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The Perceptions of University Students Using WhatsApp Mobile Social Learning in Blended Mathematics Courses

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ABSTRACT:

The use of mobile learning continues to gain strong acceptance as a social technology facilitation medium in many tertiary institutions around the world. Its use as the platform in blended courses is an innovation in modern educational technology delivery methodology and strategy. This study employed WhatsApp mobile learning to explore the perceptions of 50 learners at a Caribbean university. The learners were from two Bachelor of Education mathematics courses for pre and in-service primary school teachers. These mathematics courses are compulsory and the students were either from their first or second year of their four-year degree or have been teaching for no more than five (5) years. Interviews were conducted in this qualitative research and the data analyzed. The results demonstrated that mobile social learning has a place in the future of higher education and that learners are not only easily connected synchronously but the geographical gap is greatly diminished. The interaction in such a collaborative learning environment was highlighted and the communication tool of WhatsApp exploited to the delight of the users. The learners' gained a better perspective of the objectives of the course from the collaborative sessions. Their communicative skills improved and the continual interaction with their peers and facilitator accounted for them obtaining excellent grades, enjoying the class and learning in a friendly and fun environment. Online distance learning (ODL) was attained despite the challenges of access and cost to some learners. The WhatsApp groups also gave support to colleagues who were unable to attend class(es) and this was done in their own creative style.

Keywords: mobile learning, blended learning, social learning, collaboration, interactive learning

1. INTRODUCTION :

The growing availability, affordability, use and user-friendly capabilities of smartphones have placed them as the unrefuted technology of choice among young people throughout the world (Bouhnik & Deshen, 2014; Franklin, 2011). The WhatsApp feature was contemplated and implemented as a learning resource, in addition to using Modular Object-Oriented Dynamic Learning Environment (MOODLE), at the University of the Southern Caribbean, Trinidad. The courses, Mathematics for Primary Schoollevel 1 and Mathematics for Primary School level 2, represented compulsory mathematics offerings for the Bachelor of Education programme.

It was recorded in 2016 that of the 1.4 million population of Trinidad and Tobago, there were over two (2) million cell phones issued to citizens (The Trinidad Guardian, 2017). The figure demonstrated that Trinidad and Tobago has one of the highest

cellphone use per capita in the Caribbean and one of the highest population of Blackberry users in any part of the world (Ashly & Boon, 2013).The Digital Divide Survey of Trinidad and Tobago (2013) is related to the economic development through technological means, and looks at persons with access to technology, the utilization of such modes of technology, and the ease of access.The analysis of data from the Digital Divide Survey demonstrated that accessibility and affordability of Information and Communication Technology (ICT) skills were not as issue throughout T&T, though below the international average and below North Korea. Thus, the participants of the study did not have any problems with internet connectivity and its affordability.

2. BACKGROUND:

There is an increasing interest in mobile learning approaches in teacher education (Schuck, Aubusson, Kearney & Burden, 2012). Broda, Schmidt and Wereley (2011) investigated meaningful strategies for using iPads both with pre-service teacher education and within elementary school contexts. Hodges et al., (2012) explored possibilities for pre-service teachers to develop their technological, pedagogical and content knowledge, embracing the transfer of relevant skills and techniques for elementary school settings. Also, smart phones have been used to assist in the development of mathematical thinking and enhance problem-solving procedures (Tangney et al, 2010). Teacher educators need to be prepared to exploit the learning possibilities of mobile devices in mathematics education.

Blended learning has recently been adapted at the University of the Southern Caribbean as one of its instructional modalities. The author, using two mathematics courses during the same semester, in the School of Education and Humanities, Department of Teacher Education, was granted permission to explore with blended learning using WhatsApp Messenger. The two mathematics courses used were Elementary Mathematics Concepts and Elementary Mathematics Methods. The goal of the former is to help primary school teachers' strengthen their competencies in delivering mathematics instructions that will allow each child to perform at his/her fullest potential despite encountering difficulties along the way, through diagnosis, prescription and remediation. The goals of the latter include, to develop an understanding of the role and nature of mathematics; to develop psychological basis for the teaching of mathematics at the primary level; to develop competencies in using different approaches to the teaching of mathematics; to develop competencies in the planning, implementation and assessment of mathematics; and to develop competencies in teaching in an inclusive classroom environment.

It follows that there were numerous learning outcomes for both courses and that collaborative and social learning were ideal methods and concepts to ensure that the course goals and objectives were articulated and achieved. WhatsApp Messenger was chosen based on it requiring no training, its simplicity to use and its availability to all learners.

3. IMPACT OF MOBILE PHONE ON EDUCATION

Social media tools have not only significantly transformed the way organizations, communities, and individuals communicate and intermingle with each other, but they have also altered the way people learn, share information, exchange knowledge, and create new ideas. The continual use of these emerging and ubiquitous technologies is growing rapidly among the present generation (and there is no indication that this will change) of learners. The present generation has grown-up with web 2.0 social media tools and it follows that they have an incredible popularity in learners' social lives. Prensky (2006) stated that students today are no longer little versions of us, as they may have been in the past.

They are so different from us that teachers can no longer use 20th century knowledge or their training as a guide to what is best for learners' educational needs. Students, as digital natives, will continue to evolve and so quickly that it will be difficult to keep abreast with them.

Educators, administrators and policymakers must recognize the power of social media to transform learning and should endeavour to see technology not simply as an add-on but the vehicle to modern education in terms of the learning environment. The features of social media complement the constructive philosophy of teaching and learning that allows learners to create, co-create, analyze and share knowledge with their community and globally (Seo, 2013). Despite social media tools having the opportunity to transform the way teachers facilitate learning, many institutions still have issues about adapting to these technologies (Barnes & Tynan, 2007). Thus, understanding learners' attitudes and expectations regarding the utilization of social media tools to support learning is important and useful.

Smart mobile phones (smartphones) can easily promote collaborative and different types of learning approaches through their wireless connection to the internet and social media applications, such as WhatsApp (Cochran & Bateman, 2013; Chen & deNoyelles, 2013). In the classroom mobile phones has the potential to motivate students to be more engaged to the lesson, thereby encouraging and promoting learner-centered facilitation. The impact of smartphone technologies on learning are because of its portability, collaboration and user-friendliness it supports (Barker, Krull, & Mallinson, 2006). The smartphone's portability enables student learning to be ubiquitous in obtaining or retrieving information and being connected to classmates and facilitators anytime and anywhere they can be connected to the internet. It is an expansion of the classroom which remains alive through internet connectivity. Collaboration Social networks such as Facebook, Twitter, Instagram and WhatsApp allow learners to easily form groups to distribute, share information and assist each other with ease in an informal environment. This can result in a more successful collaborative learning experience for all types of learners.

Mobile phones in education can increase students' confidence to learn. However, the facilitator must be trained to prepare appropriate content and have the skills to ask and answer questions, especially in terms of mathematics courses. In the study by Eteokleous & Ktoridou (2009), it was reported that teachers use of the smartphones in learning increased group participation in activities done during learning in class and this benefited and supported student learning in tertiary institutions.

Lu & Churchill (2014) postulated that the teacher plays a fundamental role in guiding students in online sessions. Their study showed that the social interaction aided the learners to construct and share knowledge with the teacher acting as a facilitator and thus demonstrated a student-centered approach in an online environment. The instructor's pertinent and timely infrequent interactive messages in the online communities validated the need for learners to construct their own knowledge in a social learning environment.

Further research in the arena of mobile learning has establish that online learners are using mobile educational technologies and are integrating it in online learning through learning communities and that the usefulness and ease to use of the mobile technology are the principal factors influencing students' participation (Litchfield et al, 2007). The familiarity of using social media in online communities is the major factor that is influencing student's participation in online communities (Cheung et al, 2008).

4. WHATSAPP MESSENGER

WhatsApp Messenger, or WhatsApp for short, is a cross-platform mobile

messaging application which allows users to exchange messages without having to pay for Short Message Service (SMS).WhatsApp Messenger is available for iPhone, BlackBerry, Android, Windows Phone and Nokia and those phones can all message each other. This application has been on the market since 2010 and was designed to replace the then existing SMS environment. WhatsApp has a variety of functions which include, sending and receiving messages to and from individuals or groups, text messaging, attaching images, audio files, video files, and links to web addresses. Theoretically, WhatsApp can be regarded as a social network that allows people to access a great deal of information rapidly. The simple operation scheme makes the program accessible to a variety of people of different ages and backgrounds. WhatsApp enables communication with anyone who possesses a Smartphone, has an active internet connection, and has installed the application.

One the of the application's exceptional features is the option to create a group and to communicate within its boundaries. And this more than anything else creates a platform for collaboration in education. The creator of the WhatsApp group becomes its manager, a position that includes the privilege of adding and removing participants without the need for approval from the group members. Aside from this, all of the participants in the group enjoy equal rights. The application features enables the participants to easily manipulate and use the system in a truly user-friendly environment.

5. MATHEMATICS AND MOBILE LEARNING

Mathematics learning is undergoing major reformation as a result of the impact of technology and the skills and competencies needed in the 21st century (Friedman, 2007; Smith, 2004; Wagner, 2008). The focus of learning in the 21st century has shifted from an emphasis on behavioural changes and towards acquiring certain skills and competencies, for the world of work that awaits them (Beers, 2011; DiSessa, 2000; Partnership for the 21st Century Learning, 2009). Mathematical learning is being redefined to demonstrate connections among topics within mathematics and between mathematics and other disciplines and its deployment to creativity and innovative explorations in many fields (Prichard, 1993; Wagner, 2008). The National Council of Teachers of Mathematics (NCTM) and the Mathematical Association of America (MAA) have published professional standards for mathematics instructors that recommend learning approaches that utilize appropriate computer-based technology resources (Battista, 2001). Curriculum development experts are also making increasing use of online facilities through the use of Web 2.0 tools and online educational resources (OERs). Thus, the ability of using online and other modern technology to create new educational designs to deliver an effective mathematical learning experience is of supreme importance. The use of mobile learning as a possible platform for mathematics learning is therefore a possibility to reconnoitre.

Today, facilitators, learners, administrators and curriculum officers are exposed to increasing quantities and complexities of technological tools which can impact educational experiences, such as mathematics educational experiences (Piotrowski & Vodanovich, 2000). The role of mobile learning in educational applications is expected to increase rapidly. With the abundance of these hand-held tools and the 'smartness' of smartphones, there must be the potential to use them as an educational resource. Mobile learning has been around for some time, but its use in mathematics has not been common.

Mercier & Higgins (2013) examined the implementation of online cooperative and collaborative learning strategies in online communities to support mathematics learning activities and found that learners were stimulated, motivated

and positively focused to participate in online communities to share knowledge related to mathematics courses. It was also seen that the experience assisted some of the learners who were timid and who would normally not say anything in classroom discussions. The cooperative and collaborative online sessions was so informal and impersonal that they did not feel pressure to respond and they did share and were vocal members of their groups.

It must be noted that there are not many research being performed using WhatsApp and even fewer expending and exploring with mathematics. Thus, although WhatsApp has the potential to be used as a collaborative and cooperative tool, more research and experiment is required to demonstrate its potential in mathematics education.

6. REVIEW OF LITERATURE

The infusion of social media in education brings a supplementary element to learning which can enhance the learning process and make the experience more effective and interactive. Institutions of higher learning have initiated social media platforms to diversify the learning process (Muhammad & Musbah, 2013). There are various roles that social media platforms play in the education sector. Social media is a means for interaction, collaboration and sharing of ideas and opinions.

Blended learning pedagogies has been recognized as an avenue to improve student collaboration and promote academic performance. Poon (2013) suggested that blended learning support student success and achievement. Blended learning is a pedagogical method that joins the social, cognitive and teaching opportunities of the face-to-face classroom with the online environment, and does not focus on one delivery mode. Wallace(2014) further suggests that the blended learning delivery method contributes to improving student learning outcome, can improve students' grades, assist in receiving more knowledge and knowledge creation, and have a better understanding of concepts. Blended learning as an instructional tool, is indorsed as a source of collaboration, interaction, and motivation to assist both facilitators and learners to foster a free and relax learning community (Paily, 2013). Koch's (2014) research suggests that online learning can transformed the instructor-centered traditional classroom into a student-centered classroom, which is one of the main learning strategies today.

Huang, Ding, and Zhang, (2007), posit that student engagement is achieved when the curriculum is well-designed, bringing several types of learning activities and tools together as part of the learning process. Hayfa and Othaman (2014), cited student collaboration, student and teacher communication, active approaches to learning, instant student feedback, better time management, and regards for varying learning styles as necessities for competently encouraging student performance. As Tomlinson and Whittaker (2013) proposed, when students take active roles and remain engaged, they are likely to succeed, based on an increase in self-efficacy. The facilitator's presence is a critical facet to consider in the facilitation of blended learning. It is necessary to point out that while blended learning can provide students with unlimited access to a variety of learning resources and activities, discovering the right balance between what is delivered using face-to-face and online is the most critical factor for instructors (Krasnova & Ananjev, 2015).

7. THEORETICAL FRAMEWORK

Constructivist theories stand out clearly as the most suitable to examine the use of WhatsApp as part of the blended arsenal to aid in facilitating the two (2) mathematics college courses in the Bachelor of Education program. This constructivist theory of learning attributes most of its foundational principles to the works of Piaget (1950) and later Vygotsky

(1978). The following discussion depicts the cognitive learning theory and the social learning theory of constructivism and how well known proponents such as Piaget, Vygotsky, Papert, Bruner, and Ausubel, demonstrates its importance in the process of learning. Facilitators and learners will therefore be guided via active, collaborative and cooperative measures and strategies to accomplish the learning of content and concept in mathematics and providing strategies to deal with the struggling mathematics learner in the primary school system. It must be recognized however that it is not just the theories but the creativity the facilitators uses with these theories.

Constructivism is a theory with its foundation on observation and scientific study about how humans learn cognitively. It states that people construct their own understanding and knowledge of the world personally and this through experiencing things and reflecting on these experiences (Huitt, 2003). Constructivism as a process of learning can be explained when an individual encounters something new for the first time (Kaur, 2001). This new item of knowledge first has to be reconciled with previous ideas and experiences, and may change what was believed, or maybe discard the new information as irrelevant. Thus, constructivism involves actively creating our own knowledge by asking questions, and exploring and accessing what we know. It is a truism that everyone has been impacted by technology and its familiarity today presents the opportunity for it to be used as a teaching learning resource.

The world does not exist in the classroom alone so it is important that teachers in constructivist classroom use real world problems and applications (Kaur, 2001). This is essential today as the twenty-first century requires graduates to solve new and dynamic problems (Wagner, 2008). Learning therefore is not simply the positive acquisition of facts from one person to another, as a teacher presenting facts to students or a student simply reading and memorizing facts; as in rote learning. Children create new knowledge by thinking physically and intellectually on their actions.

Vygotsky's theory formed the core for social constructivism, which emphasized the importance of social interaction and culture in the construction of knowledge and learning. According to Vygotsky, knowledge and learning are constructed through human interaction with one another. Knowledge is a human product that is socially and culturally constructed (Gredler, 1997). Learning is not simply the assimilation and accommodation of new knowledge but is acquired by actual relationships between learners.

Vygotsky proposed that a child's propensity for cognitive growth is bounded on the lower end by the child attempting to learn on his/her own and on the upper end whereby the child learns with the help of persons more knowledgeable, such as a peer, tutor or teacher. Based on Vygotsky belief, that learning is a collaborative process and influenced by culture. He distinguishes two levels of development – the level of *actual development* and *potential development*. Actual development is the level of development that a learner has already obtained and can solve problems independently. The level of *potential development* is the level of development that learners are not capable of doing at the moment but has the potential to do so.

The use of WhatsApp took into consideration the need to prepare the learners for facilitation in the primary school system. At the core of the implementation is collaboration and cooperation. With this backdrop and the need to create learning environments that assist students to acquire knowledge using diverse strategies and designs, WhatsApp was used to reinforce both cognitive and social learning in the math courses.

8. PURPOSE OF THE STUDY

The specific research questions were:

1. What are teachers' perceptions of using WhatsApp in the teaching and learning of elementary mathematics concepts?
2. What are teachers' perceptions about using WhatsApp in the teaching and learning of elementary mathematics methods?
3. What were teachers' perceptions of the challenges using WhatsApp in the teaching and learning of elementary mathematics concepts and elementary mathematics methods?

9. METHODOLOGY

A qualitative research designed was used in the study whereby the two classes of pre and in-service teachers were interviewed using the one-on-one and focus group approaches. Specifically, semi-structured interviews, consisting of a list of open-ended questions, determined how teachers perceived their experiences with WhatsApp as part of the blended platform for their mathematics course. The open-ended nature of the questions provided opportunities for the researcher and interviewees to discuss their experiences in greater detail. When the interviewees had difficulties in answering a question or hesitated, the researcher was able to probe further. Three types of probes were used, as stated by Barriball & White (1994), namely, the detailed-oriented probe, the elaboration probe and the clarification probe.

The sample selected was from a total of 50 pre and in-school teachers. There were a total of twenty-seven (27) pre and in-service teachers from the course, Elementary Mathematics Methods, and twenty-three (23) from the course Elementary Mathematics Concepts. There were altogether 2 males and 48 females, which is consistent to the population of males and females primary school teachers in the primary school system in Trinidad and Tobago (UNESCO, 2017).
The study is based on the students using WhatsApp over a 15-week period. In order to determine the perceptions of the pre and in-service teachers based on the research questions above. Interviews were conducted, both one-on-one and collectively (focus group format). There were 2 focus group sessions, one from each course. Specifically, semi-structured interviews were held consisting of a list of open-ended questions. The interviews were conducted at the conclusion of both courses.

The interviews were held in a quiet room and in an atmosphere where little or no disturbance was possible. The length of each interviews were approximately 45 minutes. The focus groups consisted of 16 participants, eight from each course and each lasted approximately 50 minutes. The interviews were done in a sharing environment. Both male teachers were interviewed along with 20 female participants, ten from each of the courses.

Using focus groups have the advantage of interaction among interviewees which can yield the best information (Kruegar. 1994; Stewart & Shamdasani, 1990; Creswell, 2007). Morgan (1988) advised that in focus groups care must be taken to hear everyone and not let one person dominate in the discussions. Code names were given to each interviewee in the transcription of the interviews, in order to maintain and uphold confidentiality.

The interviews were analyzed using open coding approaches (Ryan &Bernard, 2000). Once the data was categorized, the smaller sets were analyzed further to determine if they will be defined based on any particular properties. The frequencies of themes and patterns were noted so that the findings were developed.

10. WHATSAPP GROUPS

The WhatsApp groups with all the members of each class were created by a member of each class during the first week of commencement of the semester. However, when sub-groups were formed to perform certain group-work, more groups were formed. Thus, participants belonged to at least 2 groups for this duration of the course. Assignments were given and discussions included everyone. The amount of messages used was of a

great number at times. When problems could not be solved and issues were raised, there was lots of assistance. At several times photographs of worked problems were given. There were also times when audio chats were sent with explanations. At times the participants had to be caution because of the content and there were rules. However, for the most parts groups functioned appropriately.

There were strict rules drawn-up by the author to regulate conversations while they used WhatsApp. These rules included no unnecessary jesting, no over-use of emotional graphics, nothing of a sexual nature and no casual talk. Everything is to be academic for the most parts. The author explained how unfair and time consuming it will be to deviate from the topics being discussed. These measures were put in place because of the normal use of WhatsApp and not wanting the learning experience to be compromised. Thus, this WhatsApp space became an educational environment.

11. DISCUSSION AND FINDINGS

This section is a presentation of the analysis of data describing teachers' perception of using WhatsApp.

Research question 1

What are teachers' perceptions of using WhatsApp in the teaching and learning of Elementary Mathematics Concepts.

Teachers of the Elementary Mathematics Concepts course revealed that the borderless classroom that WhatsApp forged, accounted for the learning outcomes to be accomplished, appreciated and investigated, always in an interactive and sharing atmosphere.

Teacher EMC2 and Teacher EMC7 expressed their understanding of the factors that affect the struggling mathematics learner – one of the course objectives. EMC2 highlighted

"From my research and the research ideas and comments of my colleagues on WhatsApp, I have a better appreciation of what affects the struggling mathematics students and I have a variety of concepts on how to assist them. I have learnt so much from the sharing". [EMC2, recorded December 18th 2016].

EMC7 said:

"I was able to communicate with my classmates anytime and in a friendly and informal manner. Sometimes we use text and most times it was easier to use voice chat or make a call at a mutual time. I understand the principles and strategies for effective math instruction and I gathered many ways from the WhatsApp to try". [EMC7, recorded December 18th 2016].

Most of the teachers commented that the semester's work was easily accomplished and the objectives attained. There were 16 objectives and because of the WhatsApp interaction with the group activities, the class was kept active every day and night of the week. The following excerpts were obtained from teachers using the one-on-one interview format.

EMC12:

"To be honest, I only saw WhatsApp as a medium for informal talk but using it in this course was great. For example, when we investigated why some students struggle with problem solving, I had my views and researched a few. But by seeing the information of the others whilst sharing was amazing. I have gained so much and I have good ideas how to use problem solving in lessons. I also understand its importance as one of the main ingredient in math education". [EMC12, recorded December 19th 2016].

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understand its importance as one of the main ingredient in math education". [EMC12, recorded December 19th 2016].

EMC1:

"When I saw the 16 objectives of this course, I was overwhelmed. And the areas of concern were my personal areas of concern in mathematics. For example, how to teach decimals. I had problems with decimals myself in primary school. Two teachers shared their experiences with me on WhatsApp and I am feeling much better to teach decimals or any other topics in math. The conversations motivated me as I was given their experiences, and this helped me". [EMC1, recorded December 18th 2016].

EMC5:

"One of the objectives was to implement the guidelines to diagnose prescription and remediation of common fractions. As someone now getting into teaching as a profession, I did not know how to diagnose someone with a problem in any math topic. The experiences shared by those practicing teachers meant a great deal to me. What was explored in class was good but the sharing that took place on WhatsApp was even better. The informal space was ideal for me to learn. The sharing too was very encouraging". [EMC5, recorded December 19th 2016].

Most teachers highlighted that the active borderless classroom that WhatsApp engendered was ideal for this course. The collaborative atmosphere and interaction it fostered were enjoyed by most of the teachers. In describing what was enjoyable and different about the semester's work, this is what some of the interviewees stated:

EMC9:

*"*One of the topics that I personally enjoyed from the course was searching for strategies for improving problem solving. From the WhatsApp group I realized that problem solving is a major part of math and lacking in most classrooms. We were given instances of what can be done to improve problem solving. For example, a WhatsApp chat stated that every lesson in math can be a problem solving venture. The explanation which followed was deep (very interesting and worthy of much thought). I intend to use this approach as much as possible. One person even said that life is based on solving problems and that we can prepare students to see this and start solving all types of problems". [EMC9, recorded December 18th 2016].

EMC23

*"*I am a fan of learning and only saw the power of social media in the form of WhatsApp as a teaching medium during this course. I took some online courses before and there were issues using their platform (learning management system). Not only is WhatsApp easy to use but I did not need any class to learn how it works and how to use it. An enjoyable topic to me was looking into using place value as a concept lesson. Not only were there lots of information but the variety and examples to choose from were exciting. The sharing on WhatsApp was also something that was permanent in that we could return to it. It was not like words spoken and lost in an instant (like when the teacher speaks)". [EMC23, recorded December 19th 2016].

EMC14:

*"*What I enjoyed most was being able to work on what I term challenging topics, which were made easier by having the WhatsApp tool and media. At first I was not sure of WhatsApp for teaching and learning. But how wrong I was. Having help anywhere and anytime was a plus for me and this made learning for me exciting and really enjoyable". [EM14, recorded December 18th 2016].

For the focus group sessions for this course, Elementary Mathematics Concepts, the teachers' reactions to the questions were similar to those received by the individuals who were interviewed. The following are excerpts from individuals of this focus group:

EMC21:

"I particularly like the feature of WhatsApp to leave and receive voice chat. Not only did it give me the opportunity to speak and hear myself, but it allowed me to replay over and over important points made by my colleagues. This was welcomed in the objectives which were complex and difficult for me. For example, to implement guidelines for diagnosing, prescription and remediating of addition of whole numbers, this assisted me. I asked my colleagues to send the voice chat with their suggestions". [EMC21, recorded December 19th 2016].

EMC4:

"To begin with, the results were more pleasing than I expected using WhatsApp. I can see the importance of social learning in an informal setting. I am thinking about using WhatsApp in my practice. To me collaboration is key to learning. In the end, I received for the first time, quite easily, all that I can gain from a course. The interaction helped us all, and I am safely speaking for all present here". [EMC4, recorded December 19th 2016].

EMC19:

*"*Not only was the course content fully dealt with on WhatsApp, but it was enjoyable and for a very long time learning was fun, despite certain minor challenges. My experience was a bit different from what I am hearing. Let me say this emphatically I saw Vygotsky's social learning theory in practice in this course. I can also see why this generation spends so much time on social media and how easily they learn from each other. We certainly learnt from each other and it was exciting". [EMC19, recorded December 19th 2016].

Research Question 2

What are teacher's perceptions of using WhatsApp in the teaching and learning of elementary mathematics methods?

Teachers of the Elementary Mathematics Methods course revealed that they had similar experiences to those of the Elementary Mathematics Concepts course. Their use of WhatsApp as their collaborative platform during the semester was seen as important for their deliberations. Most teachers discovered that their understanding of the role and nature of mathematics were not sound but based on calculations and one's need to be successful to get a job. Also, their development of a psychological basis for the teaching of mathematics at the primary level, was easily discussed on WhatsApp in an informal but constructive manner. The following are some excerpts from teachers as they answered questions based on how using WhatsApp accounted for their learning the course content and ensuring that the goals were achieved.

EMM11:

*"*The class discussions were good. The WhatsApp discussions assisted me to understand firstly that my understanding of the role of mathematics was faulty. I realized that after chatting and sharing that I was not alone and that in the end our students will benefit from our understanding of what the role and nature of mathematics really is. The discussions were always motivational and educational on WhatsApp". [EMM11, recorded May 16th 2017].

EMM15:

*"*I was able to develop competencies in preparing to teach in an inclusive classroom environment. My subgroup did the research about inclusive education, discussed it on WhatsApp and this helped us to make a good presentation. The discussion on WhatsApp aided the group in learning about inclusive education and begin to prepare us to teach math in such an environment". [EMM15, recorded May 16th 2017].

EMM2:

"I enjoyed the topic of developing a psychological basis for the teaching of mathematics at the primary level. It was awesome and WhatsApp played a major role. I never thought I can get so excited about math but I did. My group was always online sharing on WhatsApp. I think the informal nature of the sharing helped us learn what we had to in the time we had. I will think about using WhatsApp in my practice". [EMM2, recorded May 16th 2017].

EMM13:

*"*I must say how valuable a session was to develop competencies in using different approaches in the teaching of primary mathematics. The classroom sessions were great but our WhatsApp sessions were very interactive and fun. I was motivated to research more to share as I receive so much from my fellow group mates. I think WhatsApp is a good medium for informal learning". [EMM13, recorded May 16th 2017].

EMM18:

*"*Of tall the topics we looked into for this course, I think developing competencies in the planning implementation and assessment of mathematics units and lessons were important to me as a practicing teacher. I received some great ideas from our discussions on WhatsApp from the pre-service teachers. The sharing on WhatsApp was a major part of our course. Not only did we learn from each other but we became better acquainted and formed a community of learners". [EMM18, recorded May 16th 2017].

The focus group session for this course, Elementary Mathematics Methods, demonstrated in their answers similar views as expressed above. However most of this group showed excitement, contentment and utter surprise that WhatsApp was such a positive medium for facilitating and learning mathematics. Most of them suggested ways that they think WhatsApp can be used in primary school with rules for the students to strictly observe. The following are excerpts from some of the interviewees:

EMM10:

*"*I missed a couple classes because of certain family emergencies. The discussions on WhatsApp were very detailed as to what took place in class and what some of the main points were. I was not only able to get what I missed but to be a part of the discussions". [EMM10, recorded May 17th 2017].

EMM17:

*"*Because of the impact that WhatsApp had on me during this semester, I am going to ensure that collaboration is a part of my practice as a teacher. I realize that everyone was a part of the discussions and I enjoyed hearing all the views. The interaction was also different as the class had no boundaries". [EMM17, recorded May 17th 2017].

EMM14:

"What I enjoyed most about using WhatsApp was that the environment was fully academic, in that there was no room for distractions and unnecessary jesting. The rules presented to guide us were good". [EMM14, recorded May 17th 2017].

Research Question 3:

What are teachers' perceptions of the challenges faced using WhatsApp in learning elementary mathematics concepts and elementary mathematics methods?

There were not many challenges faced by teachers in both courses. Due to the importance of what was shared and the amount of what was commented on, if teachers were not on the group chat for several hours, some complained of the amount of entries to be read and voice chat to listen too. This they commented was a bit burdensome at times. The author intervened and suggested that a limited amounted of responses be given and some other communication be sent to group

members. There were also some teachers who only had Wi-Fi connectivity when at home or at school, while others had it continuously. This resulted in asynchronous interaction at times when it would have been ideal for synchronous discussions. For a couple of teachers, connectivity was a problem in the beginning at various times. Both overcame this during the course by obtaining a better internet package.

There was one main group with all teachers on WhatsApp and there were subgroups based on the various topics. In some of the subgroups formed for different topics, a few members attempted to dominate the discussion with too much postings. The author intervened after these teachers complained of these occurrences.

12. CONCLUSION

Learning in the 21st century is no longer conceptualized as austerely following the behavior is model of the early 20th century, neither is it based primarily on the learning theories from the findings of cognitive research of the latter half of the 20th century. Vygotskyian social theory of learning should not also be the dominant approach. New instructional designs and strategies are needed today to harness the combination of these theories creatively and innovatively to deal with the 21st century learner in online and face-to-face environments. This substantiates what Adegbenro, Gumbo and Olakanmi (2017) suggests in there study, that in the educational field there is a strong demand for creativity, innovation, advancement and enriched performance of learners in their domain. The use of WhatsApp as a learning platform for mathematics education means that access to the internet can transformed any class to one where using a blended approach is possible. This transformation is what Tomlinson and Whittaker (2013) posit in their student as they recognized that students take a more active roles and remain engaged for longer periods, insomuch that they are likely to succeed, based on an increase in self-efficacy. Not only does it not require any training to learn the platform but its user-friendliness and familiarity are great positives.

It is imperative to generate useful paradigms and pedagogy for mathematics education and educational research needs to focus on understanding both the intellectual skills involved in the learning process and how these skills then interact to produce acceptable performance on facilitating mathematical concepts at all levels of mathematics teaching. Also, it is important that these studies focus not only on the processes that facilitate immediate learning, but also on processes that generate retention of knowledge and skills, as well as the transferability of the knowledge and skills to a broader range of tasks. The interactions collaboration, sharing and the flexibility of this studying using Whatsapp, purports the findings of many researchers (Beers, 2011; Hayfa &Othaman 2014; Khechine &Lakhal, 2018;Koch, 2014;Muhammad & Musbah, 2013). Thus, the use of creative methods to facilitating learning must be explored and experimentation sort. This was the genesis of the use of WhatsApp for this study.

Most of the participants commented that WhatsApp was a refreshing and positive inclusion to the blended platform of the courses. The fact that someone was always there to give support was seen as a significant gain. Some commented that even if the person could not assist immediately, that it was good to have someone to strive to get a solution outside of classes. The familiarity of the use of WhatsApp by all participants meant that there was no need for any formal training to use this resource and this was mentioned as an advantage. The pre and in-service teachers perceived that WhatsApp was a really great addition to the course because they themselves had several problems with mathematics and that it provided an avenue for maximum help from their peers and facilitator. These views of using Whatsapp by the participants of the study are similar by

those in the studies performed by Kashou (2016); Kraushaar and Novak (2010) and Smith (2015).

When asked, what were the most positive aspects of their WhatsApp experiences with mathematics facilitation, there were varying responses. Some stated that it was the synchronous responses most of the time they received while others said that the classroom was extended to anytime. Some admitted that the use of voice chat as explanations and screenshots were tools which were extensively used while collaborating. The most challenging aspect of using WhatsApp most cited was when they came on and a discussion was in session and there were over 100 messages. Similar experiences were made by participants in the study by Ngaleka and Uys (2013).

Generally, the students said that they welcomed and enjoyed the WhatsApp experience and that it made their mathematic learning different, unique, engaging and fun. Most of the participants saw the relevance of using WhatsApp and declared that it is something that they are willing to experiment with in their practice.

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