

Technological Factors and Academic Performance of Grade 9 High School Students in Mathematics

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Abstract

Technology is a one of the essential things that we really needed the most, especially on this situation. As we adapt to the vast and fast-changing environment, opted to use technology as a means of communication and in the teaching-learning process. The primary goal of this study was to determine the relationship the technological factors on to the academic performance of the students in mathematics in an online classroom setting. The result of the study indicates that there is no significant relationship between technological factors and academic performance of Grade 9 High School Students in Mathematics. On the other hand, the indicators or factors that can really affect the most on the students' academic performance was the internet connectivity. Since, the internet connectivity was very common issue to all that can give us positive and negative feedback. This issue rounds all around the world. As part of the growing technological industry, the results and findings of this study shows that with the technological factors, we should maximize the use of technology so as with the right blend of pedagogy and the content mastery.

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And above all, to our Almighty God, for always giving us strength and inspiration in finishing this research.

To Him, I wholeheartedly owe my success.

The Researcher

Dedication

For good times and bad ones.
For victorious and defeats.
For days and nights.
For sun and moons.
For slumber and sleepless nights.
For love and hate –
It made us great.
To my family and friends.
To my brothers and sisters.
And even to our love ones who care.
For His power that proves eternity.
Love and blessings that He showed upon us.
To all everyone,
You are in this every page of this craft.
This is dedicated to all of you.

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Declaration

I, **SILVER FEB J. AUMENTADO**, declare that this research is original to the best of my knowledge. I declare further that the content of this research is my own work. This research has not been submitted for any degree or other purposes.

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January 2021
Date Signed

CHAPTER 1 THE PROBLEM AND ITS SCOPE

Introduction

Over the past two decades, the researchers highlighted the use of technology in mathematics education. Digital natives, the net-generation, the digital-generation, and millenniums are all labels to identify today's learners. The term digital native was created by Marc Prensky (2001) in his work *Digital Natives, Digital Immigrants* to describe the generation of learners growing up interacting with digital technology.

In the United States, technology was considered "essential in teaching and learning mathematics" (p.3) by the National Council of Teachers Mathematics (2000). As we became modernized, the evolution of technology goes stronger and stronger that we can integrate the use of technology in the teaching and learning process, particularly in Mathematics. The use of technology in appropriate and effective ways allows for learning experiences to promote the enjoyment of mathematics, Scotland's Curriculum for Excellence (Education Scotland n.d., p. 40). In the United States survey of mathematics over the past 30 years, found that technology produced a positive effect on students' performance in comparison to traditional methods (Cheung and Slavin, 2013). Hence, they also indicated that effects varied by the kind of educational technology used.

In recent years, technologies have been gaining wider acceptance in education. With the level of initiatives of the Schools Administration and Government agencies, they have implemented the use of technologies in the classroom setting (West, 2012). *Facilitating learning across contexts, facilitating contextual learning, and providing personalization in both personal and collaborative environments* are potential benefits of using technologies for learning (Cochrance, 2010). These potentials benefit makes technology to be an ideal tool for learning mathematics.

In Davao del Norte, particularly in Tagum City, St. Thomas More Montessori School is adapting the current and new mode of teaching-learning environment. Through the use of technology teachers and students attend their class online with the help of different platforms such as the Zoom Meeting, Google Meet, and others. Teachers faced many challenges as they adapt to the new normal way of teaching. With these new normal ways of teaching, technological factors will arise as it will be good or bad, make the students learn or become hindrances to the teaching and learning process. These technological factors will determine if the students' performance will be affected.

Thus, this study is conducted because of the new normal ways of delivering the lesson to the students. This study will help us to determine the performance of the students as we face technological factors externally or intrinsically.

Review of Related Literature and Studies

Technological Factors

In our everyday life, the use of technology is an integral part. In the public schools setting, the students are considered digital natives and have become accustomed to always being connected to technology (Harrell and Bynum, 2018). As we go into the high technology millennium, students and the new generation are coping with the needs and trends of society and in terms of education. They always use technology in their day-to-day living like mobile phones, laptops, computers, and the likes. The technology is now part of the teaching and learning process in which the students rely on the use of it. Also, to compete in the 21st-century global economy is an obvious need for the students to be prepared for the use of technology. Technology is important for life skills in the field of work; teachers and students who are technologically knowledgeable have a better chance of getting a job and do excel in their career paths. Hence, to become meaningful the learning is, our task is to integrate technology in the classroom setting and during our instruction and it is a very challenging part for us as a teacher (Savage & Brown, 2015).

In adapting technologies in a virtual environment, and to provide new opportunities to the learners, we must enhance the traditional classroom setting with the use of technology (Muniasamy, et al., 2014). The traditional classroom setting is just merely the use of visual aids, and textbooks while the new set-up of a classroom setting or the virtual classroom uses the integration of the technology and other platforms that can be utilized in delivering a lesson. While the teacher utilizes technology as a tool for teaching, likewise it is an effective tool for learning. It makes learning easy and effective and can produce learning outcomes that call for technology-assisted teaching. The use of technology provides different approaches in learning, thus, the learners engage in contextualizing the teaching-learning process with the help of technology (Tangney, et al., 2010); and connect learners using gadgets and social media platforms (Roberts and Butcher, 2009).

In terms of the digital learning environment, the Internet and Web-based simply means a highly interactive learning environment that redefines the concepts of teaching. It allows the learners to use technologies for them to communicate with the world scientist to acquire such experience of skills (Anderson, 2007).

As Harrell and Bynum (2018) pointed out, they classify the technological factors that limit technology integration into *External Factors* and *Internal Factors*. They believed that several instances can affect the proper implementation of technology such as external and internal factors. External factors may include *Internet Connectivity*, *adequacy of technology*, and *knowledge of technological tools used*. Internal factors include *self - efficacy*, and *Students' perceptions*. Technology integration is vital in preparing the students to be college and career ready.

In terms of Internet Connectivity, poor infrastructure can limit access to the devices of technology and can also affect the Wireless Fidelity (Wi-Fi) Connection, most especially in far-flung school areas or rural school buildings without a proper current supply to support the usage of technology (Harell & Bynum, 2018). This poor infrastructure affects the revolution underway in the K-12 classrooms as they adopt a new style of classroom setting and pedagogy. To succeed in this kind of technology integration in the teaching-learning process it must be supported by a strong foundation of technology, specifically on network infrastructure (Build the 21st Century Classroom, 2018).

The *adequacy of technology* can really help the students to learn and be active in the teaching-learning process. The use of different gadgets can access the learning materials through online and different platforms. These may include the use of cellular phones, Smartphones, laptops, Computers, Tablets and etc.. Also, it may use the headphones, and others that can really help the students to learn more in such way that the learning is meaningful for them. Using high-end technology can really engage the students in the teaching-learning process, but it is only good for the students who are fortunate enough to afford. For those who cannot afford the gadgets, it is very challenging for them to learn and how to cope-up on the discussions and classes. In rural areas, there are limited funds and budgets that schools do not have the resources on providing adequate technology for each learner. Thus, there is inadequate use of technology. However, from the perspective of learning theory, technology integration serves the constructivist and socio-cultural principles. Learners create and generate knowledge as a result of their interactions with the environment and build existing schema and learners are dependent on the relevance of the content or instructional activity, a view from a constructivist. On the other hand, Socio-cultural views it as technology provides platforms, and tools to actively engage the students on the numerous media with other learners beyond their immediate reach (Pittman & Gaines, 2015).

The research suggested that to provide teachers with professional opportunities, it must be related to the use of technology that does not translate into higher levels of integration in the classroom. To maximize its effects on the teaching and learning process, it is only provided by the knowledge, skills, resources, and support upon the curriculum technology integration (Papanastasiou, Zemblays, & Vrasidas, 2003). With sufficient access to technology, students may be effective in developing their knowledge and with the integration of technology in the teaching and learning process.

On Bandura's Social Cognitive Theory (1977), self-efficacy is the belief that a learner can do a task to achieve the desired goals and outcomes, and this affects how the students prefer to interact with his society and its surroundings. It is anticipated that the involvement of technological devices in digital classrooms will help improve students' performance. Yet, it is irrational to claim that it is possible to reach the goals without online technology self-efficacy and integration of technology (Ozerbas & Erdogan, 2016).

Teachers are usually portrayed as reluctant users, in spite of the increased access to technology integration. Teachers were established on the old standards which creates frustration when they try to adapt and shift to a new paradigm that leads them to deviate from the use of 21st-century technological devices. They foresee the efforts that they need in learning the new technology and the practicality or value it as a significant consideration whether they use it or not (Callum, et. al., 2014). Teachers who are not illiterate on using technologies are able to understand, properly integrate the use of technology in the teaching-learning. Some other teachers perceived the integration of technology as negative because of the amount of time it takes them into the curriculum that leads to additional training and planning. This integration really requires the preparation, the classroom management pedagogy, and demands attention that is not normally spent on the setting. Also, it is safer and easier to just remain with the "status quo".

As cited on the work of Nwankwo (2015), the alternative form of course delivery is online education that students enable to pursue their professional and educational goals with ease than the traditional instructions (Beqiri, Chase, and Bishka, 2009). The feasibility of distance education is dependent on students' experiences with the online learning (Song et al., 2004). DiSlavio (2008) argued that the students' perception on the online learning can shape the future of distance education. The spread of the online learning has been made a need to analyze on how the method of content delivery can affect the students' perception on their learning (O'Malley and McGraw, 1999). Students' satisfaction of students in an online learning environment is important and requires further study, argued by Roach and Lemasters (2008).

Students' Academic Performance

Technological development is a reality today. This fact is reflected in our society, specifically in the labor, social and educational fields. This technological advance facilitates, strengthens, and speeds up the performance of daily tasks.

In the educational field, technological progress is reflected in the development of so-called information and communication technologies (ICT). This ICT promotes active learning and influences the teaching and learning processes. They also promote innovative pedagogical action, as well as to create new learning spaces on the teaching-learning process.

The method of teaching nowadays is e-learning, due to the rise of COVID-19 cases in the world. Before this method, we have a traditional method that is classroom-based in a synchronous manner. But today, teaching mathematics is difficult for both teachers and students to achieve specific learning standards. Hence, the students' performance is affected by this kind of mode of learning. The so-called e-learning is flexible in terms of location, time, effort, and costs that make it an appropriate option for training and evaluating the students' performance (Guerrero et al., 2020).

Students' Academic Performance is vital for the school and institution because the outcomes are good it may lead to better job performance in the near future (Kuncel et al., 2005). This may lead to the students striving harder and better to get higher grades and perform better. With this, teachers nowadays, see to it that the new mode of learning does not affect the performance of the students. Hence, teachers give supplementary consultation to assess the learning and progress of the students. According to (Hijazi & Naqvi, 2006) the academic performance is not affected by age, gender, and place of residence but they also said those who live near to school and university can perform much better than others who live far from the school and

university. According to (Hijazi & Naqvi, 2006) also weak students if a group with good students will do better in academics and it will lead students to graduate on time. The fact is the effort from the students themselves if they want to improve their academic performance then they will (Zajonc, 1980).

One of the basic goals of educational planning is the improvement of students' academic performance and through its academic performance that students can fully actualize their talents and capabilities in line with educational goals. However, the students' academic performance is considered as the vital criteria of educational quality. Hence, the students' academic performance is a major issue among students, teachers, parents, school administrators, and the community (Kanyinulia, n.d.,).

Even though education or the students' academic performance is not the only key feature to success in the world of work, more effort is needed to identify, evaluate, track, and encourage the progress of students in schools. Parents and guardians care for the academic performance of their children because they believe that the better the performance the better opportunities in the world of work and for securing their job (Bell, 2017). Academic performance is usually measured through examinations or a continuous assessment. Yet, there is no such general concurrence on how it is best to assess or which characteristics are most important - procedural knowledge such as skills, or declarative knowledge such as facts (Bhagat, 2013).

Theoretical Framework

This study is anchored on the TPACK Framework by Punya Mishra and Matthew J. Koehler's, 2006. Technological Pedagogical Content Knowledge (TPACK) Framework is focus on the Technical knowledge (TK), Pedagogical knowledge (PK), and Content knowledge (CK), that offers a productive approach to many of the problems that teachers face upon implementing the integration of educational technology in their classroom. By differentiating these three types of knowledge, the TPACK framework outline how content – what is being taught; and pedagogy – how the teacher imparts the content, must form the foundation for any effective educational technology integration. This order is important because the technology being implemented must communicate the content and support the pedagogy in order to enhance students' learning experience and performance, Mishra, P., & Koehler, M. J. (2006).

According to the TPACK Framework 2006, the specific technological tools such as hardware, software, applications, associated information literacy practices, etc. are best used to give instruction and guide students toward a better, more vigorous understanding of the subject matter.

This is supported by the Learning Theories for Online Education: 1) Community of Inquiry (CoI); 2) Connectivism; and 3) Online Collaborative Learning Theory. The Community of Inquiry (Garrison, Anderson & Archer, 2000) is grounded on the concept of the three distinct “presence” which are the cognitive, social, and teaching. This model supports the design of online and blended courses as engaging, active learning environments or communities that is dependent on instructors and students that shares ideas, information, and opinions. The what we so-called “presence” is a social phenomenon and manifests itself through interaction among teachers and students.

Connectivism (George Siemens, 2004), is a learning model that acknowledges a major shift in the way knowledge and information flows, fosters, and changes because of a vast change of data communications network. The internet technology has moved learning from internal, individualistic activities to group, society, and even online platforms. Siemens emphasized the connectivism model as the integration of principles explored by chaos, network, and complexity and self-organization theories, that is where learning is a process that occurs within indistinct environments of moving core elements that is not entirely under the control of individual. He also noted connectivism as a theory is driven by the dynamic of information flow.

As cited by Picciano(2017), The Online Collaborative Learning (OCL) is a theory that is proposed by Linda Harasim which focuses on the facilities of the Internet that provides learning environment a foster

collaboration and knowledge building. According to Harasim (2012, p.81) “OCL is a new learning that gives focus on collaborative learning, knowledge building, and Internet use as a method to redesign formal, non-formal, and informal education for the Knowledge Age.

Conceptual Framework

Figure 1 presents the variable of the study in which the independent variable is the Technological Factor with the following indicators: *internet connectivity*, *adequacy of technology*, and *Knowledge of technological tools used* (external factors); *self - efficacy*, and *students’ perceptions* (internal factors).

The dependent variable of this study is the Students’ Academic Performance with an indicator of *students’ academic achievement*.

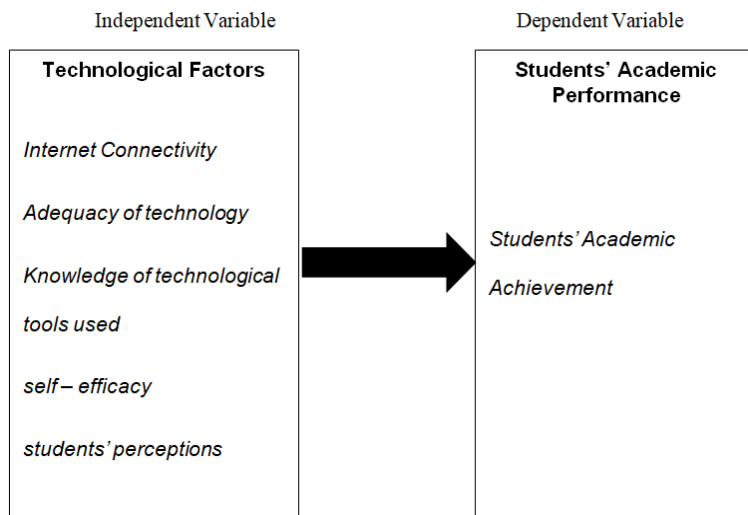


Figure 1. Conceptual Framework of the Study

Statement of the Problem

The main intent of this study is to determine the significant relationship of Technological factors and Students’ Academic Performance of Grade 9 High School Students of St. Thomas More Montessori School.

Specifically, this study shall seek answers to the following objectives:

1. What is the level of Technological Factors in terms of:
 - 1.1 internet connectivity;
 - 1.2 adequacy of technology;
 - 1.3 knowledge on technological tools used
 - 1.4 self – efficacy; and
 - 1.5 students’ perceptions
2. Is there a significant difference between the level of technological factors as classified into external and internal factors?
3. What is the level of Academic Performance of Grade 9 High School Students in Mathematics?
4. Is there a significant relationship between the Technological Factors and Academic Performance of Grade 9 High School Students in Mathematics?
5. What indicator of technological factor can influence the most to the academic performance of the students?

Hypothesis

The hypotheses of the study were tested at 0.05 level of significance stating that, there is *no significant relationship* between Technological Factors and Students’ Academic Performance of Grade 9 High School Students in Mathematics of St. Thomas More Montessori School.

Significance of the Study

The outcome of this study will benefit the following:

Teacher. This study will directly help the teachers for them to know the effectiveness of the new normal mode of teaching specifically the online teaching. Hence, they can modify their teaching strategies in Mathematics subject when it comes to online delivery of learning.

Parents. Since the parents of the students are one who are involve on the online class conducted. It will help them to identify the needs for them to improve the partake knowledge of their children on their end.

School Administration. This will directly address the issue of the academic performance of the student when it come to the online classes. Since this is new to the students and to the school administrator, they can modify the learning strategies and explore more of use of the platforms in an online class.

Future Researchers. The result of this study will help the researchers in technological factors and students' academic performance. Though indirectly, identifying these challenges and

Definition of Terms

For a better understanding of this research, the following terms are herein defined conceptually and operationally.

Technological Factors. They can be defined as factors which relate to the presence and development of technology, on either a local or global scale.

Internet Connectivity. Refers to the way people are hooked up to the *Internet*, and may include dial-up telephone lines, always-on broadband connections, and wireless devices.

Adequacy of Technology. The sufficiency of availability of technology (e.g. cellphones, laptops, computer, and the likes).

Knowledge on Technological tools used. It refers to the background knowledge and trainings or applications of the technologies being used by the students.

Self – Efficacy. In this study, refers to an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments (Bandura, 1977, 1986, 1997)

Students' Perceptions. Refers to the thoughts or mental images of the students to the use of technology.

Academic Performance. Academic performance or academic achievement is the extent to which a student, teacher or institution has attained their short or long-term educational goals.

CHAPTER 2 METHOD

This chapter presents the research methodology used in the study. This includes the research design, research subject, research environment, research instrument, data gathering procedure, statistical tools, ethical considerations, and reliability test.

Research Design

The researcher employed the quantitative research design using descriptive -correlational technique. This involves descriptive and accurate interpretation of findings. This method will employ for determining the relationship of technological factors and students' academic performance of Grade 9 High School Students of St. Thomas More Montessori School.

Herson (2005), a descriptive method of research describes and interprets what are the revealed conditions and relationships that exists, practice that are prevailing, and the effects that are being felt on those trends that are developing.

Research Subject

The respondents of this study will be the Grade 9 High School Students of St. Thomas More Montessori School, in Doctolero Avenue, Brgy. Magugpo East, Tagum City, Davao del Norte.

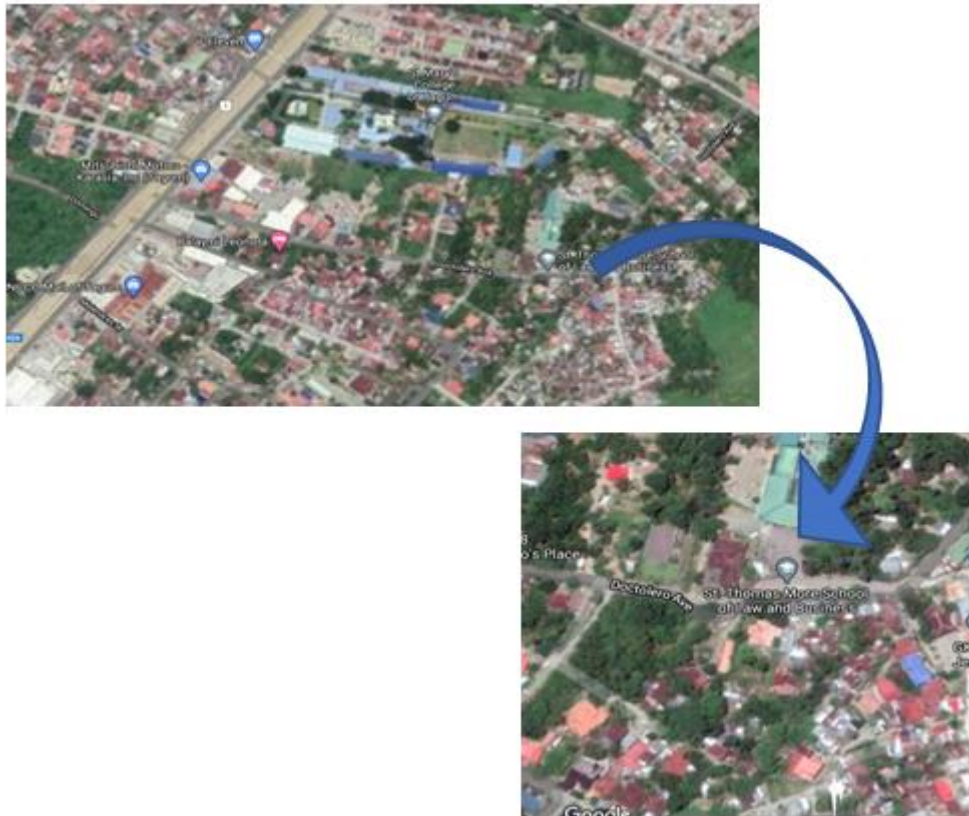
Table 1. Distribution of Respondents

Respondents	Sample Size
Grade 9 High School Students of St. Thomas More Montessori School	20

Table 1 shows the distribution of the respondents.

Research Environment

The locale of this study is in St. Thomas More Montessori School which is located at Doctolero Avenue, Brgy. Magugpo East, Tagum City, Davao del Norte. Due to current situation, school administration changes the mode of learning. Hence, the researcher will communicate the respondents through Facebook, E-mail, Messenger and Google Forms.



Research Instrument

The researcher used a survey questionnaire and collect study related data from the respondents. Researcher-made questionnaire will be used upon collecting the data. The set of test questionnaire will be the indicators of the independent variable which is the technological factors. The researcher-made questionnaire will undergo pilot-testing and use Cronbach’s Alpha for testing the reliability.

To determine the level of technological factors the following parameter limits to be used are:

Table 2. Scale of Interpretation for Independent Variable

Range	Level	Interpretation
4.30 – 5.00	Very High	This means that the level of technological factors is very much observed.
3.50 – 4.29	High	This means that the level of technological factors is much observed.
2.70 – 3.49	Moderate	This means that the level of technological factors is moderately observed.
1.90 – 2.69	Low	This means that the level of technological factors is less observed.
1.00 – 1.89	Very Low	This means that the level of technological factors is not observed.

To determine the level of Academic Performance of Grade 9 High School Students the following parameter limits to be used are:

Table 3. Scale of Interpretation for Grades

Range	Level	Interpretation
91 – 100	Exemplary	This means that the level of Academic Performance is very much observed.
81 – 90	Accomplished	This means that the level of Academic Performance is much observed.
80 – 85	Emergent	This means that the level of Academic Performance is moderately observed.
75 – 79	Developing	This means that the level of Academic Performance is less observed.
74 and below	Beginning	This means that the level of Academic Performance is not observed.

Data Gathering Procedure

The researcher will undergo the following steps: First, is to seek permission from the St. Thomas More Administration to facilitate the research process. After which, the researcher will secure a letter to conduct study from the respondents to allow them to carry out research in the school. Primary data will be used for the study. Structured questionnaires will be used as a tool of data collection. The questionnaires will be prepared and distributed to the Grade 9 High School Students by the researcher through the use of online platform such Google Forms and Messenger. Respondents may write their names or not in the questionnaire for the purpose of confidentiality and will be given a week to fill in the questionnaire, and finally, the data will be analyzed and interpreted based on the research objectives.

Data Analysis

The results were analyzed and interpreted in the light and purposes of the study. The following statistical tools used are the following.

Average Weighted Mean. This test was used to determine the level of Technological Factor and Academic Performance of Grade 9 High School Students of St. Thomas More Montessori School.

Standard Deviation. This was used to measure of the amount of variation or dispersion of the data.

Pearson r. This was used to determine the relationship between level of Technological Factor and Students' Academic Performance of Grade 9 High School Students of St. Thomas More Montessori School.

Multiple Linear Regression. This was used to determine the Technological Factor that can influence the most to the academic performance of the students.

Ethical Consideration

In the conduct of the study, ethical considerations will be observed. The data collected will be used with confidentiality, and it will seek the permission from respondents to be part of the study. Republic Act 10172 also known as Data Privacy Act of 2012 will be utilized for the confidentiality, under Article 2, Section 8, states the ensuring of the confidentiality of any personal information that comes to its knowledge and possession at all times. Any act of that violates this law will be dealt accordingly.

Reliability Test

Table 4. Reliability Statistics

Table 4. Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.873	.872	25

The table shows the Reliability Statistics that gives the result of Cronbach's Alpha was **0.873**. Since the minimum standard of the Cronbach's Alpha to test the reliability of the research instrument was at least 0.70, hence, the result was greater than 0.70, therefore the research instrument is *reliable*. (See Appendix D for the complete reliability result).

CHAPTER 3 RESULTS AND DISCUSSION

This chapter presents the results and the discussion on the correlation of technological factors and academic performance of grade 9 high school students in mathematics.

The main intent of this study is to determine the significant relationship between the technological factors and academic performance of grade 9 high school students in mathematics. This also intent to compare and show the factors of technology which can affect most the academic performance of the students in mathematics.

The table shows the mean and standard deviation of Technological Factors and Academic Achievement of the Grade 9 High School Students.

Internet Connectivity has an average mean of **3.06** and a standard deviation of **0.45**, the average mean indicates a **Moderate Level** on the given parameters. This implies that, the level of the Internet Connectivity was moderately observed.

Table 5. Levels of Technological Factors and Academic Achievement			
	Mean	Std. Deviation	N
Internet_Connectivity	3.06	0.45	20
Adequacy_Technology	3.28	0.49	20
Knowledge_Technology	3.58	0.58	20
Self_Efficacy	3.13	0.76	20
Student_Perception	3.31	0.90	20
Grades	82.55	5.63	20

The Adequacy of Technology has an average mean of **3.28** and a standard deviation of **0.49**, the average mean indicates a **Moderate Level**. This implies that, the level of Adequacy of Technology was moderately observed.

The Knowledge of Technological Tools Used has an average mean of **3.58** and a standard deviation of **0.58**, and this indicates of **High Level**. This implies that, the Knowledge of Technological Tools Used was much observed.

The Self-Efficacy has an average mean of **3.13** and a standard deviation of **0.76**, this indicates of **Moderate Level**. This implies that, The Self-Efficacy of the students was moderately observed.

The Students' Perceptions has an average mean of **3.31** and a standard deviation of **0.90**, this indicates of **Moderate Level**. This implies that, the Students' Perception was moderately observed.

The Academic Achievement Grade of the Students has an average mean of **82.55**, that has a level of **Accomplished** with a standard deviation of **5.63**. This means that the Academic Achievement Grade of the Students in Mathematics was much observed.

	N	Mean	Std. Deviation
External_Factors	20	3.31	0.32
Internal_Factors	20	3.22	0.78
Valid N (listwise)	20		

The table shows the Mean and Standard Deviation of Technological Factors as classified as External and Internal Factors.

The External Factors has an average mean of **3.31**, this indicates of **Moderate Level**, with a standard deviation of **0.32**. The Internal Factors has an average mean of **3.22**, indicates of **Moderate Level**, with a standard deviation of **0.78**.

Both External and Internal Factors have the same level. Thus, this implies that there is **no significant difference** between the levels of Technological Factors as classified into External and Internal Factors.

Variable	Mean	Std. Deviation	r – value	P - value	Decision
Technological Factors	3.27	0.46	- 0.002	0.992	Do not reject H₀
Academic Grade	82.55	5.63			

Table 7. Correlation of Independent and Dependent Variable

The table shows the significant relationship of Technological Factors and Academic Performance of Grade 9 High School Students in Mathematics.

Using Pearson’s *r* Correlations, we get the *r* - value of **-0.002**, and has a P-value of **0.992**, as shown on the Table 7. This implies that the *r* – value has **no or weak relationship** between Technological Factors and Academic Achievement of Grade 9 High School Students in Mathematics.

Therefore, there is no significant relationship between Technological Factors and Academic Achievement of Grade 9 High School Student in Mathematics of St. Thomas More Montessori School.

On the TPACK framework, Technological Knowledge is the last area to complete the TPACK framework. With this, the most basic and fundamental area that should be established on integrating technology is the Pedagogy and the Content Knowledge. The pedagogy is the “how’s” of teaching – the theories, strategies, and techniques on how we teach students in an online set-up. The Content Knowledge is the “what” – the understanding of the subject matter. With these two – Content and Pedagogy, we can create a meaningful learning if we can deliver the content and use of appropriate strategies, techniques on the teaching and learning process. With layered technology, on the online set-up the learning of students becomes more efficient and effective. The use of appropriate technological tools can also help the student to become equipped of the subject being taught. As cited by Myers (2009), “The existence, versatility, and power of technology make it possible and important to reexamine what mathematics students should learn as well as how they can learn it” (NCTM, 2000 p. 24).

Table 8. Analysis of Technological Factors to the Academic Achievement

Correlations

		Internet_Conne ctivity	Adequacy_Tech nology	Knowledge_Tech nology	Self_Effi cacy	Student_Perc eption	Grad es
Internet_Connecti vity	Pearson Correlat ion Sig. (2- tailed) N	1 .177 .456 20	1 -.177 .456 20	1 -.052 .829 20	1 .285 .224 20	1 .113 .636 20	1 .385 .094 20
Adequacy_Tech nology	Pearson Correlat ion Sig. (2- tailed) N	-.177 .456 20	1 .401 .080 20	1 .401 .080 20	1 .341 .141 20	1 .248 .293 20	1 .097 .683 20
Knowledge_Tech nology	Pearson Correlat ion Sig. (2- tailed) N	-.052 .829 20	.401 .080 20	1 .529* .017 20	1 .529* .017 20	1 .762** .000 20	1 .177 .456 20
Self_Efficacy	Pearson Correlat ion Sig. (2- tailed) N	.285 .224 20	.341 .141 20	.529* .017 20	1 .774** .000 20	1 .774** .000 20	1 .012 .960 20

Student_Perception	Pearson Correlation	.113	.248	.762**	.774**	1	-.042
	Sig. (2-tailed)	.636	.293	.000	.000		.862
	N	20	20	20	20	20	20
Grades	Pearson Correlation	.385	-.097	-.177	.012	-.042	1
	Sig. (2-tailed)	.094	.683	.456	.960	.862	
	N	20	20	20	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

The Table shows the result of Multiple Linear Regression Analysis of Technological Factors to the Academic Achievement of Grade 9 High School Students in Mathematics.

As shown in the table above, it shows that the Technological Factors that can affect the Academic Performance of the students most is the Internet Connectivity. The internet connectivity gave us the Pearson Correlation of **0.385**, and a significant (2-tailed) of **0.094**. The rest of the factors gives the negative result of Pearson Correlation of **-0.097**, **-0.177**, and **-0.042**, which are the Adequacy of Technology, Knowledge of Technological Tools Used, Students' Perceptions, respectively. Also, a result of Pearson Correlation which is lower than the Internet Connectivity, that is, **0.012** which is the Self-Efficacy.

This implies that the Internet Connectivity can affect most the Academic Performance of the Grade 9 High School Students in Mathematics. The Internet permits the users of significant importance of the world around them. As cited by Yebowaah, F.A. (2018), internet usage will continue to foster as long as its users are not denied easy access (Olatokun, 2008). Also, on a study by Ellore, et al. (2014), on the influence of the internet usage on academic performance and face-to-face communication showed that as a result of the availability of internet or the connectivity of internet, most students had an access to their gadgets (e.g. cellphones, laptops, tablets). And this helps the students to widen the academic knowledge (Siraj, et al., 2015). The use of computer and the access to online resources according to Akende and Bamise (2017) are pertinently important to students.

CHAPTER 4 CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the conclusions and recommendations of the findings based on the theories, results, interpretations, and discussions of the data collected.

Conclusions

The technology nowadays is very useful, especially with the use of technological tools that can help young learners of the new generation. Today, we are facing the new normal setting of learning. Everyone is adapting to the fast-pace of integrating technology through teaching and learning process. This study is conducted due to the current situation which we really use the integration of technology. With this, the researcher was decided to conduct the study and perceived if there is a relationship between the technological factors and the academic performance of the students.

With the result provided, it proved that there is no significant relationship between the Technological Factors and Academic Performance of Grade 9 High School Students in Mathematics. The integration of technology is about to put a massive implementation on our current situation in which we are affected by the pandemic. We must see to it that the factors upon integrating technology will be addressed properly both external and internal factors. Technology can help students to become independent on their studies with technology integration. Thus, this cannot deny the fact that the more they use technology can lead them into addiction. With the proper guidance of the parents, guardians, and teachers we can monitor them to be not an internet addict or technologically addict.

Teachers on the 21st century must consider the 21st century learners with the integration of technology in classroom setting and even homeschooling. TPACK Framework, is a framework that conceived the Technological, Pedagogical, and the Content Knowledge of both teachers and students. Teachers needs to be pedagogically ready to teach with techniques, strategies and the likes on their students to become more interactive, engaging, and meaningful on the teaching and learning process. Teachers must have the mastery of the content of the knowledge of what is being taught. Teachers needs to be technologically ready for them to introduce the content knowledge with pedagogy. With these three, Technological, Pedagogical, and Content Knowledge, will meet half-way upon the teaching and learning process. If these three will meet, there is a meaningful learning that the student will gain.

The intersection is what we called TPACK, so, TPACK is about what teacher know, how they teach and how technology is used in the delivery of the lesson to make it more engaging and making learning more relevant in the 21st century. TPACK will start with content and then pedagogy and layer in technology. Sometimes, you might get excited about the technological tool and design a lesson around it. But we must remember, it is not about the technology tool but it is the right blend of the three knowledge areas.

On the other hand, students need to attend to the standard of being a 21st century learners. They need to be technologically knowledgeable for them to cope the trends of today's teaching methods. Technological factors are the way of how we are going to perceived and adapt to the fast - changing environment that we lived in. On todays' current problem facing by the government and educational system, we must work hand – in – hand to support the teaching and learning process. As we adapt to the new normal setting, those technological factors can be useful or can be taken for granted by the students that can affect their academic performances especially in Mathematics.

Internet connectivity is one of the technological factors that can affect the most on the academic performance of the students in Mathematics. As we experiencing the pandemic, we adapt to the blended learning, synchronous and asynchronous mode of learning, and even online class. This internet connectivity can help students to learn more or can not help them to learn. With high internet connectivity or what we

call the strong and stable internet connection, students can really help themselves on how to cope the standard of the education. By doing so, they may research for the topics that they did not understand. Also, by having a strong and stable internet connectivity, students can attend the online session, can listen and participate to the discussion by the teachers. However, to have strong and stable internet connectivity can cost you too much. Some students can not afford to provide such strong and stable internet connectivity. With this, students who can not afford this internet connectivity are not able to join online classes and discussions by the teachers. And, the effect, students can not pose questions with regards to the topics that did not understand on their own pace.

In addition, having a strong and stable internet connectivity will lead students to not focus on their studies. It is due to the fact that students tend to surf while having an online class. They are not focusing on the online classes and take it only for granted. Teachers believed that once students are attending the online class, students are focused on the discussion and activities provided. In which, teachers can not escape this reality that some of the students might lose focus on the discussions. And as a teacher, we can not take action just to lessen such kind of student's lose of focus. Instead, being a 21st century teachers, we must create discussions and activities that which create a fun, engaging and meaningful learning through the integration of technology and with the internet connectivity and access.

Generally, students, parents and/or guardians, and teachers must work hand in hand to promote the quality of education. As we are undergo to the what we so called new normal classroom set up, we must see to it that the academic performance of the students is well monitored and properly taken into considerations. As a teacher, I really believed that learning will takes place on different ways, either passive or active. We can not control the students especially we are having the online classes, but we must help the students to take responsibility on their own learning with the guidance of the teacher. According Dale's Cone of Experience, the more the concrete of the experience is, the more you can understand and give a meaningful learning.

Recommendations

With the findings of the study, the researcher recommends to the following individuals:

Teacher. Researcher recommends to the teachers to promote the integration of technology properly. With the use of technological tools, applications that is readily available on the Internet. Researcher suggests that with the use of proper technological tools upon conducting a lesson, students can actively participate all throughout. It also suggests that, teachers must see it first the availability of the gadgets of the students and considers the internet connectivity before integrating the technological tools. The first thing that the teachers must consider is the availability of the materials of the students. After putting some considerations, teachers must create an active, engaging, and meaningful learning on the teaching and learning process. As they adapt on the new normal classroom set up, teachers must be flexible on the fast-pace of integrating technological tools.

Parents. Researcher recommends to the parents to make use of time to monitor their child while having an online class. They must see to it that their child is participating and attending their classes. Researcher suggests that with the proper guidance of the parents, students can actively participate on their online classes. And with the parents monitoring their child's progress they can make sure that the academic performance of their child is on the track.

School Administrations. Researcher recommend the school administrators to check the record of the platforms used by the teachers. It is on the platform that can also make use of the effective teaching and learning process. Researcher suggests that it must put into consideration the internet connectivity of the teachers used for them to be able to deliver the lesson properly. Also, make use of other platforms that is relevant to the online teaching. School administrators must consider to re-align the system of education of the institution - both public and private to cater the needs of the majority of the students.

Future Researchers. Researcher recommend to future researchers, if a related study will be conducted, the future researchers must find new technological factors that can influence the academic performance of the students. It is also recommended, that they must focus on the internet connectivity as a factor that can really affect the most on the academic performance of the students.

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APPENDICES

APPENDIX A

LETTER TO CONDUCT STUDY

03 November 2020

Vina M. Zaragoza, Ed.D. (Sgd.)

School Principal

St. Thomas More Montessori School

Doctolero Avenue, Brgy. Magugpo East, Tagum City, Davao del Norte

Ma'am:

Greetings!

This is to inform you of undersigned's intention of conducting his research entitled, "***Technological Factors and Students' Performance of Grade 9 High School Students in Mathematics Subject***", in your school. Further, the undersigned would like to ask permission from your good office to have the Grade 9 students to be the respondents or participants of the study.

The primary purpose of this undertaking is to evaluate the performance of the students with regards to the technological factors in online class conducted. The study is expected to generate insightful lessons worthy to be part of the database literature. Moreover, the result also could be an aid in formulating strategies in the implementation of online class in St. Thomas More Montessori School.

Your positive response with this matter will greatly contribute to the success of the researcher's endeavor.

Respectfully yours,

SILVER FEB J. AUMENTADO, LPT.

Researcher

APPENDIX B
RESEARCH INSTRUMENT

QUESTIONNAIRE FOR TECHNOLOGICAL FACTORS AND ACADEMIC PERFORMANCE OF GRADE 9 HIGH SCHOOL STUDENTS IN MATHEMATICS

Name: _____ **Age:** _____
Gender: _____ **Grade & Section:** _____

In answering this questionnaire, I understand that my responses should be true from my experience and perspective. I am also well-informed that my responses or any personal information provided hereof are viewed confidential and should not be used for any other purposes apart from this study.

Signature: _____

Direction: The following questions are intended for the study titled “**TECHNOLOGICAL FACTORS AND ACADEMIC PERFORMANCE OF GRADE 9 HIGH SCHOOL STUDENTS IN MATHEMATICS**”. Use the rating scale as a guide in evaluating statements below. Put an (X) mark in the column that indicates your answer.

Range	Scale	Interpretation
5	Strongly Agree	The condition embodied in the item is observed at all time.
4	Agree	The condition embodied in the item is oftentimes observed.
3	Moderately Agree	The condition embodied in the item is fairly observed.
2	Disagree	The condition embodied in the item is hardly observed.
1	Strongly Disagree	The condition embodied in the item is not observed.

I. TECHNOLOGICAL FACTORS

External Factors					
A. Internet Connectivity	5	4	3	2	1
1. I have strong internet connection (at least 3mbps)					
2. I have easy access to the Internet Service providers.					
3. I do not have compatibility issues while using the internet (e.g. windows system is up-to-date, Microsoft word is updated, etc.)					
4. I use alternate methods in accessing the internet (e.g. borrow an internet enabled device from a relative family member or friend).					
5. My access to technology at home is currently regular and adequate.					
B. Adequacy of Technology	5	4	3	2	1
6. I have gadgets (e.g. Smartphones, Tablets, Computes, Laptops, etc.)					
7. I use e-library to support teaching and learning materials.					
8. I use noise-cancelling headphones to minimize unnecessary/static noises.					
9. I have sufficient access to the school's technology platform used.					
10. I think that there is too much technological change coming too fast without enough support from teachers.					
C. Knowledge on Technological Tools Used	5	4	3	2	1
11. I have a background on the use of technology (e.g. Zoom, Google Meet, Edmodo, Google Classroom, etc.)					
12. I have insights on the integration of technology to deliver lessons (e.g. use of day-light projector or DLP, etc.)					

13. I have sufficient knowledge on the use of technology (e.g. Zoom, Google Meet, Edmodo, Google Classroom, etc.)					
14. I have met the required technological skills on the use of technology (e.g. Zoom, Google Meet, Edmodo, Google Classroom, etc.)					
15. I know the basics of software used (e.g. Microsoft Word, Excel, PowerPoint, etc.)					
Internal Factors					
D. Self-Efficacy	5	4	3	2	1
16. I see myself as effective and efficient when using technology.					
17. I am not hesitant during online classes.					
18. I am able to comprehend the lessons using technology.					
19. I do not need any assistance accomplishing my project/assignment.					
20. I am satisfied with the information found in the internet.					
E. Students' Perception	5	4	3	2	1
21. I see the online classroom as conducive for learning.					
22. I believe that online classes can help me learn despite the pandemic.					
23. I believe that I can do better with the use of technology.					
24. I believe that Internet resources helps me in understanding my project/assignment better.					
25. I believe that the use of technology will make me an effective and efficient student.					

APPENDIX C
VALIDATION SHEET FOR QUANTITATIVE RESEARCH INSTRUMENT

Name of Evaluator: RONA C. APOLINARIO

Degree: Master of Arts in Teaching, on-going Ph.D. major in DRA

Number of Years in Teaching: 7 years

To the Evaluator: Kindly check the appropriate box for your rating

Points Equivalent: 5 – Excellent 4 – Very Good 3 – Good 2 – Fair 1 – Poor

CRITERIA / INDICATORS	5	4	3	2	1
1. CLARITY OF DIRECTIONS AND ITEMS The vocabulary level, language structure and conceptual level of the questions suit to the level of respondents. The directions and items are written in clear understandable manner.	5				
2. PRESENTATIONS/ORGANIZATION OF ITEMS The items are presented and organized in logical manner.	5				
3. SUITABILITY OF ITEMS The items appropriately represent the substance of the research. The questions are designed to determine the condition, properties and attitudes that are supposed to be measured.	5				
4. ADEQUATENESS OF ITEMS PER CATEGORY The items represent the coverage of the research adequately. The number of questions per area category is represented enough to all the questions for the research.	5				
5. ATTAINMENT OF PURPOSE The instrument as a whole fulfills the objectives for which it was constructed.	5				
6. OBJECTIVITY Each item question requires only one specific answer that measures only one behavior and no aspect of the questionnaire has been suggested by the researcher.	5				
7. SCALE AND EVALUATION RATING SYSTEM The scale adapted is appropriate for the items.	5				

Remarks/Other Suggestions: The instrument submitted was good, recommendations were followed. God bless.

Evaluated by:



RONA C. APOLINARIO, MAT-Math

Signature over Printed Name

VALIDATION SHEET FOR QUANTITATIVE RESEARCH INSTRUMENT

Name of Evaluator: MARY JOY V. DAYO

Degree: MASTER OF ARTS IN EDUCATION MAJOR IN MATHEMATICS

Number of Years in Teaching: 20 years

To the Evaluator: Kindly check the appropriate box for your rating

Points Equivalent: 5 – Excellent 4 – Very Good 3 – Good 2 – Fair 1 – Poor

CRITERIA / INDICATORS	5	4	3	2	1
8. CLARITY OF DIRECTIONS AND ITEMS The vocabulary level, language structure and conceptual level of the questions suit to the level of respondents. The directions and items are written in clear understandable manner.	/				
9. PRESENTATIONS/ORGANIZATION OF ITEMS The items are presented and organized in logical manner.	/				
10. SUITABILITY OF ITEMS The items appropriately represent the substance of the research. The questions are designed to determine the condition, properties and attitudes that are supposed to be measured.	/				
11. ADEQUATENESS OF ITEMS PER CATEGORY The items represent the coverage of the research adequately. The number of questions per area category is represented enough to all the questions for the research.		/			
12. ATTAINMENT OF PURPOSE The instrument as a whole fulfills the objectives for which it was constructed.	/				
13. OBJECTIVITY Each item question requires only one specific answer that measures only one behavior and no aspect of the questionnaire has been suggested by the researcher.	/				
14. SCALE AND EVALUATION RATING SYSTEM The scale adapted is appropriate for the items.	/				

Remarks/Other Suggestions: _____

Evaluated by:



MARY JOY V. DAYO, MAEd

Signature over Printed Name

VALIDATION SHEET FOR QUANTITATIVE RESEARCH INSTRUMENT

Name of Evaluator: MARIA TERESITA T. BALIGA

Degree: MS Applied Mathematics (CAR)

Number of Years in Teaching: 6

To the Evaluator: Kindly check the appropriate box for your rating

Points Equivalent: 5 – Excellent 4 – Very Good 3 – Good 2 – Fair 1 – Poor

CRITERIA / INDICATORS	5	4	3	2	1
1. CLARITY OF DIRECTIONS AND ITEMS The vocabulary level, language structure and conceptual level of the questions suit to the level of respondents. The directions and items are written in clear understandable manner.	/				
2. PRESENTATIONS/ORGANIZATION OF ITEMS The items are presented and organized in logical manner.	/				
3. SUITABILITY OF ITEMS The items appropriately represent the substance of the research. The questions are designed to determine the condition, properties and attitudes that are supposed to be measured.		/			
4. ADEQUATENESS OF ITEMS PER CATEGORY The items represent the coverage of the research adequately. The number of questions per area category is represented enough to all the questions for the research.	/				
5. ATTAINMENT OF PURPOSE The instrument as a whole fulfills the objectives for which it was constructed.		/			
6. OBJECTIVITY Each item question requires only one specific answer that measures only one behavior and no aspect of the questionnaire has been suggested by the researcher.	/				
7. SCALE AND EVALUATION RATING SYSTEM The scale adapted is appropriate for the items.	/				

Remarks/Other Suggestions:

Make sure alignment of the Statement of the Problem with the proposed instrument. Provide operational definition of the term 'technology'.

Evaluated by:

MARIA TERESITA T. BALIGA

Signature over Printed Name

APPENDIX D
Reliability Results

Item Statistics			
	Mean	Std. Deviation	N
I have strong internet connection (at least 3mbps).	3.2667	.70373	15
I have easy access to the Internet Service provider.	3.1333	.74322	15
I do not have compatibility issues while using the internet (e.g. windows system is up-to-date, Microsoft word is updated, etc.).	3.5333	.83381	15
I use alternate method for accessing the internet (e.g. borrow an internet enabled device from a relative family member or friend).	3.0667	1.27988	15
My access to technology at home is currently regular and adequate.	3.4000	.63246	15
I have gadgets (e.g. Smartphones, Tablets, Computers, Laptops, etc.)	4.0000	1.00000	15
I use e-library to support teaching and learning materials.	3.0000	1.00000	15
I use noise-cancelling headphones to minimize unnecessary/status noises.	2.2667	1.33452	15
I have sufficient access to the school's technology platform used.	3.0667	1.03280	15
I think that there is too much technological change coming too fast without enough support for teacher.	3.1333	.91548	15
I have a background on the use of technology (e.g. Zoom, Google Meet, Edmodo, Google Classroom, etc.)	3.8667	1.06010	15

I have insights on the integration of technology to deliver lessons (e.g. use of day-light projector or DLP, etc.)	2.7333	.79881	15
I have sufficient knowledge on the use of technology (e.g. Zoom, Google Meet, Edmodo, Google Classroom, etc.)	3.7333	.79881	15
I have met the required technological skills on the use of technology (e.g. Zoom, Google Meet, Edmodo, Google Classroom, etc.)	3.8667	.74322	15
I know the basics of software used (e.g. Microsoft Word, Excel, PowerPoint, etc.)	3.4667	.83381	15
I see myself as effective and efficient when using technology.	3.2667	.70373	15
I am not hesitant during online classes.	3.0667	.96115	15
I am able to comprehend the lessons using technology.	3.2000	1.08233	15
I do not need any assistance accomplishing my project/assignment.	3.1333	1.18723	15
I am satisfied with the information found in the internet.	3.3333	.89974	15
I see the online classroom as conducive for learning.	3.1333	1.12546	15
I believe that online classes can help me learn despite the pandemic.	3.6667	.97590	15
I believe that I can do better with the use of technology.	3.2667	.79881	15
I believe that Internet resources helps me in understanding of the project/assignment better.	3.6667	.81650	15
I believe that the use of technology will make me an effective and efficient student.	3.1333	1.24595	15

Summary Item Statistics							
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.296	2.267	4.000	1.733	1.765	.145	25
Item Variances	.920	.400	1.781	1.381	4.452	.145	25
Inter-Item Correlations	.214	-.716	.856	1.572	-1.196	.137	25

Item-Total Statistics						
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	
I have strong internet connection (at least 3mbps)	79.1333	137.552	.220	.	.873	
I have easy access to the Internet Service provider.	79.2667	142.352	-.069	.	.879	
I do not have compatibility issues while using the internet.	78.8667	133.267	.401	.	.869	
I use alternate method for accessing the internet (e.g. borrow an internet enabled device from a relative family member or friend).	79.3333	143.810	-.123	.	.888	
My access to technology at home is currently regular and adequate.	79.0000	138.000	.221	.	.873	

I have gadgets (e.g. Smartphones, Tablets, Computers, Laptops, etc.)	78.4000	123.829	.757	.	.858
I use e-library to support teaching and learning materials.	79.4000	133.829	.296	.	.872
I use noise-cancelling headphones to minimize unnecessary/status noises.	80.1333	133.981	.192	.	.878
I have sufficient access to the school's technology platform used.	79.3333	126.667	.600	.	.863
I think that there is too much technological change coming too fast without enough support for teacher.	79.2667	151.210	-.460	.	.891
I have a background on the use of technology (e.g. Zoom, Google Meet, Edmodo, Google Classroom, etc.)	78.5333	121.695	.807	.	.856
I have insights on the integration of technology to deliver lessons (e.g. use of day-light projector or DLP, etc.)	79.6667	146.381	-.276	.	.884

I have sufficient knowledge on the use of technology (e.g. Zoom, Google Meet, Edmodo, Google Classroom, etc.)	78.6667	127.810	.733	.	.861
I have met the required technological skills on the use of technology (e.g. Zoom, Google Meet, Edmodo, Google Classroom, etc.)	78.5333	130.267	.641	.	.864
I know the basics of software used (e.g. Microsoft Word, Excel, PowerPoint, etc.)	78.9333	141.210	-.011	.	.879
I see myself as effective and efficient on the use of technology.	79.1333	129.981	.699	.	.863
I am not hesitant on the online mode of teaching.	79.3333	127.810	.596	.	.863
I am able to comprehend the lessons using technology.	79.2000	119.600	.883	.	.853
I do not need any assistance accomplishing my project/assignment.	79.2667	124.781	.584	.	.863

I am satisfied with the contents of the information found on the internet.	79.0667	125.352	.771	.	.859
I see the online classroom as conducive for learning.	79.2667	119.924	.831	.	.854
I believe that online class can help to learn despite pandemic.	78.7333	126.210	.662	.	.861
I believe that I can do better with the use of technology.	79.1333	132.267	.478	.	.867
I believe that Internet resources helps me in better understanding of the project/assignment.	78.7333	125.210	.865	.	.857
I consider myself using technology will make me an effective and efficient student.	79.2667	118.781	.786	.	.855

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
82.4000	141.686	11.90318	25