Research Article

Asynchronous-Synchronous Teaching Techniques to Reinforce Achievement in Grade 2 Mathematics

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ABSTRACT

This study aimed to explore teaching techniques that would reinforce academic achievement in Mathematics of Grade 2 pupils in Camp Evangelista Elementary School in Cagayan de Oro City, Philippines for school year 2020-2021. Asynchronous and Synchronous teaching techniques were employed in the class. The instruments used in the study were the School Learning Modules (SLMs) crafted and provided by the Department of Education, the video lessons patterned from the SLMs, the First and Second Quarter grades that represent their achievements in Mathematics, and the Reflection papers submitted by the pupils every grading period for feedbacking. The study was quantitative in nature and data gathered were analyzed using frequency, percentage, and paired sample t-test. Findings revealed that there was a significant difference in the academic achievement of the pupils in Mathematics after exposure to Synchronous and Asynchronous learning as evident in the Second Grading grades. It was disclosed that the intervention employed to reinforce pupils' achievement in Mathematics is effective in this new normal learning. The researchers recommend that teachers may use this teaching technique to reinforce achievement particularly in Mathematics.

Keywords: asynchronous-synchronous, academic achievement, video lesson, virtual mentoring, feedbacking

Introduction

Amidst threat and challenges posed by the COVID-19 Pandemic, the Department of Education headed by Secretary Leonor Magtolis Briones still pushed through the school year 2020-2021 last October 5, 2020. Sec. Briones considered the start of the school year as a declaration

of victory against the pandemic [1]. The Department did not only dismiss the calls for academic freeze [2] but also addressed the challenges by preparing "a new method of transmitting learning" [3] through its Basic Education Learning Continuity Plan (BE-LCP).

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The Department's BE-LCP aims to "ensure the health, safety, and well-being of the learners, teachers, and personnel in the time of COVID-19, while finding ways for education to continue amidst the crisis" [4]. Specifically, BE-LCP is designed for the "new normal" [4]. Under BE-LCP, the Department provides a list of learning modalities that can be utilized by the teachers and learners to provide quality learning to learners. These modalities include modular, television-based, radio-based instruction, blended, and online [1].

Further, DepEd Undersecretary Alain Pascua stated on November 11, 2020 that to enrich learning, teachers, parents, and learners may use a combination of more than one learning modality [5]. This, according to him, is blended learning. This statement of Usec. Pascua calls for educators to strategize methods to provide quality learning to the learners despite the pandemic.

In the case of Camp Evangelista Elementary School (CEES), a public school in the Division of Cagayan de Oro, the parents are given the chance to choose between Printed Modular Learning (self-learning printed modules) and Digital Modular Learning (messenger, Facebook group, etc). Most of the parents opted for the self-learning printed modules.

However, the results from the first quarter showed that Grade 2-Santan (Digital Modular class), the advisory class of one of the researchers, had low scores in Mathematics. The class adviser, being a Mathematics teacher, found this alarming. To properly assess the observed problem, the adviser-researcher asked the learners to make a reflection of their learning during the first quarter. It was found that most of the learners would like to meet their teacher at least once a week for them to ask for clarifications and for mentoring.

This becomes the driving force of the researchers to derive an intervention that involves Synchronous (e-mentoring, online discussion) and Asynchronous (video lessons, self-learning modules) techniques to enhance the pupils' achievement particularly in Mathematics.

Framework of The Study

The purpose of the study is to find the effects of combining synchronous (e-mentoring, online class discussion) and asynchronous (video lesson, self-learning modules) techniques to the mathematics achievement of Grade 2 pupils. Since the study involved integrating technology, it is anchored to the Technological Pedagogical Content Knowledge (TPACK) framework.

The origin of this framework can be traced back to Shulman's [6] introduction on pedagogical content knowledge [7], which later on revolutionized to understanding teachers' knowledge, including its development [8]. Mishra et al. [9] claimed that TPACK is a kind of knowledge that is different from technology expert's knowledge and is from teacher's general pedagogical knowledge. It is a specialized type of knowledge supporting the integration of content-based technology [8]. The framework is characterized by the relationships among the three basic components: technology, pedagogy, and content [9]. These three components show teachers' experiences on technology integration through four ways: pedagogical, content and knowledge (PCK); technological, content and knowledge (TCK); technological, pedagogical and knowledge (TPK); and technological, pedagogical, and content knowledge (TPACK) [10]. These components are shown in Figure 1.

Figure 1. The Technological Pedagogical Content Knowledge Framework (adapted from [11])

The following are the definition of the components of TPACK Framework by several researchers [8, 11, 12]

- Technology Knowledge (TK) is the teacher's knowledge of the traditional and new technologies that may be applied in the curriculum, ranging from pencil and paper, to digital video, and software programs.
- Content Knowledge (CK) is any subject-matter that is to be taught by the teacher.
- Pedagogical Knowledge is the teacher's knowledge of the various instructional practices, approaches, methods, and strategies that enhance students' learning.
- Technological Content Knowledge (TCK) is the relationship between content and technology and is defined by technologies and their functions and representations and how they are used to support specific content-based percepts
- Pedagogical Content Knowledge (PCK) is Shulman's [6] notion on teaching specific content-based material
- Technological Pedagogical Knowledge (TCK) refers to the understanding on how to use specific technologies
- Technological Pedagogical Content Knowledge (TPACK) is the knowledge on the complex relation of the three basic components and how to teach specific content-based material using appropriate technologies and strategies.

During the process of creating instructional videos and e-mentoring applied in the present study, the researchers made sure that the videos were aligned to the components of TPACK framework. Specifically, the findings of the present study informed knowledge to TPK and PCK related to instructional videos. Moreover, the implementation of the intervention used in the present study was heavily anchored to TPACK framework.

Objectives of The Study

The present action research aimed to improve the achievement of Grade 2- Santan pupils in Mathematics as shown by their grades. Primarily, it sought to 1.) determine the pupils' grades in mathematics during the first grading period which was before the

implementation of the intervention; 2.) determine the pupils' grades in the second grading period, which is after the implementation; 3.) test if the asynchronous-synchronous techniques employed improved the mathematical achievement of the learners by comparing their 1st and 2nd grading grades.

Literature Review

Philippine Educational System in the New Normal

As the Philippine educational system pushed through the academic year 2020-2021 amidst the threat of COVID-19 Pandemic, the Department of Education (DepEd) addressed the challenges faced by implementing "new method of transmitting learning" [3]. DepEd implemented Basic Education Learning Continuity Plan (BE-LCP) which was specifically designed for the "new normal" [4]. This plan presented different learning modalities. Among the modalities, Distance learning which includes Modular Distance Learning, Online Distance Learning, and Television-Based and Radio-Based Instruction, [4] was the most opted modality, specifically, modular learning [13]. Even if most parents prefer a specific modality over the other, Department of Education Undersecretary Alain Pascua stated that combining multiple learning modalities can provide better learning to the learners [5].

To facilitate modular learning, DepEd schools distributed Self-learning modules (SLMs) which were made available in digital and print format. These were uploaded to Learning Resource Portal; on the other hand, digital interactive SLMs together with corresponding video lessons were uploaded in DepEd Commons [14].

DepEd further capacitated the teachers and school leaders by conducting capacity building. Teachers and school leaders were introduced to varying modalities, tools, and mechanisms that they may use depending on their localities' context of accessibility to delivery platforms, readiness of learners, household community partners, and other factors [14].

As much as DepEd provided almost all the necessary alternatives they may find to provide quality education amidst the pandemic, challenges in the implementation still arose. Amidst

these challenges, it is in the hand of individual teachers on how to make learning productive in their own localities' context.

E-mentoring

The present study integrated e-mentoring to the self-learning modules of DepEd. Even before COVID-19, e-mentoring has been applied and studied by several researchers in different fields. Due to the rise of information and communication technology, e-mentoring, sometimes referred to as virtual mentoring, digital mentoring, online mentoring, or computer-assisted mentoring gain popularity in the past decades [15]. It has drawn attention both in industry and academia since it has the potential to sustain an effective communication between mentors and mentees [16]. E-mentoring programs target specific outcomes and circumstances [15], in the present study, it is on learning learners' understanding of the SLMs.

The study of de Janasz et al. [17] developed a model on e-mentoring's outcomes and antecedent. The respondents were business students and were mentored by practicing managers. The result showed that effective e-mentoring leads to the enhanced academic performance, job opportunities, and professional networks of the mentees. The study recommended including e-mentors to broaden mentoring relationships.

Another study conducted by Williams et al. [18] shows the outcome of mentoring as a functional component for students of the online graduate course. In the implementation of the online course, students were paired with distanced practitioners who served as their mentors in independent field projects. The study further discussed the benefits of e-mentoring to the e-mentors.

Moreover, Kang et al. [16] focused on analyzing mentoring process and possible facilitation strategies. The study reviewed four mentoring programs in South Korea and designed and proposed effective strategies for mentoring phases. The designed strategies support participants in joining mentoring programs, facilitating mentoring activities, diffusing information, and developing inner network as they soon become mentors. These strategies are

believed to benefit both mentors and mentees once fully developed and implemented.

Further, a study of Heaton-Shrestha et al. [19] evaluated a 2-year face-to-face and e-mentoring program in one university in UK. The program included second- and third-year students who mentored first-year undergraduates. The paper discussed the commonalities between face-to-face and e-mentoring; showed that e-mentoring had different impacts on mentors and mentees; and highlighted challenges on e-mentoring. The study concluded that thorough training of mentors should be included in e-mentoring schemes, and that e-mentoring is a step closer to the expectations of popular forms of professional and educational development support.

These studies only show that e-mentoring could be a very good strategy in guiding learners especially that at present, the educational system prohibits face-to-face learning.

Video Lessons

Usage of instructional videos is also integrated in the study. As information and communication technology developed in the past decades, multimedia provides a significant part to the ICT development [20]. As a multimedia resource, video technology provides potential for quality education, stimulating learners' interest, and academic excellence involvement [21]. Since instructional videos can be downloaded and accessed anytime, learners can learn in their own pacing and remain motivated even when facing challenges in virtual learning environment (Lucido, 2007 in [21]).

The study of Lalian [20] determined the effects of using video in mathematics learning to the cognitive and affective aspects of the students in a school in Indonesia. Quantitative analysis was done and the results showed that usage of videos improved students' motivation in learning; enhanced knowledge and understanding of the lesson; and improved students' achievements. The study concluded that usage of learning videos in mathematics education puts emphasis on cognitive aspects rather than affective. However, it also increases the students' interests and motivation which in turn helps them in achieving learning objectives easily.

In the Philippine context, Abragan and Hambre [21] conducted a study on the effects of video-assisted instruction to the Science and Health performance of Grade 6 pupils of Naawan Central School. The 40 pupils were grouped equally to control (lecture method) and experimental (video-assisted instruction) groups. Pre-test and post-test were conducted and subjected to percentage, mean, and t-test. The pre-test scores of the pupils showed that they already have background knowledge of the topic. Results showed that there is no significant difference in the post-test scores between the two groups; however, there is a significant difference between the pre- and post-test scores of the pupils taught using lecture method and video-assisted instruction. The researchers recommended that several trials should be conducted to compare the effectiveness of video-assisted instruction. They also recommended comparing video-assisted instructions with other strategies.

On the other hand, the study of Robles and Acedo [22] focused on developing and validating educational video tutorials for the 21st century learners. The study used Research and Development design; and the skills in the video tutorials came from K-12 Curriculum Guide. The video tutorials were validated by forty-five (45) experts. The result showed that the developed videos were highly relevant and highly acceptable. This meant that the video tutorials were substantial and may help improve computation skills of the students. The study concluded that the videos may now be used for remediation, instructional materials, and enhancement activities.

Lastly, the study of MacLean [10] investigated video design formats and video characteristics that influence student engagement; and gained insight to teacher experiences in the creation of instructional videos. The result showed that quality instructional videos had a statistically significant difference in the students' level of engagement. Also, teachers reported that creating videos was challenging and time-consuming; but teachers' responses displayed that instructional videos are a valuable resource.

While it's true that DepEd's BE-LCP provided video lessons, contextualization of learning is a must. This urged the researchers of the present study to create their own video lessons based on the context of the learners with the aim of improving their achievements in mathematics.

Methodology

Design and Data Gathering Procedure

The study was quantitative in nature. Descriptive measurements like frequency, mean and standard deviation were computed. These numerical data serve as foundation for later analyses and interpretation [23]. Moreover, paired t-test was used to test a significant difference between the first and the second grading grades of the pupils. The research utilized purposive sampling wherein every pupil of Grade 2-Santan became respondents.

The researchers created a video lesson every week which was posted on the Facebook group every Monday that will be accessed by the learners, guided by their guardians, anytime. This was in addition to the TV-Based Instruction and Radio-Based Instruction in which learners have been encouraged to watch and regularly informed about the schedule of airing. Moreover, Mondays were the days for module posting. This was also the time when the teacher-researcher omit talked to parents to address their concerns and to encourage their involvement in the learning of their children, and during Thursdays every week, the teacher-researcher conducted virtual feed-backing and mentoring. Learners, who found it hard in understanding the self-learning module and the video lesson were encouraged to join this synchronous activity where they can directly ask the teacher their concerns. This scheme was done during the whole second quarter, thus an 8-week duration. After the implementation of the program, the researchers summed up the pupils' score to see if there is a significant difference from the learners' grades prior to and after the implementation. The learners were also asked to write their second quarter reflection to share their thoughts if they find the program helpful to them.

Respondents of the Study

The participants involved in the study were the 39 pupils of Grade 2-Santan of Camp Evangelista Elementary School (CEES), a public school under the Division of Cagayan de Oro, and is located at Camp Evangelista, Patag, Cagayan de Oro City in the Philippines. This section is handled by the lead researcher in one class setting during the school year 2020-2021, which corresponds to the time when Philippine educational system faced the challenge brought by the COVID-19 Pandemic.

Data Analysis

Pupils' grades were presented using frequency, percentage, and mean. To test if there is a significant improvement in the pupils' mathematics achievement as determined by their grades, paired sample t-test was used. This statistical test was done at 0.05 level of

significance, with the alternative hypothesis that the employed asynchronous-synchronous techniques reinforced and improved learners' mathematics achievement as determined by their grades.

Result and Discussion

Table 1 shows the distribution of the pupils' grades during the first grading (before the intervention), and second grading (after the intervention) periods. Corresponding description based on DepEd School Form 5: Report on Promotion and Level of Proficiency is also shown. As displayed, in the first grading period, most of the pupils are approaching proficient and proficient. There was also one (1) student who can be considered advance. These are actually good descriptions; however, as compared to other subjects, Mathematics seemed to be left behind in the pupils' grades.

Table 1. The Distribution of Students' Grades during the First and Second Grading Period

Grades	Description	First Grading		Second Grading	
		Frequency	Percentage	Frequency	Percentage
74 below	Beginning	0	0%	0	0%
75-79	Developing	4	10%	3	8%
80-84	Approaching Proficiency	17	44%	5	13%
85-89	Proficient	17	44%	25	64%
90 and above	Advanced	1	2%	6	15%

Note. n=39

In the second grading period, after the implementation of the intervention, majority of the participants are considered proficient. It is also notable that 15% percent of them are

described as advanced. Changes in pupils' grades from first grading to second grading can be inferred.

Table 2. Mean and Standard Deviation of the Students' Grade in the First and Second Grading Period

Grading Period	Mean	Std. Deviation	Descriptive Rating
1st grading	83.56	3.733	Approaching Proficiency
2nd grading	85.97	3.289	Proficient

Note. n=39

Table 2 presents the mean and standard deviation of the pupils' grades between the first and second grading period. The 1st grading displays a mean of 83.56 which can be described as approaching proficiency. Its standard deviation of 3.733 shows how spread the pupils' grades are. On the other hand, the 2nd grading mean of 85.97 is much higher than the previous

one. This mean grade is interpreted as Proficient and its standard deviation of 3.289 shows that 2nd grading grades are less scattered compared to the 1st grading's. A recorded interview, which was stated in pupil's reflection gathered by the teacher-researcher at the end of the 1st grading period is shown below:

Researcher: *Nganu mas gamay mog gradosa math compared sauban subjects?*

[Why did you have lesser grades in math compared to other subjects?]

Respondent: *Lisod man gudsabton ang module Ma'am. Mas tsadagyud tong ma-explain nimu ug makapangutana me saimuha.*

[I find it hard understanding the module Ma'am. It would have been better if you can explain it and we can ask you questions whenever there's a thing we don't understand.]

Researcher: *Unsa may possible nimu ma-suggest para mas masabtannimu ang topic ug para musakapudimunggradosa Math?*

[What can you suggest such that you would understand the topic better which in turn, will improve your grades in Math?]

Respondent: *Kuanunta Ma'am, mag meet ta para makapangutana me. Mas tsadapudunta Ma'am kung ikaw mag explain.*

[I hope there would be a session where we can meet for us to raise our question. And it would be better if you were the one to explain the topics Ma'am.]

The interview only showed that learners prefer their teacher discussing the topic. They also find it better if they could raise questions to their teacher. This interview was the reason of the researchers to create their own video lesson. This video lesson was coupled with weekly mentoring to the learners. Meeting the class for e-mentoring is a good strategy for educational development support [19]. Moreover, a video lesson crafted by the teacher-researcher could stimulate learners' interest and enhances academic excellence improvement [21].

A similar reflection was asked by the teacher-researcher to another pupil after the conduct of the intervention. The verbatim answer of the learner is shown below:

Researcher: *Kumusta man imungpagsabotsa topics sa Math?*

[How's your understanding in the topics in Mathematics?]

Student: *Mas masabtannangaikaw ang nag explain Ma'am. Dayunmakapangutana pagyud me saimukadaHuwebes, maong feeling nako Ma'am mas dakokoggradokarong second grading.*

[We understood it better since you explained it Ma'am. Also we can ask our concerns to you every Thursday so I feel like I will have a better grade in the second grading period.]

The interviewed pupil found the intervention conducted by the teacher helpful. The combination of e-mentoring, video lessons and feedbacking was deemed by the learner to have helped him improve his grade in Mathematics. Effective e-mentoring leads to enhanced academic performance [17] while video lesson provides potential for quality education as it allows learners to be motivated when facing challenges in virtual learning environment (Lucido, 2007 in [21]).

A key factor in the implementation of the intervention was the parents' involvement. Upon the start of the second grading period, the researcher informed the parents of their children's performance in Mathematics during feedbacking, and they were all encouraged to guide their children in the second grading period. The lead researcher also conducted an informal interview to a parent after the second grading period. The parent's response is recorded and shown below:

Researcher: *Kumusta man ang performance sa Mathimunganakkarong second grading Ma'am?*

[How's your child's performance in Mathematics in the second grading period, Ma'am?]

Parent: *Ay Ma'am, mas dili ko mahago ug tudlo kay igo naman lang syamutan-aw saimunggi record nga video. So far pud Ma'am, masabtanraman sad niya kay ga-Bisaya raman sad kag explain.*

[Ma'am, it was less stressful for me guiding my child because he just watched your recorded video. So far, he understood your discussion since you just used vernacular in explaining.]

The implemented intervention was deemed beneficial both by learners and their parents; however, to determine if it really improved

their achievement in Mathematics as determined by their grades, a t-test for paired sample was done.

Table 3. Paired t-test Result of the 1st and 2nd Grading Grades of the Learners

Paired	Mean	Std. Deviation	t	Df	Sig. (2-tailed)
1 st grading-2 nd grading	-2.410	1.650	-9.123	38	.000*

Note. * $p < 0.05$

Table 3 displayed the paired t-test result when 1st grading and 2nd grading grades of the learners were compared. The test was 2-tailed; however, the present study looks for improvement, thus, one-tailed. Typically, the p -value is to be divided by 2 to get the result. In the case, the result would still be lesser than 0.05.

Thus, a paired sample t-test rejects the null hypothesis and shows that there is sufficient evidence to claim that the employed intervention improved the learners' achievement in Mathematics.

This result is supported by the study of de Janasz et al. [17] which showed that e-mentoring enhanced learners' academic performance. Outcome of e-mentoring serves as a functional component for learners [18]. E-mentoring is a step closer to the expectations of popular forms of professional and educational development support [19].

The result of the present study is also aligned with the study of Lalian [20] which showed that usage of videos enhanced knowledge and understanding of the lesson and improved students' achievements; and that usage of learning videos also increases the students' interests and motivation which in turn helps them in achieving learning objectives easily. Moreover, quality instructional videos shown to have improved the students' level of engagement [10].

Conclusion

Based on the findings, it is concluded that there is a significant difference in the Grade 2-Santan pupils' achievement in Mathematics between the first grading, before the intervention was implemented, and the second grading after the intervention was applied. It was disclosed that the intervention employed to reinforce pupils' achievement in Mathematics is effective

in the research locale. Thus, the null hypothesis that there is no significant difference between the pupils' grades in the first and second grading period is rejected.

The researchers would like to recommend the following action steps:

1. The assessment of the teacher to the pupils' achievement during the first grading period should be the baseline to diagnose if ever a problem is found. The data will help in determining which part of the lessons are not clear and what particular learning competency is hard to understand using only the School Learning Modules (SLMs) this time.
2. Teachers must spare extra time to know more about the background of each of their pupils, to include, the economic status and the parents' educational attainment, especially that the parents served as the para-teachers in the Modular Distance Learning.
3. Parents' and pupils' feedback must be considered as they are the ones answering the Learning Modules at home.
4. Teachers, as the frontliners in educating the children, must continue to learn new teaching techniques, strategies, and interventions to ensure the delivery of quality education and lifelong learning to the kids.
5. Asynchronous-Synchronous Teaching Techniques will be adopted by the teachers to address the problem on pupils' low achievement in Mathematics.
6. Other researchers may explore on online interactive tools in teaching mathematics in order to enhance learners' mathematical achievements, especially during the time of Pandemic.

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