22 (2), 2021, 167-178

Jurnal Pendidikan MIPA

e-ISSN: 2550-1313 | p-ISSN: 2087-9849

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Teaching Math in The Virtual Classroom: Insights And Perspectives

Gilbert Arrieta, Annie Zulueta, Dennis Lorenzo, Geliza Gayta

Don Bosco Technical Institute-Makati City, Philippines
Philippine Normal University-Manila

Abstract: This study aims to find out experiences of the math teachers in terms of their preparations, teaching strategies and activities including their insights and realizations in teaching math in the virtual classrooms. The study revealed that student participation and technological capability are their main doubts and concerns in online teaching. It found out that math teachers used more interactive power point presentations, interactive games using gaming websites, and differentiated learning as their teaching strategies and approaches. They realized that teaching math in the virtual classroom is not actually hard, and math teachers should create a new learning environment and be more open-minded in the new normal.

Keywords: teaching math online, student participation, online teaching strategies, insights and realizations

Abstrak: *Penelitian ini bertujuan untuk mengetahui pengalaman guru matematika dalam hal persiapan, strategi dan kegiatan mengajar termasuk wawasan dan realisasinya dalam mengajar matematika di kelas virtual. Studi tersebut mengungkapkan bahwa partisipasi siswa dan kemampuan teknologi adalah keraguan dan kekhawatiran utama mereka dalam pengajaran online. Ditemukan bahwa guru matematika menggunakan presentasi power point yang lebih interaktif, permainan interaktif menggunakan situs web game, dan pembelajaran yang berbeda sebagai strategi dan pendekatan pengajaran mereka. Mereka menyadari bahwa mengajar matematika di kelas virtual sebenarnya tidak sulit, dan guru matematika harus menciptakan lingkungan belajar yang baru dan lebih berpikiran terbuka dalam kehidupan normal yang baru.*

Kata kunci: *mengajar matematika online, partisipasi siswa, strategi pengajaran online, wawasan dan realisasi.*

Gilbert Arrieta et al.
Email: gsarrieta@one-bosco.org

DOI: http://dx.doi.org/10.23960/jpmipa/v22i2.pp167-178
Received: 03 March 2021
Accepted: 16 October 2021

▪ INTRODUCTION

When numbers speak, does everybody listen? If the numbers are related to money matters, many people will listen most especially if they will benefit from it. However, when people discuss numbers in a mathematical way, they may not be interested because there is a presumption that Math is difficult. In school, Math is considered a difficult subject for it entails a lot of computation and memorization of formulas. When a child begins to learn Math, the basic things are taught particularly counting and the four basic mathematical operations which the students find interesting. However, when they start to study Math in high school like algebra, geometry, statistics, and trigonometry, the interest diminishes because of its difficulty. In fact, students experience math anxiety. The reasons for math anxiety that were most frequently reported by the students were associated with risk of failure, task difficulty, time pressure, and fear of receiving a bad grade (Szczygieł & Pieronkiewicz, 2021). Math will always be perceived as a difficult subject but teachers can spark interest among students based on how they teach the lessons. Teacher's strategies, approaches, mindset, and disposition in discussing Math lessons enable the students to take interest and gain more confidence in understanding and solving problems. In fact, a study on teaching Math using flipped classroom concluded that it led to positive changes in the researcher's fourth grade math class. The flipped instruction fostered enthusiasm, confidence and intrinsic motivation among students, which was reflected in the survey responses and observed student daily behaviors and comments. The classroom no longer resembled a traditional structure and was more analogous to a constructivist-driven, collaborative environment. Students were actively engaged in peer conversations, and for the most part, they were involved with tasks that required greater focus and a deeper understanding of the concepts (D'addato & Miller, 2016).

Teaching math has always been a challenging task because of how people have stereotyped math as a difficult subject. Math teachers have a lot of consideration to take when preparing a lesson. In particular, they think about their students who may not be able to learn more easily math concepts. Teachers need to learn how to encourage student exploration, related discussion, and reflection about the prospective math concept they teach. They need to be comfortable with students' exploration of the math concepts and possibly wandering off the "correct" track or even challenging the teachers' own mathematical viewpoint. Teachers cannot assume that when students use manipulatives they will automatically draw the correct conclusions from them. Adults may overestimate the power of manipulatives because they already understand the underlying math concepts that are being conveyed by the math manipulatives. Teachers need to keep in mind that the student does not already possess this knowledge and still needs to make the correct connections between the manipulative and the underlying math concept (Furner & Worrell, 2017).

One of the most common activity in math classes is board work. After an example has been discussed by the teacher, the students solve a given problem. Afterwards, the students are called to do board work to show how they arrived at a particular answer. In fact, various games are conducted during class to give more excitement and interest in learning math. Play and games can give young children opportunities to learn and develop foundational math skills that are aligned with common core standards for mathematics through age-appropriate, fun, and engaging activities (Ramani & Eason, 2015). It is so heartwarming for math teachers to hear how

much their students appreciate the class and assignment. More so, they feel appreciated when students ask questions and look forward to their next class.

However, teaching and learning math become more challenging unexpectedly when face-to-face classes were prohibited because of the Covid-19 pandemic in the first quarter of 2020. In the Philippines, the government imposed the enhanced community quarantine or globally known as lockdown to prevent the spread of the virus in March 2020. Public schools ended their classes early since there were only two weeks left before school year 2019-2020 officially ends. However, classes in some private schools had to continue in different modalities except face-to-face because there were still two months left in its school calendar. A private sectarian school in Manila started immediately its preparations for school year 2020-2021 after it wrapped up the previous school year. Incidentally, the Philippine government announced that classes for school year 2020-2021 will continue primarily through virtual classes. It was emphasized by the government that physical or face-to-face classes will resume only when there is already a vaccine. Seeing already a direction for the next school year, various preparations were made which included webinars, curriculum planning, and technical requirements. Aside from the provisions of the school, the teachers also prepared personally by engaging in technology training, and finding out the best possible platforms for virtual learning.

Believing that teaching math in a virtual classroom will pose a lot of challenges, teachers engaged themselves in professional and personal preparations including collaboration with other teachers. With no online teaching experience, they were groping in the dark but trying different creative ways to make math an enjoyable and interesting subject. A study revealed that the challenges faced by lecturers in implementing online learning include: limitations in presenting material, especially when courses have many mathematical equations and programming languages. Besides, the lecturers are not good at video editing or animation using various animation maker software. They are limited to presenting material using PowerPoint and text. Overall, to use online learning, lecturers must at least master presentation software, text processing, assessment, and video conferencing (Irfan et al, 2020).

This study aims to find out the insights and realizations of Math teachers based on their experiences in teaching in virtual classrooms. It will also identify teaching strategies, approaches, and activities including their preparations for online teaching and learning. Through the findings, it will help them prepare better for the next school year whether it will be online, blended, or face-to-face teaching and learning modality. The following are the research questions that the study seeks to answer:

- What are your doubts, concerns, and challenges in teaching math through online modality?
- What teaching and learning strategies, approaches, and activities did you find effective in the virtual classroom?
- Based on your experiences in online teaching, what are your new insights and perspectives in teaching math in the virtual classroom?

• METHOD

To know the insights and perspectives of Math teachers in teaching in the virtual classroom, it is important to know their experiences before and during online teaching. Online teaching and learning is the primary modality for teaching and learning during

the lockdown because of the Covid-19 pandemic. Phenomenological method was used in this study. Phenomenology is an approach to qualitative research that focuses on the commonality of a lived experience within a particular group. The fundamental goal of the approach is to arrive at a description of the nature of the particular phenomenon (Creswell, 2014). Before the start of school year 2020-2021, selected math teachers were observed during the bridging program, a preparatory class for the incoming school year. They were also observed for six months and a focus group discussion was held twice, each at the end of every term. All math teachers have no prior experience in online teaching.

The interview questions were validated by five experts in educational management, and curriculum and instruction. The following were the questions asked during the focus group discussion : 1) What were your doubts or concerns in teaching math through online modality before the start of school year 2020-2021? 2) How did you prepare for online teaching specifically in teaching math? 3)What were the difficulties and challenges that you encountered in teaching Math through online mode? 4) In teaching math through online modality, what strategies, approaches or activities did you find effective? 4) Why do you consider them effective? 5) Having taught math through online for two terms or almost seven (7) months, what new insights have you gained and perspectives have you developed as a Math teacher?

To analyze the data gathered in the study, coding was used by the researchers. In coding, the researcher organizes data collected into segments and assigns a word or phrase to them as labels (Creswell, 2014). The researchers sought the permission of the principal, assistant principal for academic affairs, and learning area head before conducting the study. The purpose of the study was discussed to the academic heads and math teachers. It was made clear that their responses will not affect their status in school and will be used to enhance the teaching and learning of math in different modalities.

- **RESULT AND DISCUSSION**

The opening of classes for school year 2020-2021 was uncertain that teachers were at a lost. However, when the Department of Education announced that classes will open through different modalities but primarily through online delivery, school heads and teachers immediately planned and prepared. Online classes may not be technically a new modality but it has never been really tried by many educators and students.

1. What are your doubts, concerns, and challenges in teaching math through online modality?

One of the subjects considered to be challenging to teach and learn is math. It becomes even more challenging because it will be fully conducted in a virtual classroom. The math teachers identified their doubts and concerns and began preparing themselves for the incoming school year despite.

Students Learning and Participation

Just like any teacher, math teachers want their students to be fully engaged in learning math through participation. With a lot of experiences in face-to-face classes, they have already a bag full of strategies and activities that will make math classes very interesting to students. However, the virtual classroom is a totally different environment. They are unsure if the students will participate in classes for there will be a lot of distractions like gaming, household chores, domestic problems, and their actual

readiness for online classes. In engaging students' participation, teachers say that building rapport with students is important as they have experienced in physical classes. A Math teacher shared that :

"One of my concerns is the difficulty of building a rapport. In a face-to-face setting, it's very easy to build a classroom relationship with the students because you meet them in person. That's a different case with virtual or distance learning wher you need to be more patient in dealing with different types of learners and handling different kinds of situations."

In relation to student learning, math teachers asked if the assessment will be as authentic as what is done in face-to-face classes. Online assessment may be much lesser and prone to academic dishonesty. It is through the normal types of tests or activities that students' learning can be authentically assessed. A teacher worryingly asked :

"How do I prepare my assessment form? What is the most effective one to measure the validity of the test?"

The concern on student participation was revealed in several studies. A study showed that that one of the main challenges posed by the COVID-19 pandemic is for students to engage in online learning environments. The results suggest that technology is a particularly important resource in the current situation in that it enables people to continue their educational activities with as little disruption as possible (Chávez et al, 2021). A similar study said that one of the challenges in online teaching, such as conditioning students to participate in online learning, is difficult for teachers. Factors that create these barriers may be divided into internal and external factors. Internal factors are difficulties arising from the student's home environment, such as interference from family members (younger and older siblings). These factors cause students who are learning not to be focused on learning. One factor is a less conducive home learning environment in which the activities of family members students cause distractions that reduce the concentration necessary to understand the subject matter. External factors that arise are the disturbances from other students when implementing learning using an online application in a virtual classroom. Students talk to other students with topics that are unrelated to the subject matter being studied (Aliyyah et al, 2020).

To prepare for this challenge, there are Math teachers who consulted their colleagues who are now working in other countries and have extensive experience in using technology in online learning. Others attended local and international webinars to find out what are the possible approaches and strategies that will work in a virtual classroom. There are Math teachers who explored on different applications and platforms that might be useful and effective engaging students to learn Math. They also said that they shared with each other what they have learned and did practice teaching among themselves in order to have more confidence and to find out what they need to improve. A Math teacher pointed out that :

"After attending webinars, I gained new experiences, knowledge, and the ability. I reached out to my fellow Math teachers and shared with them what I learned. We also practice together the methods, activities, and approaches that we learned."

Technological Capability and Support from School

Knowing that internet connection in the Philippines is unstable and most of the teachers do not have internet connections at home for they rely only on their mobile phones, they had worries in carrying out online teaching. A Math teacher shared:

"I am concern about the state of the internet connection that our country does have. We are aware that our country has the worst internet connection in Asia. It affects the learning and teaching in education in this setup."

Aside from internet connection, they did not have sufficient technological equipment like desktop computer or laptop, that will be needed for online learning. They were asking about the assistance that will be provided by the school. Some teachers upgraded their internet connection and laptops using their own money. Some bought new laptops and gadgets in order to prepare personally for online classes. Before the classes began last August 24, 2020, the school administration provided a monthly internet allowance for all teachers and staff. For those who did not have computers, the computer units in the laboratory were sent to their homes. Other new gadgets like camera and headsets were provided to each teacher for free. Obviously, to carry out online learning, the technological resources must be in place and strong. A study suggested that robust IT Infrastructure is a prerequisite for online learning. Infrastructure needs to be so strong that it can provide unhindered services during and after the crisis (Dhawan, 2020). Another study suggested that telecommunications infrastructure with focus on high bandwidth connectivity has to improve. Advanced countries can help neighboring countries. Already this technology cooperation has been happening with countries like USA, China, and India assisting their neighboring countries (Palvia, 2018).

2. What teaching and learning strategies, approaches, and activities did you find effective in the virtual classroom?

Having initially addressed the concerns in online teaching, Math teachers tried different learning strategies, approaches, and activities that they think will be effective in teaching Math in the virtual classroom.

Math Lessons in Interactive Power Point Presentations

One of the challenges experienced by Math teachers in a virtual environment is the limited time to teach Math. Believing that the regular number of hours allocated for math every week is not sufficient to teach the lessons even if the curriculum has been modified to meet the requirements of the Department of Education (DepEd) on the Most Essential Learning Competencies (MELCs), they said that they have to employ new approaches. With Math lessons already in powerpoint, some Math teachers decided to update their technology-based instructional materials by making it more interactive. They incorporated activities that will engage the students in discussion and participation. A Math teacher shared :

"One approach that I consider effective and helpful is by making my PowerPoint interactive. I use websites such as Canva and Prezi to make my PowerPoint interactive. I also study how to make ordinary PPT's in Microsoft to make them more interactive and attractive. My students appreciated it, and I was able to grab their

attention to learn. I believe having learning materials that are well-prepared and well-designed will help get students' attention."

Regardless of the platform, technology-based instructional materials that is well-planned will have a bigger chance to become effective. It must be interactive in order to elicit interest of students to learn mathematics. A study showed that the interactive mathematics multimedia learning based on iSpring Presenter has met the requirements and is considered feasible to be used in the learning process as a supporting media for learning and able to increase students' interest in learning through varied learning activities. The use of the interactive mathematics multimedia learning based on iSpring Presenter succeeded in increasing students' learning interest proven by the N-Gain value of 0.704 with a high category (Anwar et al, 2019).

Interactive Games Using Gaming Websites

Learning Math can be fun if teaching Math is carefully and creatively planned. Since education is carried out online, a lot of possibilities have been unearthed in the virtual world which have been hardly used despite being available before. With face-to-face classes becoming an impossible modality in the nearest future, Math teachers discovered that that use of gaming websites and applications made students more interested and engaged in learning Math. A math teacher shared :

"Another effective approach is the use of a gaming website. I use those sites to review our previous lessons. I also use it as an ice breaker before we start our lessons. Students are engaged if there are games that are involved. That sense of competition is still present in this kind of setup. Gaming apps such as quzzizz, kahoot, wordwall, etc. Giving rewards is one of the effective strategy. I gave an additional points for those students who got a high score in our review games."

A wide variety of games like video games have come out and being used by Math teachers even before the Covid19 pandemic. In fact, a study revealed that video games contribute to higher learning gains compared with traditional instruction (Tokac, Novak, & Thompson, 2019). In another study that investigated which teaching approach was preferred by the students. The results showed that about two-thirds of the students (64%) preferred the game-based teaching approach (Blind kahoot) over using slides (24%), interaction using Sembly (11%), and studying on their own (2%). One possible explanation for this is that the Blind kahoot enables students to be interactive and curious during the whole lecture (Wang, 2019). In another study, mathematics game on computer or android platform is one of the utilization of technology in the 4.0 era as interactive learning. This type of research is research and development which aims to produce a proper and interesting mathematics game application based on multimedia for junior high school students. The mathematics game application in this research was developed by Microsoft PowerPoint software. This research was using preliminary study and product development stages. The subjects of this research were the seventh-grade students of junior high school in Tuntang Subdistrict. The scoring results by the material expert get the average score 42 then categorized as
very feasible, while the scoring results by the design or display expert get the average score 44 then categorized as very feasible. On the limited scale trial test get the score of 42 then categorized as very good, and on the wide scale trial test get a score of 43 then

categorized as very good. Based on the results can be concluded that the mathematics game is very feasible and interesting for junior high school students (Graceota & Slamet, 2021).

Differentiated Learning

Another approach that a Math teacher did was differentiated learning. In today's technology-enhanced learning environments, it is possible to engage students more deeply than was the case in traditional approaches. Students can begin learning from their own level of expertise and achieve the expected mastery at their own pace. The presence of new technological means has created a shift towards a more personalized learning (Montebello et al, 2018). The math teacher said that :

"I believe that this is effective for my students because in this approach, I have the option to choose different mathematics teaching strategies that best fit my students."

Students have their own needs and pace in learning. Considering this seriously in online teaching, differentiated instruction and learning is an alternative method to engage students more actively in learning. Tt must be emphasized that differentiated instruction through interactive strategies provides opportunities for transition from traditional knowledge acquisition to active learning process. Each new didactic solution that improves the quality of teaching fulfilling individual learner's needs increases the chances for promotion of individual abilities in learning, motivating at the same time a qualitative pedagogical solution (Ismajli & Imami-Morina, 2018).

3. Based on your experiences in online teaching, what are your new insights and perspectives in teaching math in the virtual classroom?

Teaching Math will always be challenging be it face-to-face or online. However, it is undeniably true that online teaching is more challenging for no one has been here before in its strictest sense. Everyone was forced to go online because there is no other way to teach because of Covid19 pandemic. However, educators see a silver lining in this pandemic that will make teaching and learning better when this health crisis is over. Math teachers have their own realizations and new insights in virtual teaching.

Teaching Math Online is Not Hard

Surprisingly, Math teachers consider teaching in a virtual classroom not as hard as they expected to be. They anticipated the challenges and had doubts in their capability but they realized after seven months that it can be done. They had fun teaching Math despite the challenges and their doubts before the start of the school year. A Math teacher said that :

"Teaching Math online is not that hard, unlike what I used to believe way back last year. I thought that it is impossible, but here I am, still striving to teach my students."

Teaching is a challenging profession. Everyday, new things come out, good or bad. A teacher deals with this with the intention of becoming better and making learning happens in the classroom. It may be difficult to teach but it becomes easier once a

teacher becomes passionate in his profession. Anyone who has been in schools for a while knows that programs come and go. The people, though are the heart of education. We would get a lot more bang for our professional development buck if we invested in people first, so that's the approach I'm taking here. They are hugely important but whatever curriculum and standards we are using, in whatever type school, at whatever grade level, good math teaching starts with us. The more we know and enjoy math the way it really is, the more we will be able to bring that positive affect and deep knowledge into our math classes and teaching. We will make good instructional decisions with the resources we have and the contexts we are in and over time, we will get better and better at this incredibly challenging and rewarding job (Zager, 2017).

Create New Learning Environments

The Covid19 pandemic closed temporarily the door that teachers normally take to teach Math. However, it paved the way to unlock a door that has been in existence for years. The door led teachers and students to experience online teaching and learning. With teachers paving the way for making online education happen, they decided to leave their comfort zone and began creating new learning environments. Just like what they usually do particularly in face-to-face classes, they think, plan and implement learning environments that will entice students to study math. In an online environment, the new learning environments have to be created in order to determine which will be effective and applicable. A Math teacher shared that :

"As a Math teacher, do not stop to create learning environments that can motivate, engage, and educate the students. There are a lot of free math activities that are very useful."

One of the 21st century skills that teachers and students have to develop is creativity. It paves the way for teachers to look ahead and introduce innovations in teaching and learning. According to a study, creativity may survive in the accountability era unless teachers mistakenly subscribe to the idea that teaching content and academic skills implies ignoring creativity in classroom and rote memorization is the only way to teach the content. (Cayirdag, 2017). The lack of creativity in teaching may lead to lack of student's interest to learn and teachers' decrease in passion to teach. It is important to be reminded the importance of creativity and what hinders teachers to be creative. There are teachers' hold beliefs that enable, but also several that hinder creativity development in schools. Teachers' beliefs about creativity are heavily context dependent. It seems that there is recurrent incongruence between teachers' espoused positive beliefs and enacted classroom practices (Bereczki & Kárpáti, 2018).

Be More Open-Minded

In most cases, it is not easy to make a paradigm shift if what you believe is still working. As they say, if ain't broke, don't fix it. There are teachers who despite being provided with new growth opportunities would not change anything in the way they teach because there is nothing wrong with it. Apparently, in teaching and learning, new things are introduced and shared which means that education is dynamic. In this Covid19 pandemic, Math teachers realized that educators must be more open-minded.

New things can be discovered and applied to make online education happen, effective and interesting. Surely, there are a lot of challenges but one has to become open-minded in order for better things to take place. A Math teacher said with hope that :

"Be resourceful and don't be afraid to learn new things. Doing outside your comfort zone in teaching face to face is a must. Also, the support of the institution in all aspect would be a motivation in teaching online."

Another Math teacher pointed out :

"This experience has surely brought many challenges to me as a mathematics teacher, but it surely taught me different lessons and has broaden my perspective that there are many options that I can use in teaching mathematics."

A teacher must be flexible to any situation that may occur in the classroom. The online modality in teaching and learning enabled educators to be flexible in the delivery of the lessons. More importantly, teachers have to be more open-minded particularly in making education happen in the new normal. Since education is dynamic, teachers should always be open to changes and suggestions on what can be done in the future. As a community, teachers should be more reflective in order to identify what need to be changed and what can be done to continue teaching and learning meaningfully even in the virtual classroom. In a study on teaching science online, it was found out that the challenges can be overcome by taking initiatives and doing more creative activities that are doable online. Science teachers also see a silver lining in the new normal by becoming more updated and continuously engaging in the new developments in Science for there are better things to come (Arrieta, Dancel & Agbisit, 2020). The global issues related to modern education in high-tech era insist the teachers improve their skills to be in line with the rapid changes of world's needs. The present demands require teachers to have skillful, critical thinking, creative, and innovative human resources. One way to fulfill the needs is to enhance the system of education. In this case, the teachers' development is first coming into mind as the core of the changes. The teachers of today, so called the 21st-century teachers, are the urgency for the improvement of millenial human resources. The 21st-century teachers are viewed as the agents to make the connection between the global issues and the teaching and learning process inside the classroom (Norahmi, 2017).

- **CONCLUSION**

The study found out that Math teachers doubted students' participation and learning and their technological capability including the support from school before the actual online teaching and learning. Several months since the start of the school year, they were able to apply different approaches and strategies such as modifying and making power point presentations more interactive, engaging students in interactive games using gaming websites, and implementing differentiated learnings. Despite the challenges posed by the Covid19 pandemic in teaching Math in the virtual classroom, teachers realized that it is not hard as anticipated. They also realized that they have to create new learning environments and be more open-minded in order to make the teaching and learning of Math more interesting and engaging. Based on the findings, it

can be concluded that Math teachers were able to overcome their doubts and fears in online teaching and learning by implementing their plans and being resourceful. They have become more open-minded and decided to leave their comfort zones to become more innovative and relevant in the online modality. In their own way, they became creative by trying out new activities, approaches and strategies in teaching math. In their preparation and application of their plans, they were able to see the brighter side of things in the Covid19 pandemic particularly in teaching math which they believe will make them better teachers should everything returns to the normal. More importantly, they felt that they have become relevant to their students in online teaching as reflected in their participation in class.

- **REFERENCES**

Aliyyah, R. R., Rachmadtullah, R., Samsudin, A., Syaodih, E., Nurtanto, M., & Tambunan, A. R. S. (2020). The perceptions of primary school teachers of online learning during the COVID-19 pandemic period: A case study in Indonesia. Journal of Ethnic and Cultural Studies, 7(2), 90-109. http://dx.doi.org/10.29333/ejecs/388

Anwar, M. S., Choirudin, C., Ningsih, E. F., Dewi, T., & Maseleno, A. (2019). Developing an interactive mathematics multimedia learning based on ispring presenter in increasing students' interest in learning mathematics. Al-Jabar: Jurnal Pendidikan Matematika, 10(1), 135-150.

Arrieta, G. S., Dancel, J. C., & Agbisit, M. J. P. (2020). Jurnal Pendidikan MIPA. Jurnal Pendidikan, 21(1), 95-108. http://dx.doi.org/10.23960/jpmipa/v21i2.pp146-162

Bereczki, E. O., & Kárpáti, A. (2018). Teachers' beliefs about creativity and its nurture: A systematic review of the recent research literature. Educational Research Review, 23, 25-56.

Cayirdag, N. (2017). Creativity fostering teaching: Impact of creative self-efficacy and teacher efficacy. Educational Sciences: Theory & Practice, 17(6).

Chávez, J., Barrera, R., Montaño, R., Sánchez, J., & Fauré, J. (2021). Quality of Online Learning Participation in a Context of Crisis. Higher Learning Research Communications, 11.DOI:10.18870/hlrc.v11i0.1203

Creswell, J. W. (2014). A concise introduction to mixed methods research. SAGE publications.

D'addato, T., & Miller, L. R. (2016). An inquiry into flipped learning in fourth grade math instruction. The Canadian Journal of Action Research, 17(2), 33-55. https://doi.org/10.33524/cjar.v17i2.261

Dhawan, S. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis. Journal of Educational Technology Systems, 49(1), 5–22. https://doi.org/10.1177/0047239520934018

Furner, Joseph M. and Worrell, Nancy L. (2017) "The Importance of Using Manipulatives in Teaching Math Today," Transformations: 3(1).

Graceota, A., & Slamet, I. (2021, March). Mathematics Game as Interactive Learning Media In COVID-19 Pandemic Era. In Journal of Physics: Conference Series (Vol. 1808, No. 1, p. 012041). IOP Publishing.

Irfan, M., Kusumaningrum, B., Yulia, Y., & Widodo, S. A. (2020). Challenges during the pandemic: Use of e-learning in mathematics learning in higher education. Infinity, 9(2), 147-158. https://doi.org/10.22460/infinity.v9i2.p147-158

Ismajli, H., & Imami-Morina, I. (2018). Differentiated Instruction: Understanding and Applying Interactive Strategies to Meet the Needs of All the Students. International Journal of Instruction, 11(3), 207-218.

Montebello, M., Pinheiro, P., Cope, B., Kalantzis, M., Haniya, S., Tzirides, A. O., & Searsmith, D. (2018, June). Enriching online education through differentiated learning. In Fourth International Conference on Higher Education Advances.

Norahmi, M. (2017). 21st-century teachers: The students' perspectives. Journal on English as a foreign Language, 7(1), 77-96.

Palvia, S., Aeron, P., Gupta, P., Mahapatra, D., Parida, R., Rosner, R., & Sindhi, S. (2018). Online education: Worldwide status, challenges, trends, and implications. DOI: 10.1080/1097198X.2018.1542262

Ramani, G. B., & Eason, S. H. (2015). It all adds up: Learning early math through play and games. Phi Delta Kappan, 96(8), 27–32. https://doi.org/10.1177/00317217 15583959

Szczygieł, M., & Pieronkiewicz, B. (2021). Exploring the nature of math anxiety in young children: Intensity, prevalence, reasons. Mathematical Thinking and Learning, 1-19. https://doi.org/10.1080/10986065.2021.1882363

Tokac, U., Novak, E., & Thompson, C. G. (2019). Effects of game-based learning on students' mathematics achievement: A meta-analysis. Journal of Computer Assisted Learning, 35(3), 407-420.

Wang, A. I., Sætre, R., Rydland, T., & Dahl, Y. (2019). Evaluation of interactive and gamified approaches for teaching ICT theory: A study of PowerPoint, sembly, nd kahoot!. Reading: Academic Conferences International Limited. doi:http://dx.doi.org/10.34190/GBL.19.168

Zager, T. (2017). Becoming the Math Teacher You Wish You'd Had: Ideas and Strategies from Vibrant Classrooms. Stenhouse Publishers.