.39 (Moderate relationship); 0.20-0.29 (Weak relationship); 0.01-0.19 (No or negligible relationship). This descriptor applies to positive and negative relationships (Adapted from Dancey & Reidy, 2004).

## FINDINGS

This paper determined the students' mathematics performance in relation to their demographic characteristics and e-learning experiences. Table 1 below presents the students' GPA in Mathematics which also reflected their Mathematics performance in distance education through e-learning.

Table 1. *Students' Performance Level of Mathematics Based on GPA*

| Grade | Description | Frequency | Percentage |
|---|---|---|---|
| 1.5 – 1.0 | Superior | 98 | 20.04 |
| 2.0 – 1.6 | Very Good | 316 | 64.62 |
| 2.5 – 2.1 | Good | 59 | 12.07 |
| 3.0 – 2.6 | Fair | 16 | 3.27 |
| 5.0 – 3.1 | Failed | 0 | 0 |

The results showed that the majority of the students (84.66%) got very good to superior grades (ranging from 1.0 to 2.0) which means

that they met the expectations of the e-learning process. Morevoer, 15.34% of students obtained mathematics performance described as good to fair having a numerical rating ranging 2.5-3.0. These students were coping with the new set-up or may hardly catching up with the e-learning modality. It is interesting to note that the overall mathematics performance of the respondents was depicted as very good with an average of 1.83, implying that the students can meet the expectations of the e-learning process despite its sudden implementation.

Table 2, on the other hand, provides the chi-square test results to determine whether there were significant relationships between students' demographic characteristics and mathematics performance through e-learning.

Table 2. *Relationship between Students' Level of Mathematics Performance Based on GPA and their demographics*

| | $x^2$ Value | Cramer's V-value | P-value |
|---|---|---|---|
| Age and GPA | 60.674 | 0.231 | 0.000* |
| Gender and GPA | 3.652 | 0.086 | 0.302 |
| Combined Family Income and GPA | 12.490 | 0.082 | 0.821 |
| Mother's Educational Background and GPA | 12.530 | 0.088 | 0.639 |
| Father's Educational Background and GPA | 30.171 | 0.135 | 0.011* |

Note. *p<.05

Only the students' age (p=0.000) and fathers' educational background (p=0.011) significantly correlated to the university students' mathematical performance measured in their GPA. It was determined that younger university students (18 to 23 years old) have academically outperformed older university students (24 above). They were more competent in mathematics than the older students. Such a result may also depict their performance in using the e-learning system.

Furthermore, the father's educational background was significant in this study, which means that students' with fathers having better educational attainment showed better mathematical performance. Thus, fathers with good academic backgrounds can significantly guide the students' progress and reach a high level of success in an online learning environment. Moreover, gender (p=0.302), combined family income (p=0.821), and mother's educational background (p=0.639) were found not correlated to students' mathematics performance through e-learning. This means that both male and female students' math performance is not comparable. Also, those students in high-income and low-income families show a similar trend with that of gender. Similarly, mothers' educational background does not influence their math performance.

A chi-square test was performed for the relationship between students' level of mathematics performance and access to e-learning (Table 3).

Table 3. *Relationship between the Students' Level of Mathematics Performance based on GPA and Access to E-learning*

| VARIABLE | $x^2$ Value | Cramer's V-value | P-value |
|---|---|---|---|
| Level of Digital Literacy and GPA | 21.692 | 0.121 | 0.010* |
| Possession of Technology and GPA | 9.523 | 0.140 | 0.023* |
| Accessibility to Internet Connection and GPA | 5.039 | 0.065 | 0.539 |
| Type of Internet Connection and GPA | 10.388 | 0.146 | 0.016* |
| Technology Usage and Skills and GPA | 10.65 | 0.101 | 0.300 |

Note. *p<.05

Findings revealed that students' level of digital literacy (p=0.010), possession of technology (p=0.023), and type of internet connection (p=0.016) significantly correlated to the university students' mathematical performance. In an e-learning setting, having a certain level of digital literacy is required to make efficient use of technology for learning. The present result shows that more than half of the students are beginners, followed by digitally advanced and digitally proficient students. Moreover, students' level of digital literacy is correlated to students' mathematical performance. This means that digitally literate students are more

likely competent in mathematics through online learning. Obviously, in learning math through online instruction, they should be well-versed in the e-learning system to accomplish their learning tasks, and their digital literacy skill shows this.

Another relevant parameter of the study is the students' possession of technology, showing a positive and significant ($p<0.05$) effect on their math grades. Those students with more gadgets appeared to be more competent in math than those who own a single device (84%). Given the unavailability of computers at home in many low-income families, students are likely to access online classrooms and complete academic tasks only through their mobile phones. This study also found that the type of internet, the majority of the students (74%) actively used a single type of internet connection (Mobile data) to access relevant mathematics materials and instruction, and 26% of them used multiple internet connections (Mobile data and Wi-Fi). Since smartphones have become more available and are increasingly owned by university students, they are most likely to subscribe to prepaid promos. Students also find mobile data convenient and accessible internet connection during their online classes. The result shows that students using multiple internet connections sources obtained higher GPAs than those using mobile data only.

However, the variables such as students' accessibility to an internet connection ($p=0.539$), modes of math instruction ($p=0.634$), and technology usage and skills ($p=0.520$) were found not significantly correlated to students' mathematical performance based on their GPA through online education.

Lastly, Table 4 shows the results of the relationship between students' level of mathematics performance and students' e-learning experience.

A Spearman test was used to determine whether there were significant relationships between the students' level of mathematics performance based on GPA and students' e-learning experience. Findings revealed that system quality ($r=-0.176$, $p<0.05$) and effectiveness ($r=-0.190$, $p<0.05$) significantly correlated with students' mathematics performance. The majority agreed that they are satisfied with e-learning function, content, and interaction, but not their internet speed. Having a general mean of 2.63, it was perceived as a positive e-learning experience but with low correlation. Results further revelaed that the better the system quality, the better also the students' grades in mathematics. . For instance, if the system of e-learning works well and the content materials are related to the topic in mathematics, then the students may have a good performance. Similarly, the more effective the students' perception about the e-elearning experience, the higer is their GPA

Table 4. *Relationship between the Students' Level of Mathematics Performance based on GPA and Students' Perception of E-learning*

| VARIABLE | Sr-value | P-value |
|---|---|---|
| Self-Efficacy and GPA | 0.068 | 0.133 |
| Usefulness and GPA | 0.076 | 0.092 |
| System quality and GPA | 0.176 | 0.003* |
| Effectiveness and GPA | 0.190 | 0.046* |
| Satisfaction and GPA | 0.036 | 0.426 |
| Challenges and GPA | 0.074 | 0.101 |
| Benefits and GPA | 0.048 | 0.291 |
| Leisure Interest and GPA | 0.009 | 0.837 |

Note. *p<.05

On the other hand, other parameters of e-learning experience such as self efficacy, usefuleness,satisfaction, challenges , benefits and leisure interest did not significantly related to students' mathematics performance based on the obtained p-values which were higher than the set alpha (0.05). Also, the strength of correlations among these variables and mathematics performance showed low but positive correlations. Hence, it connotes that as their experience improves as measured by each of those mentioned parameters, they most likely have better math performance.

## DISCUSSIONS

This paper focused on the college students' mathematical performance based on their GPA

and its correlation to their e-learning experience and demographic characteristics.

The result revealed that college students were competent in mathematics despite the sudden change of learning mode to e-learning. It is inevitable that embracing the new learning platform, online learning, is accompanied by challenges enumerated by Gocotano et al. (2021), such as shortage of devices, distractive learning environment, and expensive internet data. However, students still show better grade point averages in math despite such challenges. Students' performance in mathematics in e-learning is a manifestation that they successfully managed the situation with the assistance and guidance of their instructors, and most students still maintained their outstanding performance. Moreover, online learning provides students more time to do their responsibilities. Hence, e-learning improves students' motivation, autonomy, engagement, mathematical principles/concepts, and outcomes (Moreno-Guerrero et al., 2020), and better grades (Paul & Jefferson, 2019).

This study also revealed that for the relationships between students' demographic characteristics and mathematical performance in online learning, students' age and fathers' educational attainment significantly correlated to the university students' mathematical performance. Based on the obtained results showing the younger respondents to have better mathematical performance as compared to older respondents, this might be because the factor of age is usually related to a decline in an individual's cognitive abilities, which are considered important in maintaining functional independence. Such a claim can support several studies where results showed that as students become older, there is a negative correlation between age and school achievement (Coleman et al., 1966; White 1982; Grissom, 2004; Jabor et al., 2011). In addition, younger students are more subjected to technologies that they opt to take charge of their own pace in learning. They are more aware of these technologies and their usage giving them more flexibility in this outbreak (Al-Mutairi, 2011).

The study also showed that the students' fathers' educational attainment correlated to students' mathematics performance. This result is consistent with the previous research of Nelson (2009), as he concluded that children with highly educated fathers are more likely to reach high levels of academic success. Students who had fathers with higher educational levels are said to be more intelligent and high achievers as they can give their children additional and higher-quality educational input. He highlighted that those fathers with high educational attainment have the most significant impact on students' online academic success. They can provide their child with broad mathematical and early literacy input. Such input in the early years correlates with later mathematical skills (Watts et al., 2014; Harju-Luukkainen et al., 2020). Also, it was suggested that as compared to a household with high paternal education attainment, children whose parents were not able to proceed to college have seen that pursuing into the workforce would be a better choice and that a college degree or a desired career would not be worth the cost.

Conversely, this study found that students' gender, combined family income, and mothers' educational background have no significant influenced on their mathematics performance in online learning. This study finds and agrees with Kupczynski et al. (2011), indicating no relationship between gender and GPA. The incomparable math performance of both males and females may be attributed to their characteristics toward online learning. Richardson & Woodley (2003) have pointed out that female learners are more engaged and persistent in online learning, while Nistor (2013) described males as more consistent with favorable views regarding online learning.

Concerning combined family income, the result appeared not correlated to students' GPA. This happened because both students in high and low-income families showed similar GPAs. As Gocotano et al. (2021) discussed, in the Philippines, university students from low-income families are also responsible enough to find a strategy to cope with their situation. For example, they force themselves to find their

income to sustain their needs while learning online education. In addition, in Belgium and Portugal, much of the effect of family income could be attributed to prior knowledge and skills in mathematics (Marks & Pokropek, 2019).

Furthermore, the result also revealed that mothers' educational attainment was not correlated with students' mathematics performance. Such a result means that those students whose mothers do not earn a 4-year degree did not hinder them from excelling in the online class. This may be because they are already in college and mature enough to handle their learning tasks that even without their mother's intervening factor; they can still compete with other students. But, Hijazi & Naqvi (2006) declared that the mothers could significantly guide the students' progress to be more progressive in an online environment. Besides, the college-educated parents have better earnings; hence their children will be more likely to grow up in circumstances that encourage academic preparation and accomplishment.

Regarding students' e-learning experience, it was measured in two ways, (1) information related to students' access to e-learning and (2) their perception of e-learning. It was revealed that the students' mathematics performance online was significantly correlated to students' level of digital literacy, possession of technology, type of internet connection, and system quality.

Digital literacy entails understanding how to use technology and having the necessary information management and critical thinking abilities (Meyer et al., 2013). Therefore, this study agrees with Lopez (2013) that students with a high level of digital literacy had a strong and positive effect on students' academic performance online. As the students are more engaged in technology and the internet more often, this increased utilization of the online learning platforms and improve their digital and academic abilities. Hence, there are various applications of digital literacy in mathematics, such as it provides opportunities for interaction, reading sources, and references (Zulkarnain, 2020; Swan, 2009). Digital literacy can also be interpreted as an individual's ability to apply the functional skill to digital devices to explore and obtain information, enhance critical thinking, communication, and creativity, which are all essential factors in learning the field of mathematics (Zulkarnain, 2020; Cam & Kiyici, 2017; Muliawanti & Kusuma, 2019; Swan, 2009).

Another relevant parameter correlated to the students' mathematics performance online is students' possession of technology. According to Rasheed et al. (2020), laptops, computers, and tablets at home are critical predictors for students' readiness in online learning environments. It is highlighted that it increases students' comprehension of content and development of skills, resulting in positive performance in learning mathematics. Thus, the students' possession of technology can affect their performance in e-learning, indicating that those using multiple devices have the advantage of getting better math grades. This is confirmed by Aboderin's (2011) study, as he found that engaging in technologies increases academic performance, which means that students' technology availability tends to earn high grades. He further explained that having technology in an online environment and engaging with this technology could improve the student's level of knowledge. They can learn at their own pace, leading to better academic performance.

The specific type of internet connection, on the other hand, is another parameter that plays a significant role in students' e-learning experience since the availability, speed potential, and overall quality of the internet connection affects students' performance in an online environment (Ivwighreghweta & Igere, 2014; Gocotano et al., 2021). Mobile data allows students to do their academic tasks, engage with their online instructor and other students, and access their class materials anytime and anywhere (Peters, 2002). The result showed that the type of internet connection is correlated to the students' mathematics performance. This implies that those with better connectivity will most likely obtain better mathematical performance. This

finding contradicts Cortez's (2020) study, stating that internet connection does not affect their performance in an online class setting.

On the other hand, other results showed no correlation of the accessibility of internet connection, modes of math instruction, and technology usage and skills to students' mathematics performance online. This explains that the poor to moderate strength of connectivity, the different modes of math online instruction, and their different levels of technology usage do not influence their math grades. Thus, their math performance was not comparable. However, Octaberlina & Muslimin (2020) opine that slow internet speeds may harm students' overall internet experience and can be considered a barrier to their learning process and performance in mathematics. In addition, Sahin et al., (2010) emphasized that connectivity is significant since it is the most common problem that has to be considered because students live in remote areas where internet connection is not that easy to access.

This research also found that Google Classroom was widely utilized for asynchronous classes and Google meet or Zoom for a virtual class in math instruction. Teachers need to prepare for the new normal approach for education (e.g., mastering electronic platforms commonly used in online mathematics learning are Google Classroom, Zoom, E-learning schools, and e-mail). COVID 19 pandemic led teachers to use google classroom in the teaching and learning process because it is accessible to unlimited learners (Zakaria et al., 2020). Google Classroom helps teachers manage and collect students' online assignments sent through google documents, google drive and other applications. This free application allows teachers and students to communicate well to engage beyond classroom teaching and learning (Cacase 2019). However, the result revealed that the modes of instruction were not correlated with students' mathematics performance. Lastly, in the Argentin et al. (2014) study, the technology usage and skills positively correlate to students' GPA, contradicting the present study. According to them, the availability of technology and the internet helps students quickly access learning materials and information; however, this can be acquired if learners can use the technology effectively. Technology skills refer to accessing, locating, evaluating, and processing data using technologies such as smartphones, laptops, and computers. Learners who can understand the technology and how it works have more advantages in the learning process, leading to better academic performance. However, despite students being capable, comfortable, and confident in using the computer, it does not affect their mathematics performance.

It was also revealed that in students' perception of e-learning experience, both system quality and effectiveness correlated to students' mathematical performance based on their GPA. System Quality refers to a content of an information system has (Alla et al., 2015). In general, flexibility, reliability, accessibility, stability, system, and network speed are evident factors of perceived system quality in e-learning (Davis, 1989). The study's findings support Islam's (2016) results that perceived compatibility lessens the connection between e-learning systems and students' performance. The students' performance could not be good without a high-quality e-learning system. In addition, the information and system quality generated by the e-learning system determines the quality of these courses and the interaction with learners (Alla, 2013). It implies that the content of information and how e-learning works are connected to students' mathematics performance.

However, self-efficacy, usefulness, satisfaction, challenges, benefits, and leisure interest were not significantly correlated with students' mathematics performance. Students' self-efficacy is defined in this study as the ability to use online learning systems such as the internet, computers, and web-based instructional materials and media to successfully and effectively complete their e-learning tasks and achieve a better learning outcome. Even if students are confident while using and operating the e-learning system, functions, and contents, it still does not affect their online mathematics performance. However, according to Yavuzalp & Bahcivan

(2020), developing individuals' beliefs about how well they will perform the tasks that must be completed regarding a specific goal, their performance may also be affected. Nonetheless, the findings agree with Crippen et al. (2009) that self-efficacy has no relationship with students' math performance online. As such, wether students have a low or high level of self-efficacy, they still manage to do mathematics tasks successfully in an online environment.

Mohr et al. (2012) pointed out that usefulness is the individual's belief that using a specific e-learning form can increase their academic achievement in online learning. However, it does not affect students' mathematics performance (Shahibi & Ku Nur Khafidhah Ku Rusli, 2017). Although the present study shows no significant correlation, most of the students agreed that e-learning is a helpful tool in learning and its contents are informative and valuable. Thus, still perceive those students have a good performance in online learning.

Concerning the effectiveness and students' mathematics performance, this study revealed no significant relationship between the two variables (Panyajamorn et al., 2018). Even if e-learning was especially effective for students who feel shy, intimated, and slow learners (Stern, 2004), it still does not affect their mathematics performance. However, teachers and students must still understand how to incorporate collaboration and performance into teaching and learning successfully. Other than that, it is also revealed that satisfaction does not significantly affect students' mathematics performance. Satisfaction is defined as students' attitude in an e-learning environment (Wu & Hsia, 2010). However, the result contradicts Bower & Kamata (2000) as they positively correlate satisfaction to students' academic performance.

Further, in an online modality, satisfaction is an indicator of success. Those students who are satisfied with online learning are more engaged and motivated, and as a result, they learn and do better academically, which also creates a positive learning environment. Even the challenges students faced on e-learning did not correlate to students' mathematics performance which is similar to the outcomes of Clark & Mayer (2008). Moreover, benefits and leisure interest are other parameters of this study, and it is revealed that it does not correlate with students' mathematics performance online and is parallel to the study of Jaggars & Xu (2010) (Kim et al., (2014).

## CONCLUSION

In conclusion, despite the sudden implementation of distance education through the e-learning modality, due to COVID-19 in most universities in the Philippines, students still do well in an online class as a replacement to face-to-face learning mode. This is indicated by their positive e-learning experience and their good mathematics GPA. Further, their age and their father's educational background influenced such mathematics performance. Also, such mathematics performance was significantly and positively affected by their digital literacy level, technology possession, and type of internet connection. Among the parameters of e-learning experience, only system quality has significantly associated with their GPA. At the same time, the rest of the variables, self-efficacy, usefulness, effectiveness, satisfaction, challenges, benefits, and leisure interest, show a very weak relationship with their GPA and appeared not significant. A high-quality e-learning system provides better teacher-student interaction, first-rate mathematics-related materials, and well-functioned portals contribute well to the student's improvement in e-learning. Although students face difficulties in learning mathematics online, like poor internet connection, they still obtained good grades, indicating positive Performance in Mathematics during the e-learning mode. Thus, the researchers suggest that the educational institution provides students workshops and seminars about Digital Literacy, technologies, high-speed internet connectivity, and accessible e-learning portals and material to have a practical and better e-learning experience which may improve their mathematics

performance in distance education through e-learning.

## Reference


[1] Aboderin, O. S., (2011). The Status of Information and Communication Technology (ICT) in
[2] Secondary Schools in Ondo State. (Masters dissertation). University of Ado Ekiti.
[3] Adnan, M., and Anwar, K., (2020). Online Learning amid the COVID-19 Pandemic: Students'
[4] Perspectives. Journal of Pedagogical Sociology and Psychology, 2(1), pp. 45-51.
[5] Al-Mutairi, A. (2011). Factors affecting business students' Performance in Arab Open University: The
[6] case of Kuwait. International Journal of Business and Management, 6(5), 146-156.
[7] Alla, M. M. S. O., (2013). The Impact of System Quality in E-learning System. Journal of Computer
[8] Science and Information Technology, 1(2), 14-23.
[9] Alla, M. M. S. O., Faryadi, Q., & Fabil, N. B., (2015). The Impact of System Quality in E-learning
[10] System. International Journal of Computer Science and Electronics Engineering, 3(1), 37-42.
[11] Apuke, (2017). Quantitative Research Methods A Synopsis Approach. Arabian Journal of Business
[12] and Management Review (Kuwait Chapter), 6(10), 40-47.
[13] Argentin, G., Gui, M., Pagani, L., & Stanca, L., (2014). The Impact of Digital Literacy on Educational
[14] Outcomes: Evidence from Performance Tests. EducationalStudies, 42(2), 137-162.
[15] Bower, B. L., & Kamata, A. (2000). Factors Influencing Student Satisfaction with Online Courses.
[16] Academic exchange quarterly, 4, 52.
[17] Cacase, M. (2019). Effects of using Google Classroom on teaching math students with learning
[18] Disabilities. (Master dissertation). Available from https://rdw.rowan.edu/etd/2679.
[19] Cam, E. & Kiyici, M. (2017). Perceptions of Prospective Teachers on Digital Literacy. Malaysian
[20] Online Journal of Educational Technology, 5(4), 29-44.
[21] Clark, R. C., & Mayer, R. E. (2008). Learning by viewing versus learning by doing: Evidence-based
[22] guidelines for principled learning environments. Performance Improvement, 47, 5–13.
[23] Coleman, J.S., Campbell, E.Q., Hobson, C.J., McPartland, F., Mood, A.M., Weinfeld, G.D., & York.
[24] R.L. (1966). Equality of Educational Opportunity. Washington, DC: U.S. Government Printing Office.
[25] Cortez, C. P. (2020). Blended, distance, electronic and virtual-learning for the new normal of
[26] mathematics education: A senior high school student's perception. European Journal of Interactive Multimedia and Education, 1(1).
[27] Creswell, J. W. (2002). Educational research: Planning, conducting, and evaluating quantitative (p.
[28] 676). Upper Saddle River, NJ: Prentice Hall.
[29] Crippen, K. J., Biesinger, K. D., Muis, K. R., & Orgill, M. (2009). The role of goal orientation and
[30] self-efficacy in learning from web-based worked example. Journal of Interactive Learning Research, 20(4), 385–403.
[31] Dancey, C. & Reidy, J., (2004). Statistics without Maths for Psychology: Using SPSS for Windows.
[32] Prentice Hall, London
[33] Davis, (1989). Perceived usefulness, perceived ease of use, and user acceptance of information
[34] technology, MIS Q. Journal Storage, 13(3), 319-334.
[35] El Mamoun, B., Erradi, M., & El Mhouti, A., (2018). Using an Intelligent Tutoring System to Support
[36] Learners' WMC in e-learning: Application in Mathematics Learning. International Journal of Emerging Technologies in Learning, 13, 142–156.
[37] Gafoor, K. A., & Kurukkan, A. (2015). Why High School Students Feel Mathematics Difficult? An

[38] Exploration of Affective Beliefs, Online Submission.
[39] Gocotano, T. E., Jerodiaz, M. A. L., Banggay, J. C. P., Nasibog, H. R. B., & Go, M. (2021). Higher
[40] Education Students' Challenges on Flexible Online Learning Implementation in the Rural Areas: A Philippine Case. International Journal of Learning, Teaching and Educational Research, 20(7), 262-290.
[41] Gogtay, N. J., & Thatte, U. M. (2017). Principles of Correlation Analysis. The Journal of the
[42] Association of Physicians of India, 65(3), 78-81.
[43] Grissom, J. B. (2004). Age & Achievement. Education Policy Analysis Archives, 12, 49.
[44] Harju-Luukkainen, H., Vettenranta, J., Wang, J. & Garvis, S. (2020). Family related variables effect
[45] on later educational outcome: a further geospatial analysis on TIMSS 2015 Finland. Large-scale Assess Educaction, 8(3).
[46] Hijazi, ST., & Naqvi R., (2006). Factors affecting students' performance. Bangladesh e-Journal of
[47] Sociology, 3(1).
[48] Islam, A.K.M. Najmul, (2016). E-learning system use and its outcomes: Moderating role of perceived
[49] compatibility. Telematics and Informatics, 33(1), 48-55.
[50] Ivwighreghweta O. & Igere M. A., (2014). Impact of the internet on academic performance of students
[51] in tertiary institutions in Nigeria. Information Impact: Journal of Information and Knowledge Management, 5(2), 47–56.
[52] Jabor, M. K., Machtmes, K., Buntat, Y., Kungu, K. and Nordin, M. S. (2011). The Influence of Age
[53] and Gender on the Students' Achievement in Mathematics. International Conference on Social Science and Humanity, 5, 304-308.
[54] Jaggars, S., & Xu, D. (2010). Online learning in the Virginia community college system. Community
[55] College Research Center.
[56] Joaquin, J. J. B., Biana, H. T. & Dacela M. A. (2020). The Philippine Higher Education Sector in the
[57] Time of COVID-19. Frontier in Education.
[58] Kim, C., Park, S.W., & Cozart, J., (2014). Affective and motivational factors of learning in online
[59] mathematics courses. British Journal Education Technology, 45, 171–185.
[60] Kisanga, D. H. & Ireson, G., (2016). Test of e-Learning Related Attitudes (TeLRA) scale:
[61] Development, reliability and validity study. International Journal of Education and Development using Information and Communication Technology, 12(1), 20-36.
[62] Kupczynski, L., Ice, P., Gibson, A. M., Richardson, J., & Challoo, L., (2011). The impact of frequency
[63] on achievement in online courses: A study from a South Texas University. Journal of Interactive Online Learning, 10(3), 141-149.
[64] Liaw, S. S., (2008). Investigating students' perceived satisfaction, behavioral intention, and
[65] effectiveness of e-learning: A case study of the Blackboard system. Computers and Education, 51, 864-873.
[66] Lopez, I. J. R. (2013). Digital literacy and academic success in online education for underprivileged
[67] communities: the prep@ net case. (Doctoral dissertation). Available from UT Electronic
[68] Theses and Dissertations (URI http://hdl.handle.net/2152/20948).
[69] Marks, G. N. & Pokropek, A. (2019). Family Income Effects on Mathematics Achievement: Their
[70] Relative Magnitude and Causal Pathways. Oxford Review of Education, 45(6), 769-785.
[71] Meyers, E., Erickson, I., & Small, R. (2013). Digital literacy and informal learning environments: An
[72] introduction. Learning, media and technology, 38(4), 355-367.
[73] Mohr, A. T., Holtbrügge, D. & Berg, N., (2012). Learning Style Preferences and the Perceived
[74] Usefulness of E-learning. A Journal in Teaching in Higher Education, 17(3), 309-322.

[75] Moreno-Guerrero, A. J., Aznar-Díaz, I., Cáceres-Reche, P. & Alonso-García, S., (2020). E-Learning in
[76] the Teaching of Mathematics: An Educational Experience in Adult High School. Mathematics, 8(5), 840.
[77] Muliawanti, S., & Kusuma, A. B. (2019). Mathematical Digital Literacy in the Era of the Industrial
[78] Revolution 4.0. Prosiding Sendika, 5(1), 637–46.
[79] Nelson, J. (2009). Impact of parent education on student success. Retrieved November 23, 2009 from
[80] https://files.eric.ed.gov/fulltext/ED507263.pdf.
[81] Nistor, N. (2013). Stability of attitudes and participation in online university courses: Gender and
[82] location effects. Computers & Education, 68, 284–292.
[83] Octaberlina, L. R., & Muslimin, A. I. (2020). Efl Students Perspective towards Online Learning
[84] Barriers and Alternatives using Moodle/Google Classroom during Covid-19 Pandemic. International Journal of Higher Education, 9(6), 1-9.
[85] Panyajamorn, T., Suanmali, S., Kohda, Y., Chongphaisal, P., & Supnithi, T. (2018). Effectiveness of
[86] E-Learning Design in Thai Public School. Malaysian Journal of Learning and Instruction, 15(1), 1-34.
[87] Paul, J. & Jefferson, F., (2019). A Comparative Analysis of Student Performance in an Online vs.
[88] Face-to-Face Environmental Science Course From 2009 to 2016. Frontiers Computer Science, 12.
[89] Peters, B. (2002). The future of wireless marketing. Wireless Advertising Association.
[90] Rasheed, R. A., Kamsin, A., & Abdullah, N. A., (2020). Challenges in The Online Component of
[91] Blended Learning: A Systematic Review. Computer Education, 144.
[92] Richardson, J. T., & Woodley, A. (2003). Another look at the role of age, gender and subject as
[93] predictors of academic attainment in higher education. Studies in Higher Education, 28(4), 475–493.
[94] Sahin, Y.G.., Balta, S., & Ercan, T., (2010). The use of internet resources by university students during
[95] their course projects elicitation: a case study. The Turkish Online Journal of Educational Technology, 9(2).
[96] Shahibi, M. S. & Ku Nur Khafidhah Ku Rusli, (2017). The Influence of Internet Usage on Student's
[97] Academic Performance. International Journal of Academic Research in Business and Social Sciences, 7(8), 873-887.
[98] Stern, B. S., (2004). A Comparison of Online and Face-to-Face Instruction in an Undergraduate
[99] Foundations of American Education Course. Contemporary Issues in Technology and Teacher Education Journal, 4, 196–213.
[100] Watts T. W., Duncan G. J., Siegler R. S., & Davis-Kean P. E. (2014). What's Past Is Prologue:
[101] Relations Between Early Mathematics Knowledge and High School Achievement. Educational Researcher, 43(7), 352-360.
[102] White, K. R. (1982). The relation between socioeconomic status and academic achievement.
[103] Psychological Bulletin, 91(3), 461–481.
[104] Wu, J. H. & Hsia, T. L., (2010). A study of student satisfaction in a blended e-learning system
[105] environment. Computers & Education, 55, 155-164.
[106] Yavuzalp, N. & Bahcivan, E. (2020). The online learning self-efficacy scale: Its adaptation into turkish
[107] and interpretation According to various variables. Turkish Online Journal of Distance Education, 21(1), 31-44.
[108] Zabadi, A. M., & Al-Alawi, A. H., (2016). University Students' Attitudes towards E Learning',
[109] International Journal of Business and Management, 11(6).
[110] Zaharah, Z., & Kirilova, G. I., (2020). Impact of Corona Virus Outbreak Towards Teaching and
[111] Learning Activities in Indonesia. SALAM' Jurnal Sosial dan Budaya Syar-i, 7(3), 269-282.

[112] Zakaria, M., Bustaman, H. A., Abd Manaf, K. & Abdul Rahman, R. (2020). Exploring Benefits and
[113] Challenges of Adopting Google Classroom in Perspective of Higher Institution's Learners. Test Engineering and Management, 20(1), 9739-9749.
[114] Zulkarnain, Z., Heleni, S., and Thahir, M., (2020). Digital literacy skills of math students through e-
[115] learning in COVID-19 era: a case study in Universitas Riau. In Journal of Physics: Conference Series, 1663(1).