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Creating and Innovative Primary School Mathematics Teaching Environment: The Case of Eastern Cape Province

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Abstract

Today's learner population is diverse and replete with situational, personal, emotional, and learning challenges that inevitably find their way into the mathematics classroom. This paper draws from a project intended to investigate issues of classroom practice in mathematics used, extrapolate, or improve on them for the better development of teachers and learners' meaningful understanding of intermediate and senior phase mathematics in a district in the Eastern Cape province of South Africa during the COVID-19 lockdown period. A qualitative approach in which three teachers were interviewed has been used. Results indicated that teachers benefited from technology informed collaborations with other teachers on WhatsApp groups and used those experiences to promote learning in their own environments. Moreover, it was observed that teachers modified their instructional strategies, shared mathematics teaching practices through WhatsApp, and engagements using online tools easily accessible to their learners.

Keywords: Innovation, Mathematics, Teaching, Collaboration, Technology, Environment.

Creación de un Entorno Innovador para la Enseñanza de las Matemáticas en la Escuela de Primaria: El Caso de la Provincia de *Eastern Cape*

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Resumen

La población de estudiantes de hoy es diversa y está repleta de desafíos situacionales, personales, emocionales y de aprendizaje que inevitablemente encuentran su camino en el aula de matemáticas. Este documento se basa en un proyecto destinado a investigar problemas de práctica en el aula en matemáticas, para extrapolarlas o mejorarlas para un mejor desarrollo de la comprensión significativa de los profesores y alumnos de las matemáticas de fase intermedia y superior en un distrito de la provincia de Eastern Cape de Sudáfrica, durante la COVID-19. Se ha utilizado un enfoque cualitativo en el que se entrevistó a tres profesores. Los resultados indican que los docentes se benefician de las colaboraciones con otros docentes a través de los grupos de WhatsApp y utilizaron esas experiencias para promover el aprendizaje en sus propios entornos. Además, se observó que los docentes modificaron sus estrategias de instrucción, compartieron prácticas de enseñanza de matemáticas a través de WhatsApp y compromisos utilizando herramientas en línea de fácil acceso para sus alumnos.

Palabras clave: Innovación, Matemáticas, Enseñanza, Colaboración, Tecnología, Medio Ambiente.

In South Africa, there is no adequate research that explores how innovative mathematics teaching can be created within rural schools and classrooms. Various literature posits that mathematics education research has virtually over-concentrated innovation in urban and township schools and consistently ignored rural contexts and primary schools. Moreover, arguments exist that the environments in which teaching mathematics in rural areas in South Africa have been under-studied in South Africa. The Curriculum Assessment Policy Statement (CAPS) defines mathematics as a human activity that involves observing, representing, and investigating patterns and quantitative relationships in physical and social phenomena and between mathematical objects themselves (Department of Basic Education -DBE-, 2012). Furthermore, the importance of the subject lies in developing mental processes that enhance logical and critical thinking, accuracy and problem-solving that will contribute to decision-making (DBE, 2012). One way of interpreting the DBE statement is to ensure that mathematics is approached and practised in an environment that challenges learners' imagination to develop mathematical fluency, procedural skills, and conceptual understanding. This is because the teaching and learning environment is more than just the physical classroom space but constitutes the entire setting for productive mathematics education to take place. However, the existing environments in our schools are characterised by the dominance of the teacher with his/her motives in most mathematics classrooms. Furthermore, while many mathematics classrooms in developed provinces in South Africa are furnished with smartboards and tablets for both teachers and learners, the physical working spaces in most of the Eastern Cape schools still testify to distorted and chaotic conditions that are found demotivating to the teaching and learning of mathematics. In addition, the same schools were mostly challenged by the absence of water, personal protective equipment, and sanitation facilities even when the COVID-19 lockdown was lifted. This called for alternative means to ensure that teachers deal with the curriculum recovery while they deal with the probability of becoming infected by the virus. In this paper, the researcher pays attention to innovative ways that mathematics primary school teachers in rural areas created for future empowerment of their learners with mathematics understanding.

Researchers, Viner, Russell, Croker, Packer, Ward, Stansfield, Mytton, Bonell, & Booy (2020) report that there is no currently available model or

empirically based report that shows a positive correlation between the closure of schools and curbing of the spread of COVID-19. As part of lockdown measures designed to curb the COVID-19 pandemic in South Africa, all schools were closed on the last week of March 2020. The measure was taken to prevent the spread of the coronavirus unearthed a wide range of systemic problems across the education landscape. Amongst those, the inequalities existing in the South African education system are characterised mostly in rural and semi-urban schools by water shortages, inadequate sanitation, and overcrowding became obvious. Clearly, under such prevailing conditions, the health and safety of learners were compromised or at stake. This was evident from the call made by unions when the Department of education announced that learners must return to school after two months of closure. In particular, the unions called for (i) proper school infrastructure in the form of proper toilet facilities and classrooms, (ii) observance of social distancing inside the classroom and in courtyards, (iii) reduction of class sizes, (iv) the provision of soap, sanitisers, and masks, and (v) the screening of learners, teachers and support personnel (McDonald, 2020). With some of those problems blamed on apartheid that the country suffered twenty-six years ago, it is alarming to note that the scale of the problems facing most South African schools presently dictates a no return to the classroom. Ngogi (2020) suggests that alternative teaching methods, such as blended learning, can be a useful means to ensure learners' access to learning activities during the period of national lockdown. According to Dziuban, Graham, Moskal, Norberg, & Sicilia (2018) and Hrastinski (2019), blended learning can be described as the integration of the conventional face-to-face learning method with the digital or online learning method. Under the circumstances prevailing in the rural schools, blended learning was irrelevant since no form of face-to-face teaching could be practiced.

Since it could not be predicted when schools would re-open, private schools and urban situated schools sought other means of re-enforcing a continuous teaching and learning facilitation through social media platforms. Long periods of learning continued to be lost for as long as the closures lasted in schools situated in low socio-economic communities. Whilst this was happening, UNESCO (2020) envisaged that the education of an African child would be the most affected post COVID-19 era due to economic and technological backwardness of most African countries. The purpose of this article is to use prior workshop-based evidence, semi-structured interviews,

and classroom observations to address the research question: How does the disruption of a learning environment using online teaching and learning tools could create innovative, collaborative mathematics teaching environments in situated rural schools? The researcher will refrain from repeating the considerable evidence pointing to the challenges experienced in the teaching and learning of primary school mathematics in resource challenged schools. Such evidence can be found in abundance (Felazzo, 2017; Phanthi & Belbase, 2017; Clark-Wilson, Aldon, Cusi, Goos, Haspekian, Robutti & Thomas, 2014). What is lacking in the available literature are the explanations on how the disruption of a learning environment through the use of online teaching and learning tools could create of innovative, collaborative mathematics teaching environments. In the first part of this article, the researcher provides of how education in South Africa has been affected by COVID-19 and how that translates to primary school mathematics curriculum coverage. Next, the researcher ventures into the how the disruption of face-to-face mathematics primary school teaching and learning environments engaged learners' innovative thinking. And finally, the paper by evaluates instructional strategies that teachers could use to enhance productive learning of primary school mathematics during lockdown and beyond.

The Impact of COVID-19 Pandemic in Mathematics Teaching and Learning

One of the aims of the mathematics teaching and learning framework for South Africa, designed in 2018 was to promote a learning-centred classroom which enabled and supported teachers to engage with learners in ways that foreground mathematical learning for all. Providing evidence on how COVID-19, lockdown(s) and school closure(s) affect children (<19 years), Spaul (2020) examined learning losses and the impacts on young children's cognitive development. Spaul (2020) questions how much teachers can adjust the level at which they teach to the new reality of children who have missed 29-68 out of 204 days of the school year. Moreover, how much of the curriculum can be excluded in any one grade without affecting children's readiness for the subsequent grades and the expectations of further study (Spaul, 2020)? Furthermore, Onwusuru and Ogwo (2019) suggest that curriculum needs an avenue where teachers can continue to dispense teaching

or instructions to learners appropriately, flexibly, effectively and without limitations.

It is a fact that access to computers and the internet in South African homes is very low. Also, Statistics SA (2019) reveals that while it is true that 90%+ of South African households report access to a mobile phone, only 60% report access to the internet via their mobile phone. This reality is also worsened by the fact that here is also the issue of multiple children in the same household needing to share a mobile phone, and the high cost of data, although there are now some free educational sites (Duncan-Williams 2020). While learner support through radio stations and community radio stations are also involved in carrying curriculum content daily including mathematics, it is not possible for learners to benefit from those broadcastings (Motshekg, 2020). In addition, Onwusuru and Ogwo, (2019) assert that social and collaborative learning can be effectively actualized with cloud-based technologies by creating virtual classrooms where interaction between participants is possible irrespective of distance or place. The practicalities of those suggestions are impossible presently in the rural settlements. Dzansi and Amedzo (2014) note the lack of electricity, lack of good classrooms and lack of other basic amenities as archetypal of rural schools and that those can hinder effective integration of technology with conventional teaching methods in rural schools. However, the vacuum in mathematics learning was challenged by some of the mathematics teachers in a rural district of the Eastern Cape province of South Africa. Also, the pandemic should offer the South African government the opportunity to correct the anomaly and inequality in the educational system in South Africa, which the rural South Africans have been victims over the years.

Learners' Innovative Thinking in Disrupted Face-Face Mathematics Teaching and Learning

Researchers Maass, Cobb, & Krainer (2019) assert that teaching innovation is an improvement if evidence is broadly defined to support students' progress towards identified learning goals more effectively than the typical forms of instruction in a country or region. In addition, OECD (2008) suggests that there are multiple ways to expand the potential of every student when technology is seen as an intelligent tool for supporting individual learning and

collaborative learning among different individuals. The flexible use of transformable learning spaces, student-centeredness, problem-based learning facilities, or provision for students with physical, learning or behavioural difficulties are some attributes that favour conceptual understanding in mathematics. Among the tips for parents suggested by the DBE (2020) was the formation of cooperative groups by learners via their digital devices and the creation of online learning groups on what's up. This initiative enabled the instructional use of small groups so that learners work together to maximize their own and each other's learning. In addition, some rules were set to guide those groups. DBE (2020) prescribed that in those WhatsApp groups, learners were to help each other, encourage each other, and give and accept feedback from peers. Moreover, resources like the COVID-19 learner support package relevant to mathematics learning were downloaded and available online to support parents, caregivers and learners during the lockdown. Also, those guides were available in all nine languages spoken in South Africa.

The Mail and Guardian newspaper issue of the 19th of June 2020 reports that educators and learners had to adapt rapidly to a situation where they were not allowed to interact face-to-face, and instead of navigating the school commute, many learners, parents, and teachers have been navigating secure online platforms, class video call schedules, and shared laptops, tablets and smartphones on an almost daily basis during the lockdown. In addition, COVID-19 forced schools to bring about almost overnight changes to teaching methods when classrooms were shuttered to slow the spread of the virus. Technology for distance learning has similarly revolutionized learning during the COVID-19 epidemic; teachers have been forced to become more tech-savvy to make remote and online learning fun for their learners and their parents. Those with the means have been using video-conferencing through apps and websites on laptops, tablets and cell phones to teach locked-down learners in real-time. Moreover, programmes such as Zoom, Microsoft Teams, Skype, and Google Classrooms have quickly become part of the daily school vocabulary. Some teachers could also post short, pre-recorded videos with lessons presented by themselves or experts in various online fields using tools such as YouTube, Vimeo or Microsoft Teams.

During the lockdown season, face-to-face social interactions between the teacher and learners were not possible. Rather, learners were supposed to be self-driven and self-motivated in a digital classroom, and use online tools such as discussion boards, chat, forums, email and WhatsApp to hold discussions.

One of the advantages of using digital teaching and learning tools is that they keep learners engaged. They are flexible and learners can learn wherever they are. However, in countries with huge economic inequalities such as South Africa some learners discuss whether to use Zoom or Teams for their classes, while other children wonder where their next meal will come from. This is because, education experts have warned that online schooling hasn't been possible for 80% of South Africa's schools because teachers and learners don't have adequate access to devices and data. Clearly, if this prevailing stance isn't addressed, this inequality could result in poor children lagging further behind and becoming even poorer.

There is evidence that content-neutral technologies include communication and collaboration tools and Web-based digital media, with technologies that increase learners' access to information, ideas, and interactions that can support and enhance sense making, which is central to the process of understanding mathematics. Although Briars, Larson, Strutchens, & Barnes (2015) are of the opinion that all schools and mathematics programs should provide learners and teachers with access to instructional technology, including classroom hardware, handheld and lab-based devices with mathematical software and applications, and Web-based resources, together with adequate training to ensure its effective use, none of those devices were accessible to the participants in this study. However, the South African government had provided all primary school teachers with laptops to be used as teaching tools way before the COVID-19 breakthrough. Each of those laptops was loaded with data monthly to enable the teachers to access the internet. This concurs with Street (2017) who asserts that technology, if implemented correctly, is worth the cost and effort because it lifts student achievement, enhances engagement and enthusiasm among students, improves teacher-student relationships and promotes 21st-century skills such as technological proficiency and problem solving.

Theoretical Framework

With particular reference to learning rural situated schools in South Africa, there is need for conditions that would emancipate learners, and promote social and learning conditions during and post the COVID-19 pandemic. In addition, there is a need to promote teaching and learning in deprived communities through online learning such that learners in rural contexts enjoy

the privilege of ongoing learning during and post the lockdown. For example, in most urban areas in South Africa, some schools are equipped with free Wi-Fi that the public can be able to access continuously. Connectivity can be enabled in rural areas, also.

Therefore, I used Critical Emancipatory Research (CER) as a theoretical lens to investigate how innovative primary school mathematics teaching environments could be created and enable learning during and after post-COVID-19. The roots of CER are traced to CER as a product of a “Marxist think tank founded by a wealthy son of a German millionaire, Mr Weil, who helped the Frankfurt School to create an innovative brand of philosophically oriented radical social science” (Farrell, 2019 p.109). This includes the regulative standards on which we construct, conduct and extend a field of knowledge. While the importance of the philosophy of social science derives from two things: first, the urgency and complexity of the challenges posed by the poorly understood social processes that surround us in twenty-first-century society, and second, the unsettled status of our understanding of the logic of social science knowledge and explanation, creativity and innovation in modifying our mathematics teaching environments is crucial in the COVID-19 prescribed conditions.

According to Mahlomaholo (2013), one of the objectives of the CER theory is to enable marginalised people, such as rural teachers, learners and education stakeholders, to unleash their human power and potential and transform their otherwise transient situation. Essential information needs to be communicated to mathematics teachers teaching in under-resourced schools on innovative ways that can be accessed for better understanding of the subject. In particular, Simonov, Sacher, Dubé, & Biswas (2020) asserts that CER is a theory that seeks to ensure that everyone is included in life-transforming experiences that could emancipate individuals to confront their lived realities, while also promoting values such as social justice, inclusion and human rights in the fight against COVID-19.

Methodology

This article reports specifically on the data collected during the second year of the community engagement project ‘Bizana Teachers’ Journey with Further Education and Training (FET) Mathematics’. Unlike the name of the

workshop, I worked with a population of 126 intermediate and senior phase teachers from the rural outskirts of Bizana, a small town in the Eastern Cape province of South Africa. This was because the mathematics district subject advisor *believed* equipping the teachers of lower grades with content should set a firm foundation for the learners' performance at FET level. This was a two-phase study that used participatory action research (PAR) design to generate data from the participants. This was a qualitative study premised within the broader space of a transformative paradigm. The PAR was chosen because at its heart it is a collective, self-reflective inquiry that researchers and participants undertake, so they can understand and improve upon the practices in which they participate and the situations in which they find themselves (Sendall, McCosker, Brodie, Hill & Crane, 2018). Also, PAR methodology was found suitable in this study because it is an approach that encourages active participation of affected people to construct their new identities. In addition, semi-structured interviews were conducted with two of the participants telephonically in order to comply with the lockdown rules on social distancing.

Two phases made up this empirical study. In the first phase, preliminary workshops were held face to face with that cohort of intermediate and senior phase teachers to identify challenges they experienced with mathematics teaching and how those could be addressed. In addition, an enquiry lesson on the definitions and development of geometric concepts was demonstrated to the teachers using circular papers cut out using circular household utensils. It was also that first phase that teachers were exposed to various indigenous sources of knowledge relevant to their context that could be used in the teaching and learning of mathematics.

The study was conducted after the Department of Education had supplied each of those teachers with tablets but needed to be trained on how to use them to the advantage of improving their practice in mathematics teaching. Teachers also received monthly data loaded on their laptops to assist them in continuously accessing the internet. In one of the workshops, I trained and familiarised the teachers on how to access relevant free open educational resources online using their laptops. According to the teachers' suggestions, the following workshop, which was scheduled to take place in the last week of March 2020, would practically explore the use of the GeoGebra in mathematics teaching in primary schools. That workshop did not materialise

because of the schools' closure during lockdown because of the outbreak of COVID-19 pandemic.

Since I could not conduct face-to-face workshops, a WhatsApp group consisting of a sample of sixteen teachers was created. Eight of those teachers taught the intermediate phase (grades 4-6), while the other eight were senior phase (grades 7-9) mathematics teachers. This was a purposeful sampling of those primary school teachers who owned smartphones, could connect and were participants in the project. Moreover, a snowball or chain method was used to recruit other participants. Those participants were requested to identify other possible participants who could provide useful data for the study (Onwuegbuzie & Collins, 2007). I was also a silent participant in the WhatsApp groups. The group members' participation guided the research question: How can an innovative mathematics teaching environment created in rural, under-resourced primary schools be created? To measure how the participants created innovative mathematics teaching environments during and after the lockdown, the following table guided analysis of the participant's responses.

Table 1.
Questions and responses

Question	Response
How did you make use of Mathematical concepts and process in everyday life, and solve the problems of Mathematics during and after lockdown?	Relied on internet, checked with my colleagues, discussions on what's up, watching social media, checked current issues on face-book
How did you develop proper self – confidence for solving mathematical problems?	Collaboration with other colleagues on social media, took part in topics discussed on social media, responded to questions shared on WhatsApp groups, watched videos on mathematics lessons shared on what's up, shared my knowledge on some mathematics concepts known to me with colleagues on social media

Table 1. (Continue)
Questions and responses

Question	Response
What did you do to enhance your personal qualities in mathematics teaching while helping your learners to master mathematics learning	Used my cell phone to record video lessons on how I would teach certain topics in primary school mathematics. Watching video's from open educational resources downloaded on You Tube. Learning some methods of approach to different mathematics concepts on social media
Would you mention some innovative ways learnt on enriching your mathematics knowledge during and after lockdown	Informed of future mathematics instructional practice, learnt new methods of approach on how to introduce different mathematics topics,
What were some of the resources that enhanced ways in which you can approach the teaching of mathematics during and after lockdown?	Project video recordings to learners, Facebook, WhatsApp sharing, radio, television programmes, open education resources, internet
How can you share with other primary school mathematics teachers in rural situated areas how to equip themselves on the pedagogy of the subject?	Advise them to download free open education resources, join primary school mathematics teachers' groups, collaborate with colleagues and check social media

The participants were asked for consent to participate in the study and that they could withdraw at any stage to ensure ethical considerations. It was also specified that the data collected would only be used for academic purposes, and to raise the awareness of the Department of Basic Education about the challenges faced by rural teachers during the COVID-19 lockdown, particularly teaching online.

Findings and Discussions

Junior and senior primary school teachers were introduced to WhatsApp groups as one of the learning solutions to ensure the continuity of learning in inaccessible schools in a rural district of the Eastern Cape Province in South Africa. This disruption challenged the teachers to prepare their lessons on power-point slides and record and share them in WhatsApp groups. The sharing of the lessons ensured that lessons were peer-reviewed, critiqued and modified. The Curriculum Assessment Policy Statement (CAPS) prescribes that at the end of the first quarter of a year, learners should be able to list the characteristics of shapes, describe, sort and compare 2-D shapes in terms of number and lengths of sides, sizes of angles (DBE, 2012). In addition, learners are expected to be able to draw and identify patterns in 2-D shapes on grid paper, in circles, using a pair of compasses in the intermediate phase. CAPS further prescribes that learners in space and shape must be able to recognize, visualize and name 3-D objects in the environment and geometric settings, focusing on different kinds of prisms and pyramids, make 3-D models using, and classify those objects with respect to properties, symmetry, transformations, viewing and moving of the objects (DBE, 2012). During interviews, participants answered questions like: (i) How did you foster connections with your mathematics peers during lockdown? What was your source of positive reinforcement in mathematics teaching during lockdown? What were some of the lessons that improved your understanding of mathematics teaching environments during lockdown? How did you enrich your mathematics teaching knowledge during the lockdown? How did social media influence your thinking about mathematics teaching? How did subject advisors assist you in your mathematics teaching?

Three main themes were drawn from the data analysis, namely continuous reliance on social media and peer review feedback on presentations.

Continuous Reliance on Social Media

Social media had never been considered one of the platforms for teaching mathematics before the lockdown. In fact, spending time on social media was interpreted by most participants as a waste of time and usually associated with bad behaviour. This could be associated with the time that young people

usually spend concentrating on social media platforms like Facebook and as such connecting to the whole world. In addition, those people then show signs of open-mindedness and often challenge the state of rurality since they identify better practices and behaviours in media. This is evidenced in the following quotations from participants:

‘Yho, I have never thought I could spend so much time on social media as if I am one of the young people. You know, I have always wondered why all the time, if a child has a phone, they are always on facebook. But guess what, during the lockdown, when I couldn’t interact with anyone, I asked my children to show me how to interact with my colleagues on Facebook.’

‘Ja, social media is the one that helped me. I used to look at people’s statuses only on Facebook, but I did not think I could rely on it for interaction with my colleagues and other mathematics teachers. How I wish I could send those YouTube lessons that we were taught to download from the internet to my learners, yho, but it’s impossible, abanama cell phone (They don’t have cell phones).

‘Even if social media is helpful in some way, I was not aware before lockdown, but now it looks like it is the way to go.’ ‘You know, I have always thought that is where we can put more mathematics in social media, such that whenever the young people get onto it, they find some mathematics. I have no doubt! That will improve their interest in the subject.’

From the above excerpts, it is evident that the participants initially did not view social media platforms as enablers for mathematics lessons. However, with the COVID-19 lockdown, educators were forced to unleash their human potential and transform their otherwise transient situation in order to assist themselves and prepare for the learners’ future in mathematics learning (Mahlomaholo, 2013). Also, it was revealed that the participants note the importance of inclusion in life-transforming experiences that could emancipate individuals to confront their lived realities in the fight against COVID-19, Simonov, Sacher, Dubé, & Biswas (2020).

Importance of WhatsApp Groups

Research findings in this study indicated that the initiation of WhatsApp groups by the subject advisors assisted them a lot with regard to lesson

preparation adjustments during the lockdown. Evidence is found in the following quotes:

‘You know what we have had WhatsApp groups since last year, but they were not used for teaching. We used to be told in WhatsApp where our next meeting or workshop would be held but now things have changed. You know what, also we never used to do lessons on our laptops or on PowerPoint, we used to come together and have discussions on how lessons for the quarter can be prepared. But now, lockdown rules could not allow that, but guess what we are learning. I have also noticed that most of the time I check on videos on the internet, download them and share them with colleagues.’ I have discovered a lot through sharing on WhatsApp that there is much more one can include in one lesson.’ ‘I also realised the efficiency of this tool when one of the mathematics teachers in our group shared a link with us. As I opened it, I couldn’t believe it, I saw all the 3-D shapes examples. So colourful! It would be easy moss to instruct my learners to just draw them as they see them on the pictures.’

‘It was as if the schools were opened. I enjoyed knowing that I can turn to my colleagues and share my discoveries and hence improve my lessons. With my phone, I could take pictures of things like cereal boxes at home, my children’s ball, tables and many other objects in my environment and send them to be included in my lessons. I enjoyed that because it showed me practically that mathematics is in our real-life situations.’

‘For me, I had never prepared any lesson on PowerPoint, yhoo but you know what, *lo Covid uyafundisa!* (this covid is educative). I had to check the internet and prepare one to send to my colleagues. I used to ask myself, how do you prepare and teach mathematics on What’s up? Now I know, and I think this is what we should be doing with our learners. I’ll make sure that I have their parent’s phone numbers of them when we come back so that I can send them lessons through WhatsApp. *Yheyi!* I imagine chatting to my learners almost everyday in a private space where they can ask me questions without being ridiculed by their learners, I am so excited. WhatsApp is the way to go even after COVID-19.

The use of WhatsApp by teachers in lesson preparations exposed them to better ways of enhancing mathematics learning. Most of the participants, were transformed to put more meaning into the use of the WhatsApp tool, not just for chatting but also see it as a teaching tool. Also, it was revealed that teachers

were now transformed to engage more with the internet and expand their learning territory. Also, the results revealed that the technology breached the under-resource state of rural schools by the distribution of 3-D shapes on WhatsApp as beautiful and colourful. This concurs with Street (2017), who asserts that when technology is implemented correctly, it lifts student achievement, enhances engagement and enthusiasm among students, improves teacher-student relationships and promotes 21st-century student proficiency in mathematical skills. Most importantly is the change that one of the participants mentioned, where the WhatsApp groups will change her teaching environment to accommodate learners with specific questions on content. She anticipates that through the use of WhatsApp, those learners will be able to chat with their teachers outside a school classroom environment.

Lesson Presentation Improvements

One of the strengths of social media is the sharing of knowledge and information. Results indicate that there was an improvement in the shared lessons such that during the third round of sharing, even the intermediate phase teachers' lessons were covering projected mathematics content. Evidence is reflected in the following excerpts:

‘For me, I would say, I have learnt a lot from sharing lessons on what’s up. I am even embarrassed to say that in my first lesson, I just wrote, ‘Learners will do activities in their workbooks’. But as I looked at other teachers’ lessons, I could see that they added some videos and pictures of rectangular boxes, for example, which learners were required to draw as an activity. At first, I did not know that I could include some photos of objects in my environment and ask learners to draw them, count a number of faces, give the colour of those sides, and compare them with other objects. Yhoo, I have learnt from our group.’

‘We should have been doing this from long ago. You know, when you are alone in class with your learners, under the sad conditions in which we teach, you stop thinking. Most of the time you just check on what CAPS is prescribing, and just copy it to the chalkboard and you wonder why learners do not understand. You know, you can laugh; the other teacher shared a video on WhatsApp that she downloaded from the internet on how one can introduce the Pythagoras theorem to a grade 8 class. So interesting! I am telling

you from then onwards, I am on my laptop trying to find relevant material to enrich my lessons. I even ran out of data before month end.'

'Finally, we are on the same page now! Thanks to COVID-19 lockdown. In our chats on the WhatsApp groups, you now hear other people asking, 'How did you do that? Where did you get that video? How did you find that on YouTube, can you share the link?' I am convinced that when we go back to the classroom, everyone will reach out to the internet or the group to get the best lesson to our learners. I also think we will now teach our learners interesting lessons relevant to our environment. Working collaboratively is powerful.'

These findings reveal that sharing lessons on WhatsApp improved their presentations. For some of them, it was a learning curve to find relevant open education resources that were freely available on the internet to improve their lesson presentations. Indeed, the lockdown conditions prescribed at the outbreak of the COVID-19 pandemic enhanced the participants' digital technology competence. For the participants, those were life-transforming experiences (Simonov, Sacher, Dubé, & Biswas, 2020) that could emancipate them from an under-resourced rural mentality to a 'use what is available in your environment' to teach mathematics. This concurs with the OECD (2008), which notes that technology is seen as an intelligent tool for supporting individual learning and collaborative learning among different individuals because of the flexible use of transformable technologies. Also, Onwusuru and Ogwo (2019) assert that social and collaborative learning can be effectively actualized when there is interaction between participants is made possible irrespective of distance or place.

Conclusion

This paper aimed to explore how the disruption of a learning environment using online teaching and learning tools affected the learning of primary school mathematics in situated rural schools during the COVID-19 lockdown. Findings indicated that although initially, participants did not regard social media as a tool through which they could teach Mathematics, the lockdown isolation rules they considered that technology could be one of the innovative ways to create interest in mathematics learning. Also, the participants' human

capabilities to transform their transient situation were disrupted through online tools like WhatsApp to prepare for the learners' future in mathematics learning. In addition, during COVID-19, the participants discovered better ways of enhancing mathematics learning. Moreover, the results reveal that the participants engaged more with the internet and expanded their learning territory through open education resources from YouTube videos they shared on WhatsApp. Most importantly, the findings reveal that they noticed that technology was flexible, and through it, the under-resourced status of their schools can be overlooked. Participants supported each other, and their collaborative sharing of ideas on what's up improved their teaching skills.

This study makes a practical contribution to the primary school teachers' practice. It also strengthened the use of laptops supplied by the department for each teacher. It allowed them to learn from other teachers' presentations of relevant mathematics content to their level. As the teachers shared their lessons on what's up, they tapped into their creative zones and tried other innovative ways that they learnt from each other. This study was limited in representing all the teachers teaching primary school mathematics in rural situated and under-resourced areas. Based on the findings in this study, the researcher, therefore, recommend that: (i) All schools, irrespective of the area in which they are situated, should be equipped with a connection to free Wi-Fi, (ii) teachers need training teachers such that they can use the laptops allocated to them effectively for better mathematics teaching, (iii) All learners irrespective of their backgrounds must be supplied with gadgets and data so that teachers can contact them through WhatsApp groups even during lockdowns.

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