# Mathematics and science teacher educators' experiences of using the WhatsApp platform as a tool for supporting teaching during the Covid-19 pandemic

## Eunice Nyamupangedengu

Marang Centre for Mathematics and Science Education, Wits School of Education,
Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
Eunice.nyamupangedengu@wits.ac.za
https://orcid.org/0000-0003-2338-8012

## Monde Kazeni

Marang Centre for Mathematics and Science Education, Wits School of Education,
Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
monde.kazeni@wits.ac.za
https://orcid.org/0000-0003-2314-0869

## Caleb Mandikonza

Marang Centre for Mathematics and Science Education, Wits School of Education,
Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
caleb.mandikonza@wits.ac.za
https://orcid.org/0000-0002-5530-0655

## Magdeline Stephen

Marang Centre for Mathematics and Science Education, Wits School of Education,
Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
magdeline.stephen@wits.ac.za
https://orcid.org/0000-0002-3239-2526

## Portia Mabenge (Kavai)

Marang Centre for Mathematics and Science Education, Wits School of Education,
Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
University of the Witwatersrand, Johannesburg, South Africa
portia.mabenge@wits.ac.za
https://orcid.org/0000-0002-8937-4863

# Herman Tshesane

Marang Centre for Mathematics and Science Education, Wits School of Education, Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
Herman.Tshesane@wits.ac.za
https://orcid.org/0000-0002-4492-7241

# Eyitayo Ajayi

Marang Centre for Mathematics and Science Education, Wits School of Education, Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
eyitayo.ajayi@wits.ac.za
https://orcid.org/0000-0003-1697-5016

# Lawan Abdulhamid

Marang Centre for Mathematics and Science Education, Wits School of Education, Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
Lawan.Abdulhamid@wits.ac.za
https://orcid.org/0000-0002-7822-9177

# Judah Makonye

Marang Centre for Mathematics and Science Education, Wits School of Education, Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
Judah.Makonye@wits.ac.za
https://orcid.org/0000-0001-7437-8856

# Mabel Moloi

Marang Centre for Mathematics and Science Education, Wits School of Education, Faculty of Humanities University of the Witwatersrand, Johannesburg, South Africa
mabel.moloi@wits.ac.za
https://orcid.org/0000-0002-8011-5267

# Abstract

This article problematises the media used for delivery of curriculum at the onset of lockdowns due to the outbreak of the Covid-19 pandemic, which resulted in a sudden cessation of all face-to-face teaching and learning at a South African university. The article reports on how the otherwise neutral WhatsApp social media platform was appropriated to become a serious teaching tool for mathematics and science pre-service teacher educators. The study draws predominantly on connectivism learning theory to understand how WhatsApp was used to continue the teaching of mathematics and science during the Covid-19 lockdowns. The sample consisted of 10 mathematics and science teacher educators from whom data were collected through authentic conversations and questionnaires. The article reports on the affordances and constraints the WhatsApp platform presented, as well as how it reshaped the teaching of mathematics and science. Findings indicate that teacher

educators transformed the use of WhatsApp from a social media tool to a tool for supporting teaching. However, being a social tool, WhatsApp does have affordances and constraints when used for teaching. The affordances include ease of access and ease of use, while constraints include the risk of students not possessing smartphones and intrusion into the personal lives of teacher educators.

Keywords: teacher education, WhatsApp, teaching, teacher educators' experiences, authentic conversations, affordances, constraints

# Introduction

There is an increased proliferation of research on the use of information and technology in teaching and learning. In this article, we report on our experiences as mathematics and science teacher educators at a South African university when using the WhatsApp platform as a tool for supporting teaching during the Covid-19 pandemic. The study was prompted by our informal, yet authentic conversations regarding our experiences of emergency remote and online teaching following the outbreak of the Covid-19 pandemic and the resultant lockdowns. When the Covid-19 national lockdown was announced, universities were forced to immediately adopt online emergency remote teaching (ERT), using a learning management system (LMS). ERT is considered a sudden interim shift of instructional delivery from traditional face-to-face teaching to a fully online delivery mode due to a sudden catastrophic situation (Hodges et al., 2020), which in this case, was the Covid-19 pandemic. Given the emergency nature of the shift to online teaching, there was pressure on educators to be resourceful and to ensure that teaching and learning went on without any major hiccups. However, there were several challenges that both academics and students faced during the ERT and learning, which are now well documented in literature. These included lack of laptops or access to computers, lack of access to Wi-Fi or funds to purchase data, and problematic access to the internet such as poor signal (Hodges et al., 2020), which acknowledged the diverse socioeconomic contexts of our students. Many of our students were in panic mode because of their failure to attend synchronous online sessions as a result of these challenges. As mathematics and science course presenters, we found ourselves in unchartered territory as we became our students' first port of call regarding problems with communication and teaching. We frequently received emails from students to inform us of the challenges that prevented them from accessing the LMS.

The LMS recommended for teaching during the ERT was, at the time, not configured to accommodate large numbers of participants at the same time. Consequently, use of the system by the entire university led to several technical glitches in the system. These included, but were not confined to, failure to access the system, freezing of the system, the missing of some content such as diagrams, and inaccurate grading of assessments. These glitches militated against a seamless shift to online teaching using the LMS. Furthermore, academics were unsure of how else they could use the LMS for teaching other than posting course material and communicating with students. That is the lowest level of the substitution, augmentation, modification, and redefinition model (Puentedura, 2012), where information

and communication technologies are used as a direct substitute for traditional communication practices. Despite these challenges, there were some advantages for ERT in that it saved time and space besides reaching students remotely.

Due to the separation and isolation experienced during ERT, constant communication with our students became vital to ensure that we kept them informed about course developments while supporting them to cope emotionally with the effects of the pandemic—especially to show them that they were not alone, despite learning in isolation. For these and many other reasons revealed in our shared experiences, a good, fast, reliable method of communication between us as course presenters and our students became urgent. We found ourselves resorting to the use of WhatsApp, not only for communication but also as a tool for supporting teaching. Being a social media platform, the use of WhatsApp has advantages and disadvantages. Through our authentic conversations, we have discerned the affordances and constraints of using the WhatsApp social media platform as a teaching tool in our teacher education context. Although there are several formal digital tools used to teach and communicate with students, we came to realise that little is known about the affordances and constraints of using WhatsApp for supporting the teaching of mathematics and science. Therefore, the purpose of this study was to establish those affordances and constraints of using WhatsApp as a tool for teaching mathematics and science given that we have come to appreciate its usefulness during and beyond the lockdowns. As part of our authentic conversations, each author presented a narrative of their experiences of using WhatsApp for teaching, which included the course or subject in which the platform was used. Our narratives were guided by the following questions:

- How did the teacher educators use WhatsApp for teaching during the Covid-19 pandemic?
- What opportunities for teaching did WhatsApp present for use during and beyond the Covid-19 pandemic?
- What are the constraints of using WhatsApp for teaching?

## Literature review and framework

Since the advent of smartphones in the late 1990s, many messaging apps have been launched. Of these, one of the most popular in Southern Africa is WhatsApp. According to Harma and Shukla (2016), WhatsApp was designed by Brain Acton and Jan Koum in 2009 in order to make messaging communication and circulation clearer and faster for general social communication. WhatsApp is a smartphone- and web-based instant message application that allows users to exchange information using a variety of media including text, image, video, and audio messages (Church & de Oliveira, 2013). Some authors have highlighted the importance and wide use of using WhatsApp in terms of its ease of communication and sharing of information. For instance, Amry (2014) indicated that WhatsApp is the most popular of messaging services. WhatsApp allows for the sharing of links to web addresses (Bouhnik & Deshen, 2014). Thus, it became an instrument for easy assimilation of information in education because it provides faster responses compared to other digital modes

of communication (Maphosa et al., 2020). In the WhatsApp application, there are features that can be used to help the online teaching and learning process. These features include the exchange of text (such as Word, PDF, and PowerPoint), images, video, voice, and video calls (Noer et al., 2021). Even though these features are present and accessible, there is dearth in literature of how WhatsApp has been used, and its usefulness specifically, in the teaching of mathematics, physical sciences, and life sciences, as well as the constraints of using it. Therefore, this study sought to determine the affordances and constraints of using WhatsApp for teaching those subjects.

## Affordances of using WhatsApp for teaching

According to Nguyen and Fussell (2016), WhatsApp can be a useful tool for teaching and learning because it is accessible anytime, anywhere, and allows for the facilitation of collaborative learning. Other advantages of the use of WhatsApp in education are that it allows for instant messaging and can be run on many mobile platforms (Priyono, 2016). Smit and Goede (2012) contended that as one of the instant messaging platforms that are used in education, WhatsApp has the potential to enhance learning. This is because teacher educators can easily and quickly facilitate learning by posting tasks on WhatsApp that make learning thoughtful (Bansal & Joshi, 2014). WhatsApp is also appropriate for communication, especially if teacher educators and students cannot meet face-to-face. It enables students to connect to a virtual world and communicate with other students and teachers via mobile devices instantaneously or as delayed communication (Moran et al., 2013). WhatsApp is therefore, a very accessible platform for both teachers and learners (Ramzan et al., 2019). Hence, WhatsApp has been used for distance education processes (Aktas & Can, 2019). Another advantageous feature of WhatsApp for teaching is that it allows for the creation of groups. Hence, online classes can be set up and only students registered for a course can freely interact with their teachers and among themselves. WhatsApp groups therefore enable a quick exchange of educational information including music, photos, and videos, as well as ensuring instant communication where there may be need for further clarification of information communicated through other learning platforms (Souza, 2015). Barhoumi and Rossi (2013) observed that the use of WhatsApp increased communication and collaboration skills among students, especially when they work in groups. This points to the potential of using WhatsApp to facilitate group and sociocultural learning processes.

Yilmazsoy et al. (2020) added that using WhatsApp social networks in educational processes has provided great convenience, which increased the appeal for the platform. Zan (2019) alluded to the benefits of using WhatsApp for educational purposes such as its general appeal to people of all ages. Smit and Goede (2012) stated that instant messaging applications used via WhatsApp have the potential to increase learning because they are faster, more reliable, and more efficient than messages sent via alternative communication channels such as email (UNESCO, 2014). And, messages can be confirmed as sent, received, or read, as an important indicator for communication, responses, and reactions to teaching activities (Kaieski et al., 2015).

Lohitashwa et al. (2015) categorised the use of WhatsApp as an open style discussion that enables teachers to get to know their students in-depth and to create a positive atmosphere as well as a sense of belonging. This means that by interacting with one's students, educators can create a favourable climate for social interactions that goes beyond classroom activities and builds an ambience that supports classroom interactions. Lohitashwa et al. (2015) added that using WhatsApp enables students to collaborate, improve quality of expression, and learn anytime and from anywhere because they can carry their smartphones wherever they go, and communicate as long as they have data and access to the appropriate cell phone signal. During collaboration activities, students can carry out discussions and share information using the available features (Noer et al., 2021). Plana et al. (2013) declared that the application of WhatsApp in education processes increases students' motivation because they can learn "on the go" and not necessarily in a formal classroom.

## Constraints of using WhatsApp for teaching

Although there are advantages to the use of WhatsApp in education processes, there are also some disadvantages that have to be minimised. Not all students have access to the WhatsApp platform because not all students have smartphones (Baguma et al., 2019). Even though students may have smartphones, not all smartphones are of the same or similar technological level, which differentiates the functionality of the devices. During the use of WhatsApp, there is a danger of flooding messages (where a lot of messages come in at the same time) giving the receiver little chance to respond meaningfully to each of them (Gon & Rawekar, 2017).

One of the greatest perils of WhatsApp is academic misconduct—when students collude on assessments. In this scenario, some students make little or no effort to do their assessments and ask their peers who have done the tasks for work to submit. Some students may share materials just to impress the facilitator, without using the tasks and activities for learning (Gon & Rawekar, 2017). Where fieldwork or practical work is involved, the WhatsApp application does not provide opportunities for direct feedback on practicum or field lectures because the educator is not in direct contact with the process of the activities (Noer et al., 2021). The educator needs to use features of the WhatsApp platform to track students' progress—such as pictures, videos, and voice recordings that enable the educator to know how the learner is conducting the practical.

Yilmazsoy et al. (2020) indicated that students send messages outside of class hours and can use inappropriate language because they are not in direct contact with the users at the other end. Also, there are internet-based technical problems that can interrupt the teaching and learning processes. Furthermore, students' use of WhatsApp for activities that could take less time with traditional tools has been reported. There are possible time lags in communication that need to be factored into the use of WhatsApp. For instance, Kaliyadan et al. (2016) noted that active discussions were interrupted or slowed because of delays in communication. Lohitashwa et al. (2015) indicated that the demand for constant availability is a challenge, and implies that users need to always be available so that they can receive and respond to messages as they come in. This is not always possible because participants, at times, have other commitments and can only attend to WhatsApp messages when they get chance.

Being an internet-based application, WhatsApp requires data. Hence, the cost of using WhatsApp is another challenge associated with its use for education purposes. Oriji and Anikpo (2019) noted that WhatsApp requires a lot of data to operate, especially when downloading images, videos, and audio messages—although it is still much cheaper than other platforms. This calls for educators to be cognisant of the data costs of the various forms of materials that they exchange with their students, and how they use WhatsApp during interactions. For example, voice calls consume less data than video calls, and voice notes use even less data than voice calls. Lohitashwa et al. (2015) advised that WhatsApp use during educational processes requires high levels of responsibility to monitor students and the learning situation otherwise the messages may not convey the intended tone and meanings.

It is important to note that even though some authors have written on the affordances and constraints as noted above, those are not specific to mathematics, physical science, and life sciences. Hence, it was deemed important to find out from the lecturers of such courses, the affordances and constraints of using WhatsApp.

## Theoretical framework

The connectivism theory by Siemens (2005) was used as a framework to understand how WhatsApp was used during the Covid-19 pandemic lockdown to continue teaching. Connectivism as a learning theory has its origins in distributed learning relevant to digital society (Siemens, 2005). Downes (2012) explained it as the thesis that knowledge is distributed across a network of connections into nodes and, therefore, learning consists of the ability to construct and traverse those nodes connected into networks. A node could be any entity such as a person, a group of people, a computer, or ideas, and communities. Siemens explained that connectivism paves the way for a new model of learning, adequate to the knowledge society, in which learning is "focused on connecting specialised information sets, and the connections that enable us to learn more are more important than our current state of knowing" (2005, p. 5). He posited that an ability to recognise when new information alters the landscape, based on decisions made yesterday is critical. During the Covid-19 pandemic lockdown, teaching and learning could not continue in the traditional way of contact classes as had been the practice in many institutions. This left technology as the only mode of contact and communication and, therefore, of teaching and learning. The shift to using WhatsApp as one of the channels of communication between teacher educators and students concurs with Siemens' statement that knowledge is created beyond the level of individual human participants and is constantly shifting and changing via the nodes.

According to Siemens (2005), learning and knowledge rests in diversity of opinion. This highlights sociocultural theories that learning is a social process where individuals and groups expand their zones of proximal development through interaction (see Vygotsky, 1978). Their interactions are facilitated by their active engagement on the learning platform—in this case, the WhatsApp platform. Siemens used the term node and argued that learning is a process of connecting specialised nodes or information sources. Individuals and groups are recognised as nodes that have roles to play in the learning process. Learning cannot just happen without

the involvement and contributions of the nodes. In addition, learning can reside in non-human appliances. This principle recognises that non-human artefacts can be repositories of knowledge, have mediation roles in learning, or can be used to communicate knowledge during mediation interactions. Therefore, non-human artefacts are integral to the process of learning. Furthermore, nurturing and maintaining connections is needed to facilitate continual learning. It is therefore important to ensure that the connections are healthy and that communications are amicable and give all the individuals the intended benefits.

Herlo (2017) indicated that in connectivism, learning is actionable knowledge. Conducting classes via WhatsApp allows for interaction between the teacher and students, and amongst students themselves, as well as quick sharing of resources. Downes (2012) took to characterising connectivism from three perspectives: knowledge, learning, and community. The connection of people through WhatsApp creates relationships between people—and creates a culture based on continuous learning from the individual to the social level, and from the social level to the individual level. This learning approach is akin to sociocultural theory (Vygotsky, 1978). According to Vygotsky (1978), learning is psychologically mediated through tools, signs, and symbols, and that mediation occurs on two planes—the social plane, and the individual plane. Learning through WhatsApp provides concepts whose development is corroborated by the learners from their different contextual learning spaces. Semiotic mediation via WhatsApp helps learners to understand concepts better because they receive different contributions and examples. The understanding of concepts that start off abstract is consolidated by more real and easily understood examples, and through argumentation processes on WhatsApp. This learning process and development can also be informed by Engeström and Sannino's (2020) activity theory, which involves subject, tool, community, division of labour, and rules.

## Methodology

Our study adopted a qualitative research design involving a case study methodology (Budiyanto et al., 2019) to document the experiences of teacher educators with using WhatsApp as a teaching tool. Located within the constructivist paradigm, qualitative researchers aim to understand the subjective world of human experience and take a reflexive and interpretive stance (Savin-Baden & van Niekerk, 2007). The study therefore explored teacher educators' experiences and ensuing views of the usefulness of WhatsApp for teaching in their respective classrooms. Qualitative research holds that knowledge does not exist independently of the human mind but rather, is created by humans.

The participants of the study are 10 self-enrolled academics who hold doctorates and were working at a South African university. To enhance the quality of ERT, the participants had experimented with various teaching tools and techniques such as emails, recorded PowerPoint slides, YouTube videos, and WhatsApp. This paper thus reports on their experiences regarding the use of WhatsApp as a pedagogical tool. The participants played multiple roles in the study including being co-inquirers, collaborators, and involvement in

self-reflections (Savin-Baden & van Niekerk, 2007). Table 1 shows the profiles of the participants, represented by pseudonyms.

**Table 1**
Profiles of the participants

| Name | Academic position | Gender | Area of specialisation | Lecturing experience (years) |
|------|-------------------|--------|------------------------|------------------------------|
| Lerato | Associate professor | Female | Life sciences | 15 |
| Dumisane | Senior lecturer | Male | Mathematics | 17 |
| Jabulane | Lecturer | Male | Life sciences | 16 |
| Nolwazi | Lecturer | Female | Life sciences | 22 |
| Thembi | Lecturer | Female | Life sciences | 7 |
| Tshepo | Lecturer | Male | Mathematics | 7 |
| Nqobile | Lecturer | Female | Physical sciences | 6 |
| Mark | Lecturer | Male | Life sciences | 4 |
| Buhle | Lecturer | Female | Physical sciences | 1 |
| Peter | Sessional lecturer | Male | Life sciences | 5 |

## Data collection

Data were collected from participants' self-reported experiences on how they used WhatsApp as an educational tool, during the ERT. We used a layered technique where we first collected data from open authentic conversations, which we analysed into themes. We used the themes from these conversations to create a questionnaire to triangulate the data. The following themes guided the participants' documentation of their individual experiences: (1) how they used the platform, (2) their experiences of using the platform, and (3) the constraints, benefits, and effects of using the platform. In addition, the participants also provided data about the subjects taught using WhatsApp, the levels of education, and the number of students involved.

## Credibility and trustworthiness of the research

To increase the credibility and trustworthiness of the research, member checking and peer debriefing (Stahl & King, 2020) were done. In research, credibility asks: "How congruent are the findings with reality?" and trustworthiness means that "When readers interpret the written work, they will have a sense of confidence and belief in what the researcher has reported" (Stahl & King, 2020, p. 26). To ensure credibility and trustworthiness, member checking, peer examination of the data, triangulation, and an explanation of the investigators' positions in the study were done (Bans-Akutey & Tiimub, 2021; Merriam, 1998). For member checking, collated responses were sent to participants to confirm or correct the accuracy of

their submissions. This was also important because it indirectly solicited further ideas that participants may have wanted to add or modify. In addition, a meeting was held to discuss the responses to the questionnaires in order to increase data saturation. Peer debriefing was done using faculty members, not directly involved or interested in the research, to seek their opinions about whether the research was sensible. In addition, all ethical protocols for research were observed.

# Data analysis and findings

Each of the participants' documented experiences was subjected to thematic analysis (Braun & Clarke, 2006). This involved a six-phase framework comprising (1) familiarisation with the data, (2) generation of initial codes, (3) search for themes, (4) review of themes, (5) defining themes, and (6) writing up. All 10 research participants were involved in carrying out the above steps during data analysis. They worked in pairs to read through and code the data. The coding was captured on a spreadsheet, which was then shown to all research participants on a projected screen. The participants collectively searched for themes from the data, which are described in the subsequent text.

## Affordances of using WhatsApp as a teaching tool

The following themes were identified as the affordances of WhatsApp in teaching mathematics and sciences: WhatsApp as 1) a means of quick and efficient communication, 2) a teaching and learning platform, 3) a way of overcoming technical glitches on the university's e-learning management system, and as 4) a user-friendly and 5) affordable teaching tool. The themes related to challenges were: 1) chats may not convey the intended message, 2) sharing of unnecessary and irrelevant information, 3) lack of confidentiality or security of information (Protection of Personal Information [POPI] Act, Republic of South Africa [RSA], 2013), 4) misuse of the platform for non-educational communication, and 5) abuse of the privacy of others, especially the teacher educators.

*Use of WhatsApp as a means of quick and efficient communication*

Nine out of 10 participants in this study indicated that they defaulted to WhatsApp as a platform for teaching and learning after the first lockdown. For example, the nine participants started to use WhatsApp for quick communication with the students, as evident in the quotations below:

> I would then communicate through class reps any information that students needed. Therefore, I used it only when I had urgent information, what I needed students to receive, through their class reps. (Jabulane)

> Firstly, I used it as communication to find out if they [students] had received data and devices. Secondly, I used it as a message of encouragement, thirdly, I used it as feedback on the functionality of the LMS; SAKAI, which we intended to use for the

sessions, and lastly, it became the teaching and learning platform for the course. (Lerato)

As can be seen from the participants' responses above, the use of WhatsApp was found to be the most convenient platform for communication and making announcements.

*Use of WhatsApp as a teaching and learning platform*

Eight of 10 participants said they started to use WhatsApp for discussions, for sharing resources (e.g. PPT presentations, diagrams, worksheets), and for question-and-answer lessons to make teaching and learning more effective.

> For tutorials, I used WhatsApp for tutorial groups as chat rooms on a given topic or to brainstorm in preparation for assessment or mini lessons. (Thembi)
>
> I would explain tasks that students may have had challenges with using voice notes, by interpreting instructions or following a certain procedure, such as instructions to use a PhET[1] simulation for a practical activity. I would also explain steps in a calculation using a video sent via WhatsApp. (Nqobile)
>
> I use it for open discussions, comments, individual and quick communications, issues that needed clarifications, challenging issues, and problems. (Buhle)

In addition to these general uses of WhatsApp as a teaching and learning platform, its use became pertinent to us as mathematics and sciences teacher educators because of the nature of these subjects, which require procedural and specific problem-solving techniques. For instance, it was possible to help more students at a time because queries related to content or instructions were addressed within the WhatsApp group.

It was also used for science practical activities when students performed practical activities at home because of the lockdown and posted their videos and findings on a WhatsApp group, and did peer assessment using a rubric provided on the group. The teacher educators were able to take screenshots of common errors and share these with students during group discussions.

Also, students could share different ways of solving problems by posting them on WhatsApp in mathematics, physical sciences, and life sciences lessons. In physical sciences, the teacher educator could post a link on WhatsApp and ask students to click on it to watch a video for about three minutes then discuss the content of the video. Such activities could be accessible to all students at once.

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[1]     PhET Interactive Simulations are open educational high quality STEM resources that create and host explorable explanations aimed at improving the way science is taught and learned (Correia et al. 2019).

Despite these affordances of using WhatsApp as a teaching tool, two of the 10 participants however, indicated that they never used WhatsApp as a teaching platform, but rather used it for communication purposes only, as stated below:

> I don't use it as a tool for teaching and learning directly. I see it as an informal platform for sharing information. (Dumisane)

> The WhatsApp group is a platform for communicating with students. I have not formally had NSI [Natural Science I] lectures on WhatsApp. I used it only when I had information that I needed students to receive urgently, through their class reps. The reps would then communicate with the student body. (Jabulane)

Therefore, from these respondents, communication was recognised as playing an informal yet important role that could be done through WhatsApp.

*Use of WhatsApp as a way of overcoming technical glitches on the university's e-learning management system (e-LMS)*

It was found that during the pandemic, WhatsApp was very convenient because participants experienced no technical glitches (nor needed know-how to use) as compared to e-LMSs, such as Canvas, Sakai, or Moodle that their institution was using. The responses below show how participants used WhatsApp for teaching, and indications of some of the technical glitches that they experienced:

> When my students and I struggled with teaching and learning using the e-learning system, we used WhatsApp. Students presented seminars (voice only) on WhatsApp. WhatsApp was also handy when we had incessant power cuts. Students could use their phones for communicating during seminars. (Jabulane)

> It's most convenient, especially because some students may be in a place where the internet is unstable and not participate fully in class in the event of such challenges. (Nqobile)

*WhatsApp as a user-friendly and accessible teaching tool*

WhatsApp relieved teacher educators from some frustrations brought on by the pandemic when they were forced to make the transition from face-to-face to complicated online systems. Connectivity was better on cell phones during the lockdown because they continued to function during power cuts. Furthermore, because WhatsApp is lighter on data use, students would always have data in their phones, which facilitated easier communication during the seminars. Eight of the 10 participants in this study emphasised that the WhatsApp platform was user-friendly and could directly reach many students at once, as indicated in the quotations below.

> Have easy access to communication from the lecturer, as it does not require complicated technological knowledge. Students are in possession of their phones most

of the time. Therefore, they are likely to see communication as soon as it is sent. (Nolwazi)

Since the students used the social platform more often for social interactions, it was easier to reach them and pass information to them as well. (Peter)

If some students cannot connect to the LMS during a seminar, I could connect to them by WhatsApp call on my phone. I called them on WhatsApp, and they listened to the voices from my laptop speaker. They could hear their colleagues' contributions and make contributions. (Jabulane)

A study by Susilawati and Supriyatno (2020) pointed out that online teaching and learning using WhatsApp Group was the most effective platform experienced during the Covid-19 pandemic because it is easy, simple, and does not require a large data credit. In our research, WhatsApp was found to be convenient, easy to track conversations or issues, good availability of information for future reference, and a quick multi-modal means of communication. It was found to be affordable and offered a real-time response to student queries and allowed free expression of views using features such as emojis. With regards to affordability, all 10 participants indicated that WhatsApp was affordable in terms of data, as quoted below.

WhatsApp is convenient, data is relatively affordable, and students usually have data on their phones, which reduces the chances of being offline. (Buhle)

WhatsApp is cheaper to use since WhatsApp bundles are cheaper than data bundles. (Thembi)

Moreover, usually students have data on their phones, which reduces the chances of being offline, as a result of lack of internet connectivity. (Nolwazi)

*Use of WhatsApp allows for free expression*

Participants also added the following comments on feedback and free expression:

WhatsApp is home to my students, as they post their feelings. Their feelings are in the form of stickers, emojis and statements. (Jabulane)

Students were able to communicate their challenges regarding areas that were taught, and appropriate responses could easily be communicated to them as well. Through communicating with me via my inbox, the students were able to share their personal experiences with me and through such avenues, I could provide or suggest probable lines of action. (Peter)

It serves as a platform for students to freely share their feelings about the activities of the course, ask immediate questions, and share resources among themselves. (Dumisane)

## Constraints of using WhatsApp as a teaching tool

Our study also highlighted several constraints regarding the use of WhatsApp for teaching and learning mathematics and sciences. For example, the participants highlighted that summarised responses to questions as WhatsApp texts during group chats might not convey the intended message. The sharing of unnecessary information was also raised as a challenge in that it could disrupt the educational purpose of WhatsApp. Dumisane had this to say, regarding the misuse of WhatsApp: "The WhatsApp platform can be misused by sharing unnecessary information," and Nolwazi added:

> Once wrong information is accidentally sent, it is accessible by most students. Students could abuse the platform by posting irrelevant information, such as adverts, or using inappropriate language towards each other or the lectures. They might also send messages at awkward times and expect you to respond.

Buhle complained about students' use of inappropriate expressions when sending messages and said: "Students could abuse the platform by posting irrelevant information, such as the use of inappropriate language towards each other or the lecturer." To this, Peter added:

> Students can be rude; the intonation of their messages can really be very frustrating and discouraging. Also, students use unnecessary memes while communicating on the platform. A lot of these memes can really be irritating.

Another challenge is the risk of anyone reading WhatsApp messages meant for the group only. Therefore, lack of confidentiality or security of information (POPI Act, RSA, 2013) needs to be taken into consideration when using such platforms. The times at which some students posted messages on WhatsApp were also a challenge according to some participants. For instance, Peter complained:

> Students sending messages at odd hours, after official working time. I have received messages at 1:00, midnight, before; sending messages directly to me through my inbox. This becomes inconvenient as one's private space is invaded and creating more work on my side.

Tshepo, having anticipated the challenges that could arise from the use of WhatsApp during teaching, avoided it: "I avoided using WhatsApp in my lessons to circumvent the intrusion (imagined or real) that I expected to follow if I had set up a WhatsApp group for my class of 96 students." These teacher educators felt that students' engagement with learning materials at any time that was convenient to them, would be problematic because it could be intrusive and they preferred to confine interactions with students to specific times. To this end, they did not subscribe to interacting with students in WhatsApp groups.

Even though Peter and Tshepo highlighted the intrusion of using WhatsApp as problematic, there were many cases where the in-box functionality was useful, depending on the circumstances. For instance, when a student needed to enquire on issues that did not involve the rest of the class or when the lecturer wanted to communicate with a student directly. The

research participants also indicated that was not advisable to use WhatsApp as the predominant platform for communication and teaching because this could exclude students who did not have, or could not afford, smartphones or data.

## Implications for teaching

Besides its pattern of use in social media for mainly or only entertainment (Susilawati & Supriyatno, 2020), WhatsApp had tended to shift towards use as a tool for teaching before the pandemic, and this exponentially increased during the pandemic. In summary, the study revealed that the WhatsApp platform and group chats could be used for the exchange of information directly and more intuitively. Generally, teacher educators can send timely reminders or notifications about exams, homework due dates, and so forth, to keep students engaged with learning materials and subjects, making it perfect for online teaching. WhatsApp is a fast, simple, and convenient way to chat, text, share photos and videos, send or receive documents, and engage in private, secure conversations at any time, making it useful for teaching and learning—especially when group members are in different locations, and teaching or learning activities need to continue or be communicated.

As alluded to under the affordances section, due to the nature of mathematics, physical sciences, and life sciences, which require procedural and problem-solving knowledge, the use of WhatsApp has reshaped our teaching because it allows us, as mathematics and science educators, easy access to, and communication with students to explain certain procedures, concepts, and steps for solving problems. It also enables the sharing and expansion of knowledge through authentic conversations in a community of practice. In addition, the findings from our study point to the effectiveness of using WhatsApp to supplement LMS as a contingency measure in the shift to ERT. Moreover, supplementing the LMS teaching with WhatsApp can enhance the teaching process.

# Discussion

This study shows that WhatsApp offered many opportunities to promote remote teaching and learning although, as with any good facility, there were some challenges. Connectivism enhances learning (Siemens, 2005), with individuals acting as nodes of information shared with others using WhatsApp. As explained by Engeström and Sannino's (2020) activity theory, learning is enhanced by individuals working on a subject (for example, a specific topic in mathematics or science) in a community (teacher educators and their students) with the help of tools (in this case, WhatsApp and smartphones or computers) for the goal of enabling students to expand their knowledge through understanding.

The shift to emergency remote and online teaching and learning brought on by the outbreak of the Covid-19 pandemic and the resultant lockdowns posed unprecedented challenges for both students and teacher educators. It created a new community of learning outside classrooms and lecture theatres. It created cloud-based classrooms. Undoubtedly, the challenges reshaped participants' ways of conceptualising and delivering their lessons, as well as assessment of their students' learning. Where these mathematics and science teacher

educators were concerned, these challenges were accentuated by a lack of familiarity, at the time, with the recommended LMS, which was not configured to carry large numbers of participants simultaneously and, as a result, revealed technical challenges that weighed against a seamless shift to online teaching. To circumvent these issues, the mathematics and science teacher educators who participated in this study resorted to using the WhatsApp platform as a tool for supporting teaching and learning.

Whilst the use of WhatsApp managed to keep the teaching and learning process going, it also introduced a new set of challenges. For instance, while it provided teacher educators with space to create a favourable climate for students to interact, given students' experiences of WhatsApp as an informal social media rather than an educational media platform, it was incumbent on the educators to spend time laying down the rules of engagement. Taking into consideration the participants' narratives, most concurred that WhatsApp was best used to support the main LMS in use at the teacher education institution.

From the findings, the use of WhatsApp, although initially perceived as a frivolous social media and informal platform, is now regarded as a very useful and transformative tool in teaching and learning during ERT and beyond. WhatsApp was supportive of the main institutional LMS whenever there were technical glitches or scheduled switchings off of electricity. From what the teacher educators presented, WhatsApp ultimately became an efficient means for prompt communication and tutorial discussions. It also allowed for the voice recording of excerpts in addition to written texts during discussions, as envisaged by Ujakpa et al. (2018). For teaching mathematics, physical and life sciences subjects, which require procedural knowledge and problem-solving techniques, the use of WhatsApp became pertinent in that it was easy to communicate these steps in all three subjects.

One might wonder what the teacher educators' balance sheet of WhatsApp experiences ultimately revealed concerning both affordances and constraints for the community of practice, and tapping from the teacher educators' experiences. It can be concluded that in the context of ERT, the affordances of using WhatsApp outweighed its constraints. WhatsApp is easier to access and cheaper to use than Microsoft Teams, Zoom, and other platforms. And, it was a tool that both educators and students were already familiar with. WhatsApp was more inclusive because many students had smartphones and it does not use a lot of data. Further, WhatsApp, unlike other systems, is not directly affected by load shedding. This is one of its secret powers, as was also confirmed by Susilawati and Supriyatno (2020).

## Conclusion

Our study showed that WhatsApp has a strong supportive role in teaching. Whether used voluntarily or not, WhatsApp has powerfully reshaped the participants' teaching practices. These profound changes are likely to be long lasting. More than ever before, teacher educators remotely shared learning material and interacted with their students collectively or individually at the same time. Students could also interact with the whole class and

individually. WhatsApp has opened the vistas of learning to all by increasing equitable epistemic access to students.

Nonetheless, one of the overriding sentiments of the educators who participated in this study was that the WhatsApp platform was better suited to a supportive role, rather than the central one played by an LMS. This corroborates Susilawati and Supriyatno (2020)'s view that the usefulness of WhatsApp platform does not extend to improving the quality of learning. At best, it allows for the instantaneous sharing of "housekeeping" information to be possible.

In as much as teacher educators would still opt for the LMS as the main platform to use for teaching, it is important to note that their experiences of WhatsApp have potentially strengthened their teaching practice. Their experiences could also impact their LMS classroom practices, such as with chat rooms that allow the use of voice notes and videos when necessary.

## Recommendations

Considering the findings from this study, the following recommendations are made,

- WhatsApp needs to be integrated into the learning management systems of teacher education institutions. It could also be introduced into programmes for staff development to promote its utilisation by teacher educators.
- One of the main challenges of using WhatsApp is the possibility of academic misconduct during assessments, where students might share work. Ways need to be explored to minimise this, while at the same time maximising its benefits to teaching and learning mathematics and sciences.

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