

Mathematics Online Learning: Long-Term Implications from a Case Study at St Theresa International College, Thailand

Melven Acasio Morales

Ongkharak Demonstration School of Srinakarinwirot University, Thailand

Email: melvenmorales533@gmail.com

Abstract

Quality delivery of Mathematics lessons conducted through online learning during the COVID-19 pandemic is one of the major concerns faced by the administrators, lecturers and students. Different opinions from different people were voiced out considering the effectiveness of its delivery. This study explored how and what the mathematics students think and feel towards the online mathematics learning during the COVID-19 pandemic. This research is both quantitative and qualitative in nature to examine the perception and level of satisfaction of mathematics students towards mathematics Online learning and to identify the factors affecting students' learning through Online. Also, this study aimed to create an appropriate guideline in managing the mathematics Online learning. Students from St Theresa International College who took Math courses during the second semester of the academic year 2021- 2022 were used as respondents. The study revealed that: (1) students have positive attitude towards mathematics; and (2) students were moderately satisfied on the conduct of Math online learning in terms of Learners' Dimension, Technological Characteristics and Instructors' Characteristics. Nine (9) factors/indicators were identified to have a successful Online Math Class such as: (1) Instructors' Professional Skills; (2) Learner Autonomy; (3) Learners' Understanding and Retention; (4) Learners' Attitude towards Mathematics and Online Learning; (5) Technological Concerns; (6) Instructional Material Concerns; (7) Convenience; (8) Lack of Motivation; and (9) Caring Instructors. The 9 indicators provided a picture for an effective Mathematics online class. With the focus shifted to these, effective online math class would be achieved and students will greatly benefit from it.

Keywords: effective Mathematics online class, factors/indicators affecting Online Mathematics learning, long-term implications, Mathematics Online learning, online class guidelines

Introduction

With the advent of science and technology, many countries in the world gained access to the internet (Ishfaq & Tehmina, 2011) that turned out to be the main venue for online learning during the COVID -19 pandemic. Many higher institutions have diverse reactions in facing the COVID-19 outbreak including the implementation of online courses and the exploration and utilization of different websites as cited by Wu (2021) like the digital social platforms, Facebook and YouTube; and the video, conferencing Google Meet and Zoom. Ramadhani, Noer & Machmud, Muhammad (2021) in their study stated that Web and video conference is most effective for learning when used in an interactive mode. They added that, interaction is achieved through collaboration with learning resources, the facilitator, and students, and it will produce interactive learning activities.

During the Covid-19 pandemic, the use of video conferencing was considered an effective way to conduct teaching and learning activities. The two authors further claim that their observation was boosted when an article from “Kompas” – an Indonesian Newspaper, declared that Video Conferencing becomes a popular delivery system in the teaching and learning process because of its advantage to facilitate face-to-face communication in digital form. Categorically, the authors declared that Video conferencing technology is considered an advantageous media for teaching and learning activities because of its ability to bring the classroom environment into digital form.

According to the study of Thygesen, H., Bonsaksen, T., Schoultz, M. et al. (2021), during the pandemic, the use of social media was at a high frequency even before the pandemic outbreak. However, the author stressed that there was a sharp increase in the use of social media several times per day (from 56.3% before the pandemic to 72.0% after the onset of the pandemic).

In the same vein, web and video conferencing have benefitted with the turn of events especially during the pandemic. Designed as a means of communicating or holding work meetings, Zoom for example, according to Karl, K., Peluchette, J., & Aghakhani, N. (2021), the number of daily participants had reached 10 million in December 2019, but drastically increased to over 300 million by April 2020. The authors also claimed that Google Meet™ and Microsoft Teams have also experienced significant increases in their daily participants.

The COVID-19 pandemic accelerated the global adoption of online learning as a necessity rather than a choice, particularly in mathematics, a subject that often requires deep conceptual understanding and interactive problem-solving. Overall, the study contributes to the global discourse on reshaping education in the digital age, ensuring that mathematics education remains robust, accessible, and innovative. The insights drawn from this case study can guide institutions, policymakers, and educators in creating a more resilient and inclusive learning environment for students in the post-pandemic world, thus this study.

This study is anchored on the idea that satisfaction is the most significant considerations influencing the continuity of online learning (Moore and Kearsley, 2011; Parahoo et al., 2016 as cited by She L, Ma L, Jan A, Sharif Nia H and Rahmatpour P, 2021). She L, Ma L, Jan A, Sharif Nia H and Rahmatpour P, 2021) also cited the work of Topala and Tomozii (2014) which states that learning satisfaction is the result of the learning experiences manifested through the learners' feelings and attitudes toward the learning processes. It was also found out as declared in the work of Ke and Kwak, (2013) as also cited by She L, et al., (2021) that learning achievements and the success of online learning is measured through the learners' satisfaction.

It is clear that in online learning, positive and negative effects are evident especially during the pandemic. Thus, spending time to know how the students feel with regards to the implementation of online learning is very significant as this will be used to create a new paradigm in teaching that will be of great help especially in the post-pandemic world.

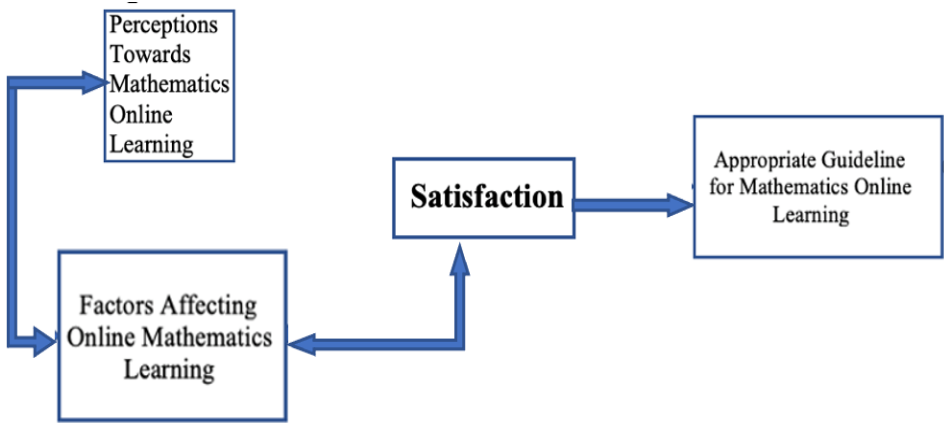


Figure 1. Schematic Diagram of the Study

While many studies focus on the short-term effects of online learning during the COVID-19 pandemic, there is a lack of research that explores the long-term implications, particularly in a subject like mathematics, where conceptual clarity and interaction are crucial. The existing body of research on online mathematics education often examines global or generalized contexts. However, there is a gap in understanding how online learning impacts mathematics education within specific regional and institutional settings, such as Thailand and institutions like St Theresa International College.

Limited studies evaluate how teachers adapted their instructional methods for online mathematics education and the long-term impact of these adaptations on student learning outcomes and engagement. While online learning became a necessity during the pandemic, little research addresses its long-term sustainability and how blended or hybrid models can be effectively integrated into mathematics education moving forward. By addressing these gaps, the study provides valuable insights that contribute to improving online mathematics education, enhancing pedagogical strategies, and informing policies for future preparedness in digital education environments.

Materials and Methods

This research employed both quantitative and qualitative methodologies with the following objectives: (1) to study the perception of mathematics students towards mathematics Online learning; (2) to determine the satisfaction level of students towards mathematics Online learning; (3) to identify the factors/indicators affecting students' learning towards mathematics Online learning; (4) to create an appropriate guideline for managing the mathematics Online learning. The respondents were 132 students from 5 Faculties of St Theresa International College who were enrolled in mathematics courses during the second semester of the 2021-2022 academic year. Although the data were collected during the COVID-19 pandemic, the insights gained remain highly relevant in the context of the post-pandemic 'new normal,' where online and hybrid learning have become enduring components of education systems.

The quantitative data, gathered through surveys, highlights key patterns in student engagement, performance, and adaptability to online learning environments, which continue to inform best practices for virtual education. Qualitative data, obtained through open-ended responses, provides a nuanced understanding of students' challenges and successes, offering critical insights into the long-term management and enhancement of digital learning platforms. These findings help inform sustainable strategies for educators and institutions to adapt effectively to ongoing shifts in educational delivery, ensuring that students can thrive in a continually evolving academic landscape.

The instrument used to examine the perceptions of the students towards online Mathematics learning is an adapted material from the work of Huda, Nuril & Wahyuni, Tutik & Fauziyah, Fida. (2021). To identify the factors affecting student learning of the mathematics Online learning, the author of this study opted to adapt the Survey questionnaire of Shaid, N. A. N., Kamruzaman, F. M., & Sulaiman, N. A. (2021). The material consists of 3 domains with the reliability to wit:

Domain 1: Learners' Dimension = 0.942

Domain 2: Technological Characteristics = 0.902

Domain 3: Instructors' Characteristics = 0.974

To achieve the objectives of this study, the researcher adapted 25 items to measure the students' perception towards online Mathematics learning and 37 items to determine the students' level of satisfaction towards Mathematics Online Learning. To identify the factors affecting Math students' learning through Online learning, 15 items intended for Learners' Dimension; 9 items for Technological Characteristics; and 13 items for Instructors' Characteristics were used.

The questionnaire consisted of three sections. Section A comprises of the students' perceptions towards Mathematics Online Learning; Section B is divided into three domains which are Domain 1: Learner's dimension; Domain 2: Technological Characteristics; and Domain 3: Instructors' Characteristics intended to measure the students' level of satisfaction towards Mathematics Online Learning; while Section C is for the students' comments regarding their perceptions and level of satisfaction towards Mathematics Online Learning.

Each item in Sections A and B are to be rated using a 5-point Scale: 1 - Strong Disagree, 2- Disagree, 3 – Uncertain, 4 - Agree, 5 - Strongly Agree. Section A will be interpreted using this scale interpretation: 1.0 – 1.80 Strongly Disagree (SD) 1.81 – 2.60 Disagree (D) 2.61 – 3.40 Uncertain (U) 3.41 – 4.20 Agree (A) 4.21 – 5.00 Strongly Agree (SA). Students level of satisfaction will be measured by the statements in Section B and will be interpreted using this scale: 1.0 – 1.80 Highly Dissatisfied (HD) 1.81 – 2.60 Not Satisfied (NS) 2.61 – 3.40 Uncertain (U) 3.41 – 4.20 Satisfied (S) 4.21 – 5.00 Very Satisfied (VS), while the Mean Score Interpretation will be based on the work of Shaid, et al., (2021) as reflected below.

Mean Score	Interpretation
1.00 – 2.23	Low
2.24 – 3.67	Moderate
3.68 – 5.00	High

After the distribution and retrieval of the questionnaire, analysis and interpretation of data were done using SPSS. Qualitative method was used for the thematic analysis to identify Factors/Indicators regarding the perception and satisfaction of students towards Math Online Learning.

Results and Discussion

Students’ Perceptions Toward Mathematics Online learning

The first objective yielded a question "What are the perceptions of mathematics students toward the mathematics Online learning?". To answer the question quantitative analysis was employed and based on the analysis conducted it shows that the research sample agrees on the effectiveness of Online Mathematics Learning with a mean of 3.47 with a standard deviation of 0.907. Statements whose mean score is between 3.41 – 4.20 interpreted as AGREE were: “I can understand the

mathematics material given by the teacher very well”; “I can only partially understand the mathematics material given by the teacher”; “I can understand math material but at the next meeting I forgot”; “Mathematics given by the teacher, I accept it clearly”; “I received mathematics lesson material clearly but easily lost”; “Mathematics is a difficult subject”; “Mathematics is an interesting subject”; “By mastering mathematics, the opportunity to understand other subject matter will be easier”; “Mathematical material has a relationship between one chapter and another”; “Mathematical knowledge is useful for solving various problems”; “Mathematics trains me to be able to think more carefully and carefully”; “Mathematics trains me to be able to think logically and rationally (make sense)”; Math has trained me to be patient”; “Mathematics subject that I understand applied in everyday life”;” When the teacher provides math material, I note important things such as formulas or problem solving”; and “I do assignments from the teacher independently”. However, it is interesting to note that one item “Mathematics is useless in everyday life” received a mean of 2.57 interpreted as DISAGREE with a standard deviation of 1.101.

The table indicates that majority of the students believed that Mathematics is a difficult subject, materials can be understood but can be easily forgotten. The findings further revealed the students’ positive attitude towards mathematics as they believed that Mathematical material has a relationship between one chapter and another. The respondents declared that Mathematical knowledge is useful for solving various problems, Mathematics trained them to be able to think more carefully, logically and rationally (make sense). In addition, the students believed that Mathematics has trained them to be patient.

Table 1. Students' perception towards online mathematics learning.

No.	Statements	5 (SA)	4 (A)	3 (U)	2 (D)	1 (SD)	Mean	SD	I
1	I can understand the mathematics material given by the teacher very well.	5 (5.8%)	33 (38.4%)	42 (48.8%)	5 (5.8%)	1 (1.2%)	3.42	.743	A
2	I can understand math material given by the teacher quickly.	2 (2.3%)	25 (29.1%)	43 (50.0%)	15 (17.4%)	1 (1.2%)	3.14	.769	U
3	I can only partially understand the mathematics material given by the teacher	6 (7.0%)	37 (43.0%)	37 (43.0%)	5 (5.8%)	1 (1.2%)	3.49	.763	A
4	I can understand math material but at the next meeting I forgot	9 (10.5%)	37 (43.0%)	27 (31.4%)	12 (14.0%)	1 (1.2%)	3.48	.904	A
5	I can receive the mathematics material given by the teacher by listening	6 (7.0%)	33 (38.4%)	35 (40.7%)	9 (10.5%)	3 (3.5%)	3.35	.891	U
6	Mathematics given by the teacher, I accept it clearly	9 (10.5%)	30 (34.9%)	43 (50.0%)	3 (3.5%)	1 (1.2%)	3.50	.778	A
7	I received mathematics lesson material clearly but easily lost	7 (8.1%)	38 (44.2%)	34 (39.5%)	6 (7.0%)	1 (1.2%)	3.51	.793	A
8	Mathematics is a difficult subject	25 (29.1%)	24 (27.9%)	24 (27.9%)	11 (12.8%)	2 (2.3%)	3.69	1.098	A
9	Mathematics is an interesting subject	11 (12.8%)	41 (47.7%)	24 (27.9%)	6 (7.0%)	4 (4.7%)	3.57	.965	A
10	By mastering mathematics, the opportunity to understand other subject matter will be easier	7 (8.1%)	38 (44.2%)	35 (40.7%)	5 (5.8%)	1 (1.2%)	3.52	.778	A
11	I have more difficulty learning math than my classmates	11 (12.8%)	23 (26.7%)	30 (34.9%)	13 (15.1%)	9 (10.5%)	3.16	1.157	U
12	Math lessons made me uncomfortable	18 (20.9%)	16 (18.6%)	32 (37.2%)	16 (18.6%)	4 (4.7%)	3.33	1.142	U
13	Math is scary, because counting goes on	10 (11.6%)	25 (29.1%)	26 (30.2%)	21 (24.4%)	4 (4.7%)	3.19	1.079	U
14	Mathematics causes stress (sadness)	18 (20.9%)	16 (18.6%)	32 (37.2%)	13 (15.1%)	7 (8.1%)	3.29	1.197	U

Table 1 Continued. Students' perception towards online mathematics learning.

No.	Statements	5 (SA)	4 (A)	3 (U)	2 (D)	1 (SD)	Mean	SD	I
15	Mathematics is useless in everyday life	5 (5.8%)	12 (14.0%)	24 (27.9%)	31 (36.0)	14 (16.3)	2.57	1.101	D
16	Math subjects cause headaches or dizziness	16 (18.6%)	21 (24.4%)	29 (33.7%)	17 (19.8%)	3 (3.5%)	3.35	1.104	U
17	Mathematical material has a relationship between one chapter and another	20 (23.3%)	45 (52.3%)	18 (20.9%)	3 (3.5%)	0 (0%)	3.95	.766	A
18	Mathematical knowledge is useful for solving various problems	12 (14.0%)	44 (51.2%)	27 (31.4%)	3 (3.5%)	0 (0%)	3.76	.735	A
19	Mathematics trains me to be able to think more carefully and carefully	17 (19.8%)	39 (45.3%)	25 (29.1%)	5 (5.8%)	0 (0%)	3.79	.828	A
20	Mathematics trains me to be able to think logically and rationally (make sense)	16 (18.6%)	41 (47.7%)	25 (29.1%)	3 (3.5%)	1 (1.2%)	3.79	.829	A
21	I understand mathematics as a whole or completely	4 (4.7%)	21 (24.4%)	47 (54.7%)	13 (15.1%)	1 (1.2%)	3.16	.780	U
22	Math has trained me to be patient	14 (16.3%)	39 (45.3%)	24 (27.9%)	9 (10.5%)	0 (0%)	3.67	.874	A
23	Mathematics subject that I understand applied in everyday life	12 (14.0%)	28 (32.6%)	34 (39.5%)	10 (11.6%)	2 (2.3%)	3.44	.953	A
24	When the teacher provides math material, I note important things such as formulas or problem solving	28 (32.6%)	37 (43.0%)	18 (20.9%)	3 (3.5%)	0 (0%)	4.05	.825	A
25	I do assignments from the teacher independently	15 (17.4%)	32 (37.2%)	34 (39.5%)	5 (5.8%)	0 (0%)	3.66	.835	A
OVERALL MEAN							3.47	.907	A

Interpretation: 1.0 – 1.80 Strongly Disagree (SD) 1.81 – 2.60 Disagree (D) 2.61 – 3.40 Uncertain (U) 3.41 – 4.20 Agree (A) 4.21 – 5.00 Strongly Agree (SA)

Students' Level of Satisfaction Towards Mathematics Online Learning

The second objective suggested a question of "What is the level of students' satisfaction towards mathematics Online class?". To answer the second question, quantitative analysis was employed and the findings are presented in Table 2.

The table shows the overall Mean Score of the students' level of satisfaction towards mathematics online learning in terms of three dimensions, Learners' Dimension, Technological Characteristics and Instructors' Characteristics. Findings revealed that the respondents of the study were moderately satisfied towards mathematics online learning with a mean score of 3.63 and a standard deviation of 0.835. The overall mean score of 3.63 can be interpreted as MODERATE, based on the interpretation table from the work of Shaid, et al., (2021), while the standard deviation of 0.835 suggests that responses are not varied, they are consistent and with not much dispersion.

Looking at the mean score for the Learner's Dimension, this study revealed that the student-participants' responses are not varied, consistent and with not much dispersion as reflected in the standard deviation of 0.894 from the mean of 3.59. From this finding, it can be concluded that the students were moderately satisfied with Math online learning. Students' responses in terms of Technological Characteristics yielded the same interpretation as SATISFIED. A mean score of 3.65 with 0.823 as its standard deviation suggests that the students were moderately satisfied towards mathematics online learning when it comes to technological characteristics. The students' level of satisfaction in terms of Instructors' Characteristics was determined by examining the students' responses to the 13 statements. It was found out that the student-participants' responses are not varied, consistent and with not much dispersion as reflected in the standard deviation of 0.788 with a Mean Score of 3.64 which is interpreted as MODERATE.

Overall, the students’ level of satisfaction towards mathematics online learning in terms of three dimensions, Learners’ Dimension, Technological Characteristics and Instructors’ Characteristics was found to have a mean score of 3.63 and a standard deviation of 0.835. The overall mean score of 3.63 can be interpreted as MODERATE, while the standard deviation of 0.835 suggests that responses are not varied, they are consistent and with not much dispersion.

Table 2. Students level of satisfaction towards Mathematics online learning.

Dimension	Mean Score	Standard Deviation	Interpretation
Learners’ Dimension	3.59	0.894	M
Technological Characteristics	3.65	.823	M
Instructors’ Characteristics	3.64	.788	M
Overall Mean Score	3.63	0.835	M

Overall Mean Score Interpretation 1.0– 2.23 Low; 2.24 – 3.67 Moderate; 3.68 – 5.00 High

Factors Affecting Students’ Learning Towards Mathematics Online Class

The third objective implied a question " What are the factors/indicators affecting students learning towards mathematics Online class?". To answer the third question thematic analysis was employed to analyze the students’ written comments on their perceptions towards online math classes.

The analysis yielded nine themes and are presented below.

Theme 1: Professional Skills

Teaching online is different from face-to-face. According to Yang, D. (2017), online teaching especially for STEM courses may not benefit from the knowledge and skills developed intended primarily for face-to-face classes as STEM courses require hand-on activities. According to Rios, T., Elliott, M., & Mandernach, B.J. (2018), instructional content;

communication and usability; teaching process; advantages of delivery approach; competencies of e-tutors; and variety of instructional material were the factors that mainly affected students' satisfaction in online classes. Teacher's delivery approach should be inclusive that everybody will benefit.

The efficacy of online teaching has long been acknowledged but challenges in its implementation continues to build up (Barrot, J. S., Llenares, I. I., & Del Rosario, L. S. (2021). According to Almahasees, Zakaryia & Mohsen, Khaled & Omer, Mohammed. (2021), students with hearing problems, technical and internet issues, lack of interaction and motivation form part of the challenges in adapting online education. These challenges make the job of the teachers even more challenging to cater everyone and for everyone to benefit from the discussion. A respondent of this study commented that:

“Online for Mathematics subject kind of hard to understand or see the white board clearly. So, I think the problem is not about online or on-site class make it harder but if we can see the clear formula and question might make it easier. Plus, when some of classmate they do not understand instead of just open mic and ask professor they keep quiet. I think it's hard to fix it but if professor make students feel comfortable to ask and not shy to be wrong it will be very funniest class.”

Accordingly, teaching is not only about knowing what to teach as the delivery of the lessons requires knowledge on how to do it. Teachers should know how to strategize teaching as teachers are not the sole source of information rather a facilitator of learning. This is in line with what Morales (2020) had said in his work that “to effectively teach the students, teachers should need not only the knowledge on what to teach but also how to teach”. Morales added that a facilitator knows different methods and strategies that are helpful in the maximization of students' leaning.

The respondents of this study have this to say with regards to the teachers' ability to deliver the lesson:

“I would love to have more time to learn and less assignment, because everything going so fast to catch up with all information that we should learn and i need the answer to be given after

sending assignment already, to checking myself that i clearly understand and have nothing wrong. Also when some teachers have inappropriate gadget it also hard to understand or read what they write and use more time.”

“So quickly”

“I want to teach slowly and clearly with examples and related tasks. It's not a good idea to create a simple example. and let difficult problems self practice and when students can't or can't answer the questions You should not rush to get an answer because it may cause stress on the student. Since each person's knowledge and understanding are not the same, please consider it. Thank you.”

(A) Good Classroom Strategist

A teacher may be considered as a motivator if students' feelings of competence is the result of the teacher's effort in influencing the students positively (Morales, 2020). However, if students feel bored and stressed because of difficult and too much homework then teachers need to strategize the giving of extra works to the students. Students who have low motivation will find it difficult to do homework given by the teacher. This kind of behavior according to Neola Samah (2019), homework will unlikely to work on them. Thus, proper planning is needed so that students will appreciate the need in giving homework.

The feedback below from the respondents of this study may serve as good reminders for the Math teachers to strategize the delivery of the lesson as suggested:

“Good teaching is to make students understand the lesson. By using various teaching materials that are interesting and suitable for students Teaching doesn't have to be too many assignments for students. This will make students feel stressed and may have a bad attitude about math. The teacher's assignments should be a good mentor to the students along with explaining more information to make them understand more”

“I think online learning make it comfortable But I think teachers should give less homework. or forcing students to complete work within the class because some students stay with family May be ordered by family members to do housework Or have a part-time job to do? Not everyone has that much free time for homework.”

According to Geir Nyborg, Liv Heidi Mjelve, Anne Edwards & W. R. Crozier (2020), teachers who are striving to have inclusive classrooms may encounter challenges from shy children. More attention therefore should be given to these types of students by strategizing the delivery of the lesson.

(B) Good Facilitator of Learning

A teacher who is a facilitator of learning is someone who will give directions and help lead the students towards the development and enhancement of their full potential towards the attainment of the goal (Morales, 2020). According to Aclao, et al (2014), a facilitator is someone who can manage group interaction by selecting appropriate technique for a context. A facilitator knows different methods and strategies that are helpful in the maximization of students' learning.

From the respondents point of view, the Math teachers of St Theresa International College are describe below. Below are their words copied verbatimly.

“During online classes, the teacher may use difficult words to communicate with students and not explain them then which can cause misunderstood when the teacher gives us work.”

“I think the way teacher teach student is the main point if it boring and not interesting student won't interest to study with the teacher. I am a student that want very very very very clearly explaining and slowly to go if it is math.”

“Some of the lecturer must improve their speech to explain the lesson to make the student understand the topic.”

“I want the instructor to teach slowly if it's math because maybe someone who is weak in math like me can't keep up. I want to write

a recipe for you to see. I don't want to skip the steps because I might think that the students understand now. Thank you."

"I am satisfied with the teachers in all subjects. I feel okay with learning from the teacher's explanations and the content is easy to understand."

"Teaching is good, but the internet and signal are not good, handwriting is difficult to read."

"I do appreciate with lecturers at St. Theresa because most of them are good and get ready to share all knowledge whatever we have questions. But if we talk about online class the quality of graphics aids kind of poor when they wanted to open some video or pics all kind of poor quality."

"As for teachers, he's always doing well, but it's just too boring."

"Instructors use interesting areas and technology to present interesting but sometimes the Instructor has a poor internet."

"Some teachers are doing well in class and understand their students. But some teacher never listens to his students."

"I believe many teachers have difficulty teaching online. Many times they feel in a bad mood because the students have no response to their teaching."

Theme 2: Learner Autonomy

(A) Self-efficacy and Responsibility

Self-efficacy as defined by Bandura (1997) is an individual's belief in his or her own ability to organize and implement action to produce the desired achievements and results" (p. 3), and this influences learning (Cook, D. A., & Thompson, W. G. (2014). According to Yokoyama S. (2019), students with high self-efficacy tends to have higher academic achievement as they are highly motivated. This declaration is also supported by Doménech-Betoret, F., Abellán-Roselló, L., & Gómez-Artiga, A. (2017) that says there are evidences to show that self-efficacy beliefs has something to do on academic achievement.

In the same vein, being responsible to one's own learning contributes to individual students' academic performance (Ayish, Nader & Deveci, Tanju, 2019). Personal responsibility as defined by Linley & Maltby (2009) refers to "people[s] skill of] taking individual accountability for their decisions and actions, together with the outcomes they create and their impacts on others" (p. 685). According to Ayish, Nader & Deveci, Tanju. (2019), by overcoming challenges in developing meaningful learning opportunities over time, personal responsibility can lead to life-long learning.

A learner who is exercising self-efficacy and being responsible for his/her own learning is termed as learner autonomy. Bringula, R., Reguyal, J.J., Tan, D.D. Ulfa (2021), define learner autonomy as the learners' ability to understand and take control of the online materials with little supervision to maximize learning.

The statements below showed the efficacy and how responsible the students are in their own learning.

"Online Mathematics class is very useful for me and I understand the lesson clearly but sometimes teacher teaching very fast. So, some students didn't understand and after class, we learned again by ourselves."

"I think if I listen to the teacher's accent when teaching I should have done it well but it's my responsibility I will improve myself better."

"In online learning, I understand the lesson sometimes but not much. I have to review after studying."

"Can listen to the teacher immediately, sometimes using a screen capture and use it to understand more."

"Maths is difficult to understand at the first but I always do practice and study continuously and ask teacher when I can not solve the problems."

"What I have learned in learning mathematics online is that I have tried using various teaching media programs myself. I learned to use it myself."

Handling such challenge efficiently and responsibly, means being responsible of your own learning, students will stand to benefit academically and to afford satisfaction in Online Math Class.

(B) Self-Directed and self-regulated Learning

Self-directed learning in a university is a practice that every teacher should consider to help students prepare themselves for their future life. According to Kleden, M.A. (2015), university students who are involved in self-directed learning process are not only learning within the four corners in the university classrooms but these students are on the right track in preparing themselves to learn for life. As practiced in a traditional learning setting, students are expected to sort, assimilate and synthesize information which are considered as primary activities for students who are doing self-learn.

Linkous, H. M. (2020) defined Self-directed Learning as both “a process of learning in which the individual establishes elements of control over their own learning, and characteristics of learners including self-efficacy and motivation”. Self-regulated learning (SRL) on the other hand according to Linkous, H. M. is a process of learning that is self-directed in nature. Fauzi, A & Widjajanti, Djamilah. (2018) on the other hand states that:

“Self-Regulated Learning (SRL) is a very important ability for students in learning process. Students who have Self-Regulated Learning will be able to plan goals, plan strategies, manage behaviors, and evaluate self-improvement.”

According to Gilbert, B. (2015), “online courses have been found to be conducive to students who favor self-regulated learning”. One of the respondents of this study expresses his/her agreement by stating: “Online learning is comfortable, safe time, and easy to learn for me. Not having problem.”

This line is in agreement with what the respondents of this study are saying about Mathematics online learning:

“Studying online has both advantages and disadvantages. But whether we will be successful in learning or not depends on us.”

“In my opinion, if i understand the way that teacher teach me no matter that i'm online or onsite the result is the same. It depends on my understanding of the lesson not the online or onsite.”
“I think that is good because I could take a photo for reviewing”

It was found out that, according to Gilbert, B. (2015), learners' who are skillful in self-regulated learning can utilize time management at their advantage. In addition, the learners' can schedule a review of the materials regularly, sought help from professors or peers, meet deadlines, and had the skill of metacognition in order to reflect upon their own learning. These actions are in agreement with the very concept of Self-regulation as defined by Gilbert, B (2015) as the “ability of students to plan, monitor, and evaluate their own behavior, cognition and learning strategies”.

Theme 3: Learners' Learning and Retention

The transition in the delivery of lessons during the pandemic from face-to-face to online learning, have caused a lot of changes and challenges are observed in the teaching and learning process. These challenges, especially those experienced by the students were not known to some mathematics lecturers (Radmehr, F., Goodchild, S., 2022).

Bringula, R., Reguyal, J.J., Tan, D.D. Ulfa (2021) identified personal concerns as one of the barriers to online learning. Personal concerns according to Pena-Bandalaria are the difficulty to interact and contact teachers, difficulty to seek help, difficulty in understanding the topics. In the same vein, “lacking motivation or confidence to seek help, completing assignments, greater responsibility for self, shock and difficulty to adapt” are also identified as barriers to online learning (Radmehr, F., Goodchild, S., 2022)

Many students considered mathematics as a difficult subject because the subject is very abstract and has a lot of formulas among others. According to Suliani, M., Juniati, D., Ulfah, F., (2021), in online teaching, teachers should adopt teaching methods and online learning

media that will help students to learn mathematics in an easy way, because learning through online media is difficult to understand.

Feeling embarrassed is also another barrier in online learning especially when one has some questions to ask directly to the teacher. Students tend to have difficulty in understanding the provided teaching materials, thus it affects the learning process (Suliani, M., Juniati, D., Ulfah, F., 2021).

Some of the challenges experienced by the students in online learning are described below:

"I can understand it in the second or third teaching."

"Difficult to understand within 1-2 times"

"Being an online student means that most of your time is spent in front of a computer reading and finishing assignments."

"When I confused something I never got a clear answer."

"it's difficult and hard to understand the whole things that the teacher gave us."

"I gained knowledge from the theory taught by the teacher. But when I practice, I try to practice but I can't."

Theme 4: Attitude Towards Mathematics and Online Learning

(A) Attitude Towards Online Learning

People's feelings towards online learning, according to Bringula, R., Reguyal, J.J., Tan, D.D. Ulfa, Saida (2021), is being referred to as their attitudes towards online learning. The finding in the study of Chen, W. and Jia, J. (2016) to 192 Chinese students who learned face-to-face, and another 311 Chinese online learners revealed that attrition rate is lower for those students who attended onsite class compared to those students who attended online classes. This finding is in agreement with the observation of Singh, Jitendra & Steele, Keely & Singh, Lovely (2021) that students who used to benefit from face-to-face classes find it difficult to sit down in front of the computer for the whole duration of their class. It is a fact that onsite classes provide real time interaction among students

and teachers which in turn can spark innovative questions and conversations.

Chen, W. and Jia, J. (2016) stated further that in-person learning provides a lot of benefits like “motivation, helps in building a sense of community, and provides much needed encouragement to students”. The positive experiences of students in face-to-face class, aside from being used to it, contributed to their choice of the onsite class over online.

The respondents of this study prefer onsite class over online class because of the following factors: uncomfortable to ask questions, lack of understanding of the course material, decrease in communication levels between the students and their instructors, and negative feeling towards mathematics. This is in agreement with what Alawamleh, Mohammad & Al-Twait, Lana & Al-Saht, Gharam. (2020) had stated in their study that face-to-face class is still the preferred mode in the delivery of learning. This finding, according to Alawamleh, et al (2020), is mainly because of the problems the students experienced when they attended online classes such as lack of motivation, understanding of the material, decrease in communication levels between the students and their instructors and their feeling of isolation caused by online classes.

Students perception towards Mathematics Online Learning is described below:

“I think learning math online is less knowledgeable than on-site and it's inconvenient to ask the teacher when I don't understand.”

“If learning math online, I can't understand the course material. Because learning math should be studied in class for more understanding.”

“Learn formular and how to solve the problem in the question and the teacher must be Teach and lead students to do all the answers to see all the questions for a better understanding.”

“I think Mathematics Learning when studying online is make us confused ”

“On my opinion is online mathematics learning it's can be hard to focus on, because it not the same way like on-site class. But

on-site class can be focus, easily to understand and have more contact with teacher when we have questions."

"Difficult to comprehend through online classes."

"learning math online for me not so good because it is an online learning It's difficult to ask the teacher to explain what we want to know. Because we have to take into account the friends in the room. and for i think it's too boring and too many exercises."

"Harder than actual class"

"My perceptions towards online Mathematics Learning is very hard but sometimes if the Teacher is very understandable or very kind , he will teach or help you to learn. But sometimes it's more fun if you will study mathematics in personal because your classmate or even your Teacher can help you."

"During online math class, it gets me more stress because some other classmate they understand what the teacher said and then go to the next problem and this is not good for people like me who can't understand math quickly like other students. (teacher can't check all the students during online class so that means the teacher may call or ask randomly from a quick learner in the class)"

(B) Attitude Towards Mathematics

According to Maria de Lourdes Mata, Vera Monteiro, Francisco Peixoto (2012), attitude towards mathematics refers to "a disposition towards an aspect of mathematics that has been acquired by an individual through his or her beliefs and experiences but which could be changed". Maria de Lourdes Mata et al (2012) added that in order to understand the variability of students' math performance, attitudes of the students towards the subject should be taken into consideration. Furthermore, the authors state that students' attitude towards the subject tends to become less positive as they progress and "frequently become negative at high school". Negative attitude towards mathematics is a dangerous thing when not properly addressed. Dowker, Ann & Ashcraft, Mark &

Krinzinger, Helga. (2012) in their study declared that negative attitude towards mathematics may impair mathematical performance.

The feedback below from a respondent of this study reflect their attitude towards mathematics that may contribute to his/her performance.

“Mathematics is a difficult and difficult subject, I can't understand it because I don't like it.”

“Actually mathematics subject is hard for me. To be honest I chose to study at St. Theresa because I like English language and I think I'm our lesson will not have mathematics. I'm really try to understand but I can't because I don't like. It's hard to understand and complicated.”

“Incomprehensible”

“I was petrified.”

Attitude of the students, according to Dowker et al. (2012) and Tahar, N.F., Ismail, Z., Zamani, N.D., & Adnan, N.S. (2010), can be influenced on how the teachers deliver the lesson in the teaching and learning process and eventually it will influence on student learning and performance (de-la-Peña C, Fernández-César R, Solano-Pinto N., 2021). In the same vein, Zakariya, Yusuf (2017) stated that “Students’ attitudes towards mathematics have been correlated with mathematics achievements and performance and found to be an important predictive factor of achievement in mathematics.

The above mentioned-information is enough to conclude that if a student has a positive attitude towards Mathematics, a student might benefit from it. The feedback below from a student entails positivity that might help her/him to perform better.

“I don't have any problems with online mathematics learning. I'm totally understand how maths work by learning from teacher.”

“I don't have an aptitude for this subject, although it's a subject that I'm not good at all, but I'm always ready to accept it.”

“Understand”

“I acknowledged”

“I understand the lesson”

“Quite good”
“Good”

Theme 5: Technological Concerns

According to (Muthuprasad, T., et al.,(2021), suitability of devices and bandwidth availability poses a serious challenge for online learning. Internet connection is not only an issue for online learning but also a challenge to everyone involve including students, teachers and the institution (Asio, J. M. R., Abarintos, E., Paguio, D., & Balce, M., Gadia, E.,2021). Barrot, et al (2021) cited the work of Kapasia et al. (2020) on how lockdown impacts students’ learning performance. Poor internet service was identified as one of the problems experienced by the students during online classes.

In addition, in the study of Clarin, A. S., & Baluyos, E. L. (2022) entitled “Challenges Encountered in the Implementation of Online Distance Learning” also identified poor internet connection as one of the challenges encountered during online classes. “Lack of devices, issues with the online platform, and Internet connectivity is termed as technological” concern (Bringula, R., Reguyal, J.J., Tan, D.D. Ulfa, Saida (2021).

The respondents of this study have the same belief as the above-mentioned authorities about this learning modality that:

“Teacher device or internet have any problem and some topic hard to study with online class”

“Sometimes I missed the information because Internet's problem”

“It's really hard to study mathematics online cause of the internet is not good all the time (i missed many things when it loss) and I didn't really use mathematics in every day life. I like mathematics but cause it really me stress (if it hard). I really appreciate it if the teacher give examples when they teach mathematics and do it step by step (not just give the question and solve it).”

“I think it is better if connection is good for online mathematics

learning”

“Learning math online I think there is a bit of a barrier with the internet causing some downtime in the course of learning.”

“It’s very hard to study mathematics on online because sometimes the internet has the problem and If we missed just one part I won’t understand at all.”

(A) Learning Device Availability

With the advent of technology, online learning devices are now readily available. In the study of Asio, J. M. R., Gadia, E., Abarintos, E., Paguio, D., & Balce, M. (2021), it was mentioned that the availability of computers in the learning institutions and at students’ home have made it possible for the students to join online learning. In addition, the availability of the gadgets in the market and the very competitive price of it have given the students the opportunity to own mobile phones and smart phones that are very useful in online learning. However, according to authors, “there are still some who do not have one”.

With regards to the respondents’ satisfaction Towards Mathematics Online Learning through the availability of learning device, they have the following statements below.

“I use iPad to write instead of writing in books, it makes me feel more comfortable. I think colleges should let teachers use phones, iPads or notebooks with writing function. Instead of writing in chalkboard because I couldn't see it, last semester there was a teacher who taught using a blackboard, so I didn't know much about it sometimes. I want teachers for everyone to adapt technology to suit this era of Covid 19. Thank you.”

“In terms of technology I think 1 student should have 2 gadget (cell phone and computer or laptop or ipad) to make more effective in study (like when we have a presentation, we use cellphone for open the camera and speak or we can just used laptop to do it all but some students just have a cellphone.

The internet access sometimes is good sometimes is bad. I really like that how course materials are accessible easily, don't worry forgot the paper just see it in cellphone."

"Some people have unequal technology tools. Therefore, some people do not learn well or are slow."

"I was able to take online classes effectively because of the state-of-the

art technology in my home. From time to time there may be some internet

interruptions. which cannot know when it will happen. Hope all teachers will

understand students. Thanks."

It is revealed that the availability of online learning device is crucial in the learning process of students who are learning online. Equal access to technology affects the learning as it determines the proper pacing of learning of the students The respondents of this study have also declared that the use of more than one gadget is advisable to maximize the opportunity while attending online class. This also what the authors of the study entitled Internet Connection and Learning Device Availability of College Students: Basis for Institutionalizing Flexible Learning in the New Normal have declared: "the greater number of device types owned by a student, the greater the level of learning readiness" (Asio, J. M. R., Gadia, E., Abarintos, E., Paguio, D., & Balce, M., 2021).

(B) Internet Connectivity

One of the significant challenges that teachers and students may face while doing online teaching and learning is internet connectivity and availability (Mbongo, E. N. Hako, A. N., & Munangatire, T., 2021). Internet connection, according to Asio, J. M. R., Gadia, E., Abarintos, E., Paguio, D., & Balce, M. (2021) is both an issue and challenge not only for the students but also for teachers and the institution.

Hazwani et al. (2020) reported in her study that the most significant factor to influence the effectiveness of e-learning is internet

connection. Because according to the respondents of this study, online classes will be effective if good internet connection is available. Below are the statements of the respondents copied verbatimly.

“Both internet of students and teachers have to working well. If student's internet have problems it surely that students miss some knowledge and if teacher's internet loss, the whole class have “distracted and lost more time.”

“Some places may have internet access. May cause crashes while studying online. Sometimes due to the weather conditions of each day as well. This is something that cannot be defined and controlled.”

“In my hometown, the electricity is cut off often and the internet signal is not good because I use my data not wifi.”

“We can't control the speed of the Internet all the time, so learning to understand it is difficult.

“The university's internet should be improved to be more stable because many teachers have problems with using the university's internet, causing the teaching to be congested and uneven.”

“Teachers should also have a good connection and device”

“For me, it good. But some teachers have not good materials for teaching. or have bad internet.”

“Sometimes, the internet doesn't work.”

“I'm satisfied with my online learning and internet being stable but lacking in strength.”

“Sometimes teacher cannot answer my questions quickly due to internet connection.”

“I would like the instructor to explain more, always try to review and check the internet before teaching.”

It is clearly identified that internet connection is a major factor in the success of online teaching and learning processes. Class instructions will clearly be disrupted when the teaching and learning process have already started only to find out that the internet connection is poor. As

depicted, moderate or good internet connection is needed in order to carry out the learning plan effectively.

(C) Theme 6: Instructional Material Concerns

Instructional materials are very important in the teaching and learning process as these help in the proper and quality delivery of lessons. Tety, John Lawrence (2016) states that:

“The importance of quality and adequate instructional materials in teaching and learning can occur through their effective utilization during classroom teaching. Instructional materials here include all the tools that the teachers can use to make the learning more interesting and memorable.”

Teacher’s teaching practices and the opportunities that the instructional materials can offer to the students can be viewed through understanding the way how they prepare them. According to Skoumios, M. & Skoumpourdi, C. (2021), the teaching practices of teachers and the opportunities that the materials can offer to the students will help the teachers to come up with an effective instructional design.

The importance of quality instructional materials plays a major role in the attainment of the learning outcomes especially when the instruction is carried out through online modality. According to Mažgon, J., & Štefanc, D. (2012) learning materials or learning sources can be a great help to students especially when they want to revisit the lesson through the materials. The way how the materials prepared will affect the performances of the students, especially the online students, thus quality matters as they are important source for students.

Ahmad Zabidi, N., Woo, T.K., Rajesh Kumar, P., Fadzil, M. and Syed Husain, S.H. (2017) stated in their work that quality learning materials are the materials that can be understood easily with minimal or no supervision. Study materials that are tough or with difficult language can be a factor to high attrition rate among the learners of Open and Distance Learning.

This declaration is in agreement with one of the students saying:

“It's difficult and complicated. The content of the lesson is simple. But the content of the exam paper is more difficult.”

When materials are not properly design, the success of online learning will greatly be affected. Ahmad Zabidi, N., et al., (2017) quoted (Jayaram and Dorababu, (2015) have this to say about the success and effectiveness of online learning.

“The success and effectiveness of the distance education system ‘depends heavily on the study material, particularly in the form of printed course material’”

Theme 7: Convenience

Wiam Elshami, Mohamed H. Taha, Mohamed Abuzaid, Coumaravelou Saravanan, Sausan Al Kawas & Mohamed Elhassan Abdalla (2021) reported that “several advantages of online learning for learners have been reported in the literature, including (1) easy accessibility to knowledge, (2) proper content delivery, (3) content standardisation, (4) personalised instruction, (5) self-pacing, and (6) interactivity and increased convenience”. Because of the nature of Online Learning, many students are more than happy with the setup. Personal Convenience is high as students can do personal errands while attending online classes. A personal errand in this sense is a task performed to benefit personally while attending online classes at the same time. Many factors need to be considered for the satisfaction in online learning, according to Wiam Elshami et al, (2021), as it is complex and multidimensional. These factors include (1) communication, (2) student participation in online discussions, (3) flexibility, (4) workload, (5) technology support, (6) instructor pedagogical skills, and (7) feedback.

Convenience and the flexibility of the nature of online learning have made the students very satisfied in their participation in online learning as reflected in their statements. The respondents of this study have these to say with regards to Mathematics Online Learning:

"I am more satisfied with online learning than in the classroom. because when I have urgent business I can go run errands. should improve with some teachers when the student asks for leave Students should also be given leave. Everyone has the right and reason to leave, so there's no need to ask where to go, what to do. Privacy, thank you."

"I am happy during online class cause I can stay at my home don't have to rush for the class but on the other hand I feel like learning in the class give me more energy to study."

"They should give an assignment in class and make student submit it in class so students can have time to relax when they're have no class."

"I like online because I didn't take a shower in morning so it was comfortable and it was free for do anything"

"Online learning is convenient. We can use the time we put to do other things. But online learning costs us the cost of school supplies and the Internet, which some families may not have enough funds to study online. Online learning also affects student-student and student-teacher relationships due to online communication and work."

"Sometime I feel really good to have online classes because no need to wake up in early morning but at some point we need communication such as face to face, to live with only home kind of boring and nothing new which influence me to be less creative. As I spoke with friends half like online and half enjoying with onsite more. But for me I do like on-site and online class both."

"Rather than leave the office early or skip family dinner to commute to campus, you're logging on when it's convenient for you at a time that doesn't interfere with other commitments. That flexibility allows you to more easily balance work, life, and graduate school."

Technological capabilities paved the way to explore new ways of teaching and learning (Jang, Y., 2015) as technology enhances education and positively impacted the education process. (Mbongo, E. N. Hako, A. N., & Munangatire, T., 2021). Online teaching had given teachers the freedom to explore new strategies for submitting course work and provides additional ways for the teachers to clear misconceptions through a forum in which all students can participate (Mbongo, E. N. Hako, A. N., & Munangatire, T., 2021).

The respondents have this to say with regards to their Satisfaction Towards Mathematics Online Learning through technological characteristics.

“The class material can be loaded and kept in my devices rather than printed out.”

“I want the college to be better like other colleges. By the end of teaching, save the clip. so that students can come back to see the teaching materials again for a good understanding of the lesson, If a student has a problem on the Internet by not being able to study. or study and the internet lags can come back and watch the clip that the teacher teaches again for students' understanding of learning.”

“It is high technology for learning”

“I learned a lot about how to use technology to help myself about study and it very convenient.

“Make the lesson for teaching not be boring and teach the process or methods to solve the solution. Make it simple and easy for understanding. I was study with someone teacher he is very good teacher. He always teach a summary lesson and make the lesson it short but easy to understand.”

“For someone though that is the way for absentings' leaning”

“I satisfied only how teacher use interest mediator to present the content of subject whenever we learn on-site but for online class I dissatisfied to learn at all if we can choose. Covid-19 pandemic make us no choice but for the soon future I hope we can study face to face with all friends and teachers.”

It is clear that students find it convenient for them to study online as it is not boring and help them to go through the materials again even if they are absent during the discussion. This finding is in agreement to the declaration of (Mbongo, E. N. et al, 2021) that online learning can pave way to student-centred learning approach.

Theme 8: Lack of Motivation

According to Paolini, A.C. (2015), impactful teachers can encourage students so that these students will become self-directed, independent, and critical thinkers. As observed, teachers' role can be an instrument to motivate or demotivate students especially if it will affect the learning environment. Ahmad, Crizjale. V. (2021) identified three factors that are considered not stimulating to hold the attention and can moderately demotivate the students in their learning, and these are: (a) teachers lecture too much, (b) students have difficulty in accomplishing classwork, and (c) learning activities. In the study of Aikina, T. & Bolsunovskaya, L. (2020) entitled "Moodle-Based Learning: Motivating and Demotivating Factors", it was found that (a) technical problems, (b) set deadlines, (c) misprints in the tests and (d) incorrect automatic evaluation can affect the participation of students in Moodle online learning as these are considered as the most demotivating factors.

Indeed, online classes are very challenging particularly in cases where interaction is low. In Mathematics classes for example, only the main concepts are taught in the synchronous class, and most of the challenging activities are left for the students to work at their own pace at home. This kind of setup usually experienced low interaction among students. This activity may be the main reason why students' motivation has significantly decreased (Leo A. Mamolo, 2022).

Kim, ChanMin & Park, Seung Won & Cozart, Joe. (2014 declared in their study that students find Mathematics Online Learning as challenging especially when there is a sense of isolation and a lack of social support in online learning environments. However, "feeling a sense of connection to other classmates can be a valuable resource for

motivating students, especially in larger classes” (Lee, J., & Martin, L. (2017).

The respondents of this study have this to say with regards to Mathematics Online Learning:

“Studying online has reduced my learning curve.”

“Studying online for a long time prevented me from focusing on the material as long as I did in the classroom. I think a lot of people facing the same problem as me is that we can't manage our time. and feel that studying online is a bad environment I want to go back to class But many of my friends around him don't want that.”

“It saves my time to do things outside of school, such as traveling, preparing outfits. And I have more time to relax or do other things, such as home works. But I think studying in classroom will make me understand than studying online. Because studying in classroom will make me more focused than studying online.”

“In class will be not much stress and teacher would be talking with a student.”

“I don't really agree with online learning. Because it requires a lot of teaching materials. For example, you must have a good and fast internet system. Otherwise, problems may cause you to learn nothing. Or whether it is health, You have to stare at your phone screen all day. It may affect your eyesight.”

COVID-19 pandemic has forced the learning institutions to resort to online classes even with little preparations on the part of the teachers and students. To mitigate the negative feelings among students in the conduct of online classes, teachers are of great help to somehow help the students to think positively. To enhance students’ motivation can be a game changer as “the student can develop his or her own learning style” (Moreno-Guerrero, A.-J., Aznar-Díaz, I., Cáceres-Reche, P., & Alonso-García, S. (2020) especially Math Online classes.

Theme 9: Caring Instructors

Nushi M, Momeni A and Roshanbin M (2022) revealed in their study that effective University Professors are those “who are not strict with their classroom rules and who are pretty generous when scoring student work”. This finding is in agreement with the statements of the students as stated:

“Although there were occasions where I felt a teacher wasn’t being thoughtful/considerate in the situation, inside, they are all nice and considerate.”

“I appreciate that instructors to treat us and teach us although have some risk of internet or whatever.”

In the study of Vincent, P., Pilotti, M., & Hardy, P. (2016), it was revealed that the time spent by the instructors with their students was positively correlated with the amount of time students spent in the course. The authors further declared that:

“An instructor’s openness to experience was related to students’ overall response rates. Manner of relating to students was positively correlated with the number of student replies to the instructor”

The respondents of this study are in agreement to the declaration of Vincent, P., Pilotti, M., & Hardy, P. (2016) in their study entitled “An Exploratory Study on Instructor Conduct and Characteristics in the Online Classroom as Predictors of Student Participation”. Respondents have these to say:

“Teacher trying their best to provide the most important things to us and i appreciate it.

“I really appreciate many lecturer because they really gave me clear answer when i asked. They give us time to ask and sometimes they let us type the question in the text box (for students who shy to ask).”

“How satisfied I am about my instructors? I am very satisfied because all of them are kind and a lot of lesson in school and in your life will give you advice and inspiration thing.”

The analysis identified the characteristics of instructors according to the students of St Theresa International College as being understanding by giving their best and spending time to the students' academic needs; and relatability to the students' situation. This finding is an affirmation of the finding of Morales, M. A. (2020) that an excellent Math Teacher should have knowledge about their students aside from being a Content Expert, a Relationship-BUILDER, Enthusiastic, Academically Optimistic, Authoritative, a Role Model, a Facilitator and a Problem-Solver.

This thematic analysis of the students' perceptions towards online Math classes yielded nine themes. According to the student-respondents, the success of online learning especially in Mathematics depends on the Professional Skills of the teachers. They emphasized the importance of being a good classroom strategist and a good facilitator of learning. Learner Autonomy is also identified with emphasis on Self-efficacy and Responsibility, and Self-Directed and self-regulated Learning. Also identified is, Learners' Understanding and Retention; Learners' Attitude towards Mathematics and Online Learning; Technological Concerns specifically on Learning Device Availability and Internet Connectivity; and Instructional Material Concerns. Also identified are Convenience, Lack of Motivation and Caring Instructors as contributory for the success of online class in mathematics.

Appropriate guideline for managing Mathematics online learning

The results of the analysis of this study motivated the researcher to design a new paradigm for Mathematics Online Learning that is useful not only during the pandemic but even without the pandemic (Figure 1). The paradigm suggests that Mathematics online learning in the new normal especially in the university level can be implemented effectively by considering nine (9) indicators: Professional Skills of the teachers,

with emphasis on the importance of being a good classroom strategist and a good facilitator of learning; Learner Autonomy, with emphasis on Self-efficacy and Responsibility, and Self-Directed and self-regulated Learning; Learners' Understanding and Retention; Learners' Attitude towards Mathematics and Online Learning; Technological Concerns specifically on Learning Device Availability and Internet Connectivity; Instructional Material Concerns; Convenience; Lack of Motivation and Caring Instructors.

The nine indicators that may affect students' learning towards mathematics Online class are grouped accordingly. Although they are placed inside their own boxes, indicating they are equally important to each other, the line that binds them together shows the interrelatedness of these concepts.

Instructors are considered to be the most qualified authority in the teaching and learning process. They are expected to possess Professional Skills to allow them to strategize their teaching activities and for them to do proper planning for their teaching materials. According to Kapur, Radhika (2020), professional skills are depicted on how someone conducts oneself, how someone carries one's job duties and the way how someone communicates. The author added that *"Professional skills are regarded to be of utmost significance for the individuals in promoting well-being and goodwill."*

Identified to "signify students' active participation in learning activities", Learner Autonomy according to Dang, Tin (2012), is the "ability to take charge of one's own learning". It is therefore believed that while Math online class is being done, and if students are practicing self-efficacy and they are responsible in all of their online learning activities, and also by considering other indicators that may affect students' learning, effective implementation of Mathematics online class is possible. Vonderwell, Selma & Savery, John (2004) discussed that successful online learners need to be Self-regulated. The author defined self-regulation as "being able to plan and adjust learning strategies in order to achieve a goal or complete a task". In the study of Robinson JD, Persky AM (2020) entitled Developing Self-Directed Learners, self-

directed learning is defined as the “outcome of creating an experience that empowers learners to make decisions about the information they want to become proficient”. Thus, students who are Self-directed and self-regulated can use Mathematics online class as opportunities to make decisions about their own learning and can be translated to high achievements for students.

Another identified indicator to help implement an effective online class is Learning and Retention. According to Ritter, F. & Baxter, Gordon & Kim, Jong W & Srinivasmurthy, S., (2013), learning “provides performance improvements, sometimes dramatic improvements with practice on a task”. Learning is a dynamic process in which learners constructs his own understanding by connecting new concepts between what is known while retention “is the process by which long-term memory stores that can be easily identified, and retrieved accurately in the right time (Joseph Akpan, Charles E. Notar, Larry Beard, 2019). If students are engaged in learning through collaboration and actively engaged in the learning process then knowledge retention could be enabled (Kosar, and Bedir, 2018).

Other indicators that are equally identified which may help achieve an effective online Math class are Attitude Towards Mathematics and Online Learning. Sen, Halime (2013) posited that attitudes towards learning are necessary for the learners to achieve their goals, successfully solve problems, strengthen their beliefs about learning, and all their academic performances. Sen added that students’ positive attitudes make the students more open to learning, increases their expectations from learning process and reduces their anxiety levels.

Another equally important indicator to achieve an effective Math Online class is Technology. During the COVID-19 pandemic, technology plays a major role in the implementation of online class. According to Mushtaha, E. et al (2022), technology can be a facilitator of personalized learning as it was proven during the pandemic. It was through the different technologies that educational institutions successfully carry out their mission to continue the delivery of learning when they shifted to online classes. Learning Device Availability and Internet Connectivity are

equally identified by the students of St Theresa International College that may affect students' learning towards mathematics Online class. This means that accessibility in terms of gadgets availability and internet connectivity is one of the factors to consider in the implementation of Math Online class. Because according to Vonderwell, et al (2004) "Learners' success in online environments can be improved when students are able to use the tools afforded by the environment."

The importance of Instructional materials in Math online class is also worth to discuss. These materials are used to facilitate comprehension of ideas in the learners as well as ensure long term retention of ideas and topics taught. According to Sale, Murtala (2016), teachers need instructional materials to enhance the quality of teaching and learning. Instructional materials therefore are sight tools for teachers at all levels of education process for effective instructional delivery. In order to ensure efficient teaching and learning situation, Sale, Murtala (2016) posited that it is of paramount importance to every teacher whose interest is to promote effective learning to use instructional materials in his classes.

Another factor that may affect students' learning towards mathematics Online class according to the Math students of St Theresa International College is students' Personal Convenience. According to the study of Bali, Sandro & Liu, M. (2018) online learning has some advantages to the students. Some of these advantages are convenience and ease of time and for the opportunity to work when they wanted. Furthermore, the authors mentioned also that online education is cost efficient, and it allows learners to work at their own pace.

Wuckert, A. published an article on 2021, December 27 through <https://www.airshipman.com/technology-in-modern-day-life> declared that technology has made our lives more convenient in so many ways. Online class is very reliant on technology especially during COVID-19 pandemic. Online class during the pandemic features flexibility which, according to Li, D. (2022), is essential. Students, during this time, have more control (**convenience**) over learning materials as this mode of

teaching allows students to “appropriate access time, sequence, pace, and amount of information and may follow a more individualised approach”.

The students of St Theresa International College further declared that students’ Lack of Motivation is another factor that may affect students’ learning towards mathematics Online class. Vonderwell, et al (2004) in their study states that “online learning environments afford greater opportunities for individualization and flexibility, thereby creating an increased demand for self-directed learning”. Meera Mathera, Alena Sarkans (2018) in their study entitled “Student Perceptions of Online and Face-to-Face Learning” made mentioned of the advantages of online class and face to face class: (1) flexibility, (2) accessibility, (3) convenience of balancing personal, professional, and academic life and their desire to experience a new way of learning. However, Vonderwell, et al (2004) posited that when the requirement for self-directed and self-managed learning in online learning is far greater, students often may experience anxiety. Thus, for the Mathematics online class to be effective, instructor must have a concrete understanding of the theory and the practice in order to be effective, whether in online learning or in face-to-face learning in order to experience class participation (Bali, Sandro & Liu, M., 2018). In addition, both the learner and the faculty to take active roles to have a successful learning environment (Vonderwell, et al 2004).

Vonderwell, et al (2004), posited that “teaching online learning requires a reconstruction of instructors’ roles, responsibilities, and practices. The researcher believed that when the instructors will look into their roles in online learning, their responsibilities, and their best practices as online Mathematics teachers, successfully they will become **instructors who are caring** to their students, as good classroom strategists and as good facilitators of learning. Understanding children’s abilities and interests and the way how these students respond to different situations should be highly considered to address the diverse learning needs of the students (Morales, 2020).

The importance of indicators in the education sector is discussed in an article entitled “Quality and learning indicators” published in the UNESCO IIEP Learning Portal (n.d.) website. It is emphasized that indicators enable educational planners and decision-makers to: “(1) Monitor changes in areas such as teaching quality, the curriculum, and student performance, which can alert policy-makers to impending problems, (2) Measure the impact of educational reform efforts, (3) Encourage an education system to improve by comparing it, or parts of it, with other countries or systems, (4) Focus attention on educational subsystems that may require improvement, (5) Focus attention on key equity indicators, such as the performance of different subgroups such as girls, students living in poverty, or students with disabilities.” As stated, UNESCO IIEP Learning Portal (n.d.) website “Indicators can help track the progress of strategies and programmes within an education sector plan”.

The fourth objective suggested a question " What is an appropriate guideline for managing the mathematics Online learning?" and based on the results of the analysis of this study, the researcher designed a new paradigm in the conduct of Online Classes for Mathematics.

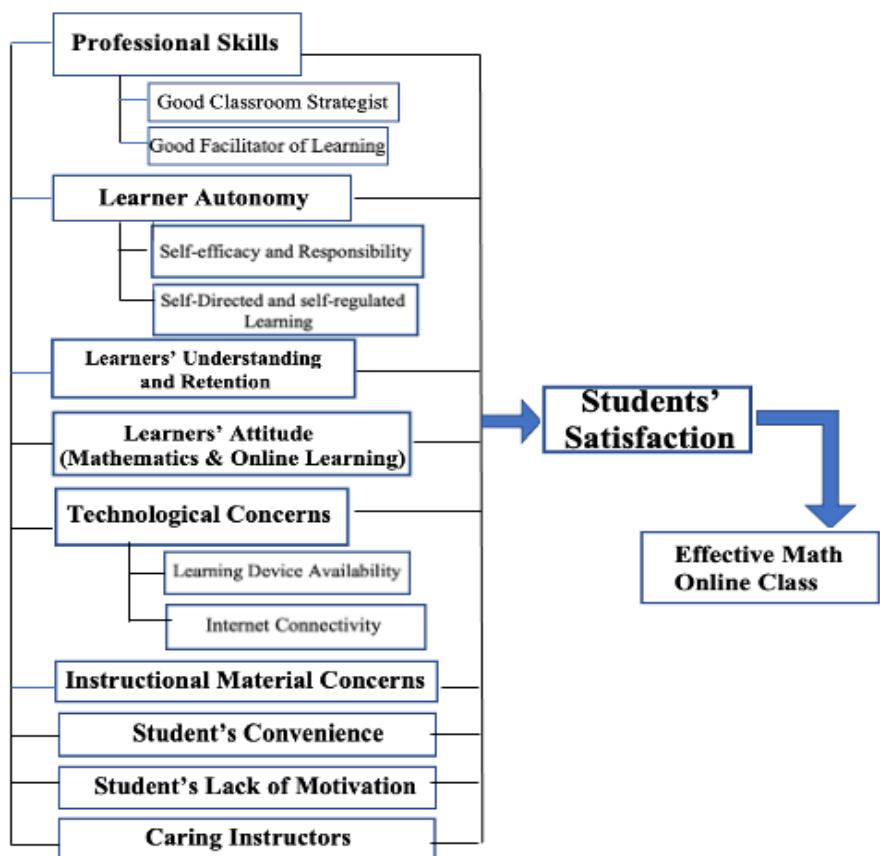


Figure 2. A New Paradigm for Mathematics Online Learning

Based on the foregoing indicators in the conduct of Mathematics online class, the researcher appropriately formulated Mathematics Online Learning Guidelines for the Mathematics students and instructors of St Theresa International College.

Table 6 Appropriate guideline for managing Mathematics online learning.

No.	Guidelines
1	In managing the conduct of Mathematics Online Learning in the university, the instructors should strategize his teaching including but not limited to the use of teaching methodologies to facilitate learning, class activities and the likes.
2	Instructors should help the students to be responsible and self-efficient in attending math online classes and to be Self-Directed and self-regulated in Learning.
3	Instructors should help the students to connect new math concepts to the concepts previously known and to use it at the right time.
4	Instructors should nurture students' positive attitudes towards Mathematics and Online Learning as this makes the students more open to learning, increases their expectations from learning process and reduces their anxiety levels.
5	Instructors should consider the availability of learning devices and internet connectivity and effectively and successfully use these tools.
6	Instructional materials intended for online class is a must at all levels for effective instructional delivery.
7	Instructors should consider some instances when a student wants to go off-cam with valid reasons to do some stuffs while at the same attending online class.
8	Instructors should consider not to regularly give class activities requiring students to do the problems by themselves at their own pace as this setup usually experienced low interaction among students and this may lead to the decrease of students' motivation.
9	Instructors should find ways to address the diverse learning needs of the students.

Conclusion and Recommendations

This study provided a rich information of the students' perception towards mathematics online learning. Majority of the students believed that Mathematics is a difficult subject, materials can be understood but can be easily forgotten. The findings further revealed the students' positive attitude towards mathematics as they believed that Mathematical material has a relationship between one chapter and another. The respondents declared that Mathematical knowledge is useful for solving various problems, Mathematics trained them to be able to think more carefully and carefully, logically and rationally (make sense). In addition, the students believed that Mathematics has trained them to be patient.

Another information drawn from this study is the students' level of satisfaction towards mathematics online learning in terms of three dimensions, Learners' Dimension, Technological Characteristics and Instructors' Characteristics. Findings suggested that the respondents of

the study were moderately satisfied in the conduct of online math classes whose responses are not varied but are consistent and with not much dispersion.

Another significant finding provided a ground to believe that to make a Mathematics Online class effective, Professional Skills - emphasizing the importance of being a good classroom strategist and a good facilitator of learning should be taken into consideration. Learner Autonomy is also identified with emphasis on Self-efficacy and Responsibility, and Self-Directed and self-regulated Learning. Also identified is, Learners' Understanding and Retention; Learners' Attitude towards Mathematics and Online Learning; Technological Concerns specifically on Learning Device Availability and Internet Connectivity; and Instructional Material Concerns. Also identified are Convenience, Lack of Motivation and Caring Instructors.

The nine (9) indicators clearly provided a picture for an effective implementation of Mathematics online class. Emphasis should be made on the importance of each indicator to one another and not to emphasize only one. With the focus shifted to these, effective online math class would be achieved and students will greatly benefit from it.

It is to this reason that the researcher believed that the 9 factors/indicators are important thus they are used as sole bases in the proposed guideline for Online Mathematics Class for the students and instructors of St Theresa International College with the purpose of using it in the new normal. The guideline presented clearly reflects the contributions of these factors/indicators on how to manage an effective online math class. However, this needs further study and validation through a follow-up study in the future.

Literature Cited

- Aclao, J., Abasolo, A., Villacora, M. & Mañego, C. F. (2014). Describing an excellent university instructor: Towards developing a new paradigm. *JPAIR Multidisciplinary Research*. 15. 10.7719/jpair.v15i1.267.
- Ahmad, Crizjale. V. (2021). What makes our students demotivated in learning? *Indonesian Journal of Educational Research and Technology*. Vol 1, No.2 DOI: <https://doi.org/10.17509/ijert.v1i2.33409>
- Ahmad Zabidi, N., Woo, T.K., Rajesh Kumar, P., Fadzil, M. and Syed Husain, S.H. (2017), "Quality assurance in learning material development at OUM", *Asian Association of Open Universities Journal*, Vol. 12 No. 1, pp. 69-81. <https://doi.org/10.1108/AAOUJ-01-2017-0014>
- Aikina, T. & Bolsunovskaya, L. (2020). Moodle-based learning: motivating and demotivating factors. *International Journal of Emerging Technologies in Learning (iJET)*, 15(2), 239-248. Kassel, Germany: International Journal of Emerging Technology in Learning. Retrieved May 19, 2022 from <https://www.learntechlib.org/p/217167/>.
- Alawamleh, Mohammad & Al-Twait, Lana & Al-Saht, Gharam. (2020). The effect of online learning on communication between instructors and students during Covid-19 pandemic. *Asian Education and Development Studies*. ahead-of-print. 10.1108/AEDS-06-2020-0131.
- Almahasees, Zakaryia & Mohsen, Khaled & Omer, Mohammed. (2021). Faculty's and students' perceptions of online learning during covid-19. *Frontiers in Education*. 6. 10.3389/feduc.2021.638470.

- Asio, J. M. R., Gadia, E., Abarintos, E., Paguio, D., & Balce, M. . (2021). Internet connection and learning device availability of college students: basis for institutionalizing flexible learning in the new normal. *Studies in Humanities and Education*, 2(1), 56–69. <https://doi.org/10.48185/she.v2i1.224>
- Ayish, Nader & Deveci, Tanju. (2019). Student perceptions of responsibility for their own learning and for supporting peers' learning in a project-based learning environment. 31. 224-237.
- Bali, Sandro & Liu, M. (2018). Students' perceptions toward online learning and face-to-face learning courses. *Journal of Physics: Conference Series*. 1108. 012094. 10.1088/1742-6596/1108/1/012094.
- Bandura A. (1997). *Self-Efficacy: The exercise of control*. New York, NY: Freeman. Barrot, J. S., Llenares, I. I., & Del Rosario, L. S. (2021). Students' online learning challenges during the pandemic and how they cope with them: The case of the Philippines. *Education and information technologies*, 26(6), 7321–7338. <https://doi.org/10.1007/s10639-021-10589-x>
- Bringula, R., Reguyal, J.J., Tan, D.D. Ulfa, Saida. Mathematics self-concept and challenges of learners in an online learning environment during COVID-19 pandemic. *Smart Learn. Environ.* 8, 22 (2021). <https://doi.org/10.1186/s40561-021-00168-5>
- Cavus, N., & Sekyere-Asiedu, D. (2021). A comparison of online video conference platforms: Their contributions to education during COVID-19 pandemic. *World Journal on Educational Technology: Current Issues*, 13(4), 1162-1173 <https://doi.org/10.18844/wjet.v13i4.6329>

- Chan W, Leung A. (2018). Use of social network sites for communication among health professionals: systematic review J Med Internet Res 2018;20(3):e117 URL: <https://www.jmir.org/2018/3/e117> DOI: 10.2196/jmir.8382
- Chen, Weichao and Jia, Jiyu (2016) "Comparison of online and onsite students' learning outcomes and experiences in a massively open online course in China," *Journal of Educational Technology Development and Exchange (JETDE)*: Vol. 9: Iss. 1, Article 5. DOI: 10.18785/jetde.0901.05 Available at: <https://aquila.usm.edu/jetde/vol9/iss1/5>
- Clarín, A. S., & Baluyos, E. L. (2022). Challenges encountered in the implementation of online distance learning. *EduLine: Journal of Education and Learning Innovation*, 2(1), 33-46. <https://doi.org/10.35877/454RI.eduline591>
- Cook, D. A., & Thompson, W. G. (2014). Comfort and experience with online learning: trends over nine years and associations with knowledge. *BMC medical education*, 14, 128. <https://doi.org/10.1186/1472-6920-14-128>
- Dang, Tin. (2012). Learner autonomy: A synthesis of theory and practice. *The Internet Journal of Language, Culture and Society*. 35. 52-67.
- Davis, Antoinette (2017) "Measuring student satisfaction in online mathematics courses – RESEARCH," *Kentucky Journal of Excellence in College Teaching and Learning*: Vol. 14 Article 2. Available at: <https://encompass.eku.edu/kjectl/vol14/iss/2>

- de-la-Peña C, Fernández-César R, Solano-Pinto N. Attitude toward mathematics of future teachers: how important are creativity and cognitive flexibility? *Front Psychol.* 2021 Jul 9;12:713941. doi: 10.3389/fpsyg.2021.713941. PMID: 34305767; PMCID: PMC8302141.
- Doménech-Betoret, F., Abellán-Roselló, L., & Gómez-Artiga, A. (2017). Self-efficacy, satisfaction, and academic achievement: the mediator role of students' expectancy-value beliefs. *Frontiers in psychology*, 8, 1193. <https://doi.org/10.3389/fpsyg.2017.01193>
- Dowker, Ann & Ashcraft, Mark & Krinzinger, Helga. (2012). The development of attitudes and emotions related to mathematics. *Child Development Research*. 2012. 10.1155/2012/238435.
- Emilia N Mbongo, Anna N Hako & Takaedza Munangatire (2021). Benefits and challenges of online teaching during the covid-19 pandemic at rundu campus of the University of Namibia. *European Journal of Educational Sciences*. December 2021 edition Vol.8 No.4 [https:// Doi:10.19044/ejes.v8no4a53](https://doi.org/10.19044/ejes.v8no4a53)
- Fauzi, A & Widjajanti, Djamilah. (2018). Self-regulated learning: the effect on student's mathematics achievement. *Journal of Physics: Conference Series*. 1097. 012139. 10.1088/1742-6596/1097/1/012139.
- Geir Nyborg, Liv Heidi Mjelve, Anne Edwards & W. R. Crozier (2020) Teachers' strategies for enhancing shy children's engagement in oral activities: necessary, but insufficient?, *International Journal of Inclusive Education*, DOI: 10.1080/13603116.2020.1711538

Gilbert, Brittany, "online learning revealing the benefits and challenges" (2015). Education Masters. Paper 303.

Hazwani Mohd N., Noor Raudhiah Abu B. and Norziah O. (2020). E-pembelajaran dalam kalangan pelajar di sebuah institusi pengajian tinggi Selangor. Selangor. Malaysian atas talian. Journal of Education.

Huda, Nuril & Wahyuni, Tutik & Fauziyah, Fida. (2021). Students' perceptions of online mathematics learning and its relationship towards their achievement. 10.2991/assehr.k.210421.077.

Ishfaq, A and Tehmina, F. (2011). A look out for academic impacts of social networking sites (snss): a students based perspectives. African Journal of Business Management, 5(12), 5022 – 5031.

Jang, Yeona. (2015). Convenience matters: A qualitative study on the impact of use of social media and collaboration technologies on learning experience and performance in higher education. Education for Information. 31. 10.3233/EFI-150948.

Joseph Akpan, Charles E. Notar, Larry Beard (2019). Learning and retention or how learning and retention impact academic success. International Journal of Social Science and Business, Vol. 4 No 2; June 2019. ISSN: 2519-9161(Online), ISSN: 2519-9153

Karl, K., Peluchette, J., & Aghakhani, N. (2021). Virtual work meetings during the COVID-19 Pandemic: The Good, Bad, and Ugly. Small Group Research.

Kim, ChanMin & Park, Seung Won & Cozart, Joe. (2014). Affective and motivational factors of learning in online mathematics courses. British Journal of Educational Technology. 45. 10.1111/j.1467-8535.2012.01382.x.

- Kleden, M.A. (2015). Analysis of self-directed learning upon student of mathematics education study program. *Journal of Education and Practice*, 6, 1-6.
- Koşar, G., & Bedir, H. (2018). Improving knowledge retention via establishing brain-based learning environment. *European Journal of Education Studies*, 0. doi:<http://dx.doi.org/10.46827/ejes.v0i0.1781>
- Lee, J., & Martin, L. (2017). Investigating students' perceptions of motivating factors of online class discussions. *The International Review of Research in Open and Distributed Learning*, 18(5). <https://doi.org/10.19173/irrodl.v18i5.2883>
- Leo A. Mamolo, "Online learning and students' mathematics motivation, self-efficacy, and anxiety in the "new normal"", *Education Research International*, vol. 2022, ArticleID 9439634, 10 pages, 2022. <https://doi.org/10.1155/2022/9439634>
- Li, D., 2022. The shift to online classes during the covid-19 pandemic: Benefits, challenges, and required improvements from the students' perspective. *The Electronic Journal of e-Learning*, 20(1), pp. 1-18
- Linkous, H. M. (2020). Self-directed learning and self-regulated learning: what's the difference? A Literature Analysis. *American Association for Adult and Continuing Education*, 2020.
- Linley, A. P., & Maltby, J. (2009). Personal responsibility. In S. J. Lopez (Ed.). *The encyclopedia of positive psychology* (p. 685). West Sussex: Blackwell Publishing Ltd.

- Maria de Lourdes Mata, Vera Monteiro, Francisco Peixoto, "Attitudes towards Mathematics: Effects of individual, motivational, and social support factors", *Child Development Research*, vol. 2012, ArticleID 876028, 10 pages, 2012. <https://doi.org/10.1155/2012/876028>Mažgo
- n, J., & Štefanc, D. (2012). Importance of the various characteristics of educational materials: Different opinions, different perspectives. *Turkish Online Journal of Educational Technology*, 11, 174-188.
- Meera Mathera, Alena Sarkans (2018). student perceptions of online and face-to-face learning. *international journal of curriculum and instruction* 10(2) (2018) 61–76
- Morales, M. A. (2020). Excellent mathematics teachers through the eyes of future math teachers: basis for developing a new paradigm. *St. Theresa Journal*, Vol. 6(2), Pages 122-146. ISSN (print) 2408-2120. ISSN (online) 2539 – 5947.
- Moreno-Guerrero, A.-J., Aznar-Díaz, I., Cáceres-Reche, P., & Alonso-García, S. (2020). E-Learning in the teaching of mathematics: an educational experience in adult high school. *mathematics*, 8(5), 840. MDPI AG. Retrieved from <http://dx.doi.org/10.3390/math8050840>
- Mushtaha E, Abu Dabous S, Alsyouf I, Ahmed A, Raafat Abdraboh N. The challenges and opportunities of online learning and teaching at engineering and theoretical colleges during the pandemic. *Ain Shams Engineering Journal*. 2022 Nov;13(6):101770. doi: 10.1016/j.asej.2022.101770. Epub 2022 Mar 23. PMCID: PMC8942013.

- Muthuprasad, T., Aiswarya, S., Aditya, K. S., & Jha, G. K. (2021). Students' perception and preference for online education in India during COVID -19 pandemic. *Social sciences & humanities open*, 3(1), 100101. <https://doi.org/10.1016/j.ssaho.2020.100101>
- Neola Samah (2019). homework routine to motivate students in english learning: A case study at SMAN 1 TAMAN SIDOARJO. Thesis. English Teacher eEducation Department Faculty of Education and Teacher Training Universitas Islam Negeri Sunan Ampel Surabaya
- Nushi M, Momeni A and Roshanbin M (2022) Characteristics of an effective university professor from students' perspective: Are the qualities changing? *Front. Educ.* 7:842640. doi: 10.3389/feduc.2022.842640
- Paolini, A.C. (2015). Enhancing teaching effectiveness and student learning outcomes. *The Journal of Effective Teaching*, 15, 20-33.
- Radmehr, F., Goodchild, S. switching to fully online teaching and learning of mathematics: The case of Norwegian mathematics lecturers and university students during the Covid-19 Pandemic. *Int. J. Res. Undergrad. Math. Ed.* (2022). <https://doi.org/10.1007/s40753-021-00162-9>
- Ramadhani, Noer & Machmud, Muhammad. (2021). Students' perspective and attitude towards video conferencing learning platform during Covid-19 Pandemic in Indonesia. 44. 41-56. 10.14456/edkkuj.2020.
- Rios, T., Elliott, M., & Mandernach, B.J. (2018). efficient instructional strategies for maximizing online student satisfaction. *Journal of Educators Online*.

- Ritter, F. & Baxter, Gordon & Kim, Jong W & Srinivasmurthy, S.. (2013). Learning and retention.
- Robinson JD, Persky AM. Developing self-directed learners. *Am J Pharm Educ.* 2020 Mar;84(3):847512. doi: 10.5688/ajpe847512. PMID: 32313284; PMCID: PMC7159015.
- Sale, Murtala. (2016). instructional materials.
- Şen, Halime. (2013). The attitudes of university students towards learning. *International Journal of Academic Research.* 5. 338-342. 10.7813/2075-4124.2013/5-4/B.50.
- Shaid, N. A. N., Kamruzaman, F. M., & Sulaiman, N. A. (2021). Online learning during ongoing Covid-19 Pandemic: A survey of students' satisfaction. *International Journal of Academic Research in Business and Social Sciences*, 11(7), 924-937.
- She L, Ma L, Jan A, Sharif Nia H and Rahmatpour P (2021) Online learning satisfaction during COVID-19 Pandemic among Chinese university students: The serial mediation model. *Front. Psychol.* 12:743936. doi: 10.3389/fpsyg.2021.743936
- Singh, Jitendra & Steele, Keely & Singh, Lovely. (2021). combining the best of online and face-to-face learning: Hybrid and blended learning approach for COVID-19, post vaccine, & post- pandemic world. *Journal of Educational Technology Systems.* 50. 1-32. 10.1177/00472395211047865.
- Skoumios, M. & Skoumpourdi, C. (2021). The use of outside educational materials in mathematics and science: Teachers' conceptions. *International Journal of Education in Mathematics, Science, and Technology (IJEMST)*, 9(2), 314-331. <https://doi.org/10.46328/ijemst.1150>

- Suliani, M., Juniati, D., Ulfah, F., 2021. Learning Mathematics in Madrasah Aliyah Muhammadiyah 2 Banjarmasin during the covid-19 pandemic era, in: Journal of Physics: Conference Series. IOP Publishing, p. 012018.
- Tahar, N.F., Ismail, Z., Zamani, N.D., & Adnan, N.S. (2010). Students' attitude toward mathematics: The use of factor analysis in determining the criteria. *Procedia - Social and Behavioral Sciences*, 8, 476-481.
- Tety, John Lawrence (2016) Role of instructional materials in academic performance in community secondary schools in Rombo district". Masters thesis, The Open University of Tanzania.
- Thygesen, H., Bonsaksen, T., Schoultz, M. et al. Use and self-perceived effects of social media before and after the COVID-19 outbreak: a cross-national study. *Health Technol.* 11, 1347–1357 (2021). <https://doi.org/10.1007/s12553-021-00595-x>
- UNESCO IIEP Learning Portal (n.d.). Quality and learning indicators. <https://learningportal.iiep.unesco.org/en/issue-briefs/monitor-learning/quality-and-learning-indicators>
- Vincent, P., Pilotti, M., & Hardy, P. (2016). an exploratory study on instructor conduct and characteristics in the online classroom as predictors of student participation. *Comprehensive Psychology*, 5. <https://doi.org/10.1177/2165222816646236>
- Vonderwell, Selma & Savery, John. (2004). Online learning: student role and readiness.

- Wiam Elshami, Mohamed H. Taha, Mohamed Abuzaid, Coumaravelou Saravanan, Sausan Al Kawas & Mohamed Elhassan Abdalla (2021) Satisfaction with online learning in the new normal: perspective of students and faculty at medical and health sciences colleges, Medical Education Online, 26:1, DOI: 10.1080/10872981.2021.1920090
- Wu, Sheng-Yi. (2021). How teachers conduct online teaching during the COVID-19 pandemic: A case study of Taiwan. *Frontiers in Education*. 6. 10.3389/feduc.2021.675434
- Wuckert, A. (2021, December 27). Technology in modern day life: enhancing convenience. <https://www.airshipman.com/technology-in-modern-day-life/>
- Yang, D. Instructional strategies and course design for teaching statistics online: perspectives from online students. *IJ STEM Ed* 4,34 (2017). <https://doi.org/10.1186/s40594-017-0096-x>
- Yokoyama S. (2019). academic self-efficacy and academic performance in online learning: A mini review. *Frontiers in psychology*, 9, 2794. <https://doi.org/10.3389/fpsyg.2018.02794>
- Zakariya, Y.F. (2017). development of attitudes towards mathematics scale (ATMS) using Nigerian data – Factor Analysis as a Determinant of Attitude Subcategories. *The International Journal of Progressive Education*, 13, 74-84.