Research Paper　　　　　　　　　　　　　　　　　　　　　　　　**Open Access**

Interrogating the Use of Smartphones in the Teaching and Learning of Mathematics at "O" Level in Chegato Rural Cluster in Mberengwa District, Zimbabwe

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Abstract

The use of technology in the teaching and learning fraternity has improved the tasks for both the teacher and the student. Accuracies that can hardly be done by humanity can easily be done by artificial intelligences. This study explored the use of smartphones in the teaching and learning of Mathematics at secondary school level in Chegato Cluster in Mberengwa district, Zimbabwe. It cross-examined the perceptions of parents, learners, school-heads and teachers on the use smartphones in teaching of Mathematics in the cluster and also examined the possibilities of maximising the utility of smartphones in the classroom and beyond. The researchers collected data from 12 parents, 12 Mathematics teachers, 4 school heads and 40 learners using open-ended questionnaires and interviews. Qualitative data gathering and analysis techniques were utilized. Findings showed that teachers, school heads, learners and parents generally agreed that there are many benefits in using smartphones in the teaching and learning of Mathematics, for instance, computational speed and accuracy as well as variety of suitable applications availability. They however sited challenges that include lack of technological expertise of some teachers, expenses associated with smartphone use and abuse of the smart gadget by the learners. Teachers suggested precautions that can be used to increase the benefits, for instance, use of passwords and software blockers to undesired sites. The study therefore concluded that parents, learner and educators in Chegato have realised the benefit of smartphones despite the encountered challenges which can be mitigated. The study recommends that learners should be taught to be responsible, teachers should attend workshops to enhance their technological skills while the educators, parents, and the responsible authorities should be supportive by providing the necessary resources.

Keywords: Zimbabwe; "O" Level; Mathematics; Smartphones

1. Introduction

Worldwide, it has become fashionable for teachers to engage technology in their teaching for almost all the subjects including Mathematics. This is so because a technology-based approach to teaching and learning provides a variety of engaging methods, such as educational movies, stimulation, data storage, database use, mind-mapping, guided discovery, brainstorming, music and the World Wide Web (www). Mhlanga (2018) states that information communication and

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technology can be employed in a variety of ways to benefit both teachers and students by facilitating their respective subject-area learning. It promotes students to engage in hands-on activities in a technology-based course that are intended to help them stimulate their understanding of the subject. Norries *et al.* (2011) show that when students use mobile learning devices, such as smartphones, during learning time, their achievement rises dramatically. This is due to the swiftness in which the gadget can be used in finishing tasks especially in Mathematics.

Clavecillas *et al.* (2020) and Boaler (2015) realise that communication is a key component of studying Mathematics since sharing of thoughts enhances understanding. This is why teacher contact plays an important role in the understanding of Mathematics where there are demands in the ability to make appropriate measurements using formulas, laws and procedures at the same time correctly (Kurniawan, 2018). Mathematical ideas can be communicated using in various ways for the learner to grasp concepts. These can be verbal, written, symbolic and visual representation that convey concept in multimedia technology (Eckert, 2017). Thus, the use of smartphones in Mathematics lessons requires communication and discussion between students and teachers. The development of Mathematical terminology and the adaptation of precise Mathematical vocabulary are both necessary for the representation and communication of results and solutions (Georgescu, 2013). This is why Susilawati (2018) concludes that any platform of multimedia can enhance students' Mathematical communication skill as well as students' interactivity.

For the above reasons, smartphones are widely used in the teaching and learning of Mathematics. Ndafenongo's study, as cited in (Batista and Barcelos, 2014) argues that in Grahamstown, in South Africa, smartphones were used to teach the Pythagorean Theorem by distributing videos to learners' mobile smartphones. The smartphones were used in learning and teaching situations to support the understanding of the concept and the result was positive. The use of video clips resulted in improved learner achievement, engagement, attention and concentration during the lessons, content delivery development improvement, collaboration, interaction and independent learning of Mathematics.

In Zimbabwe, Charamba (2012) asserts that Econet Mobile Wireless launched a digital learning platform, called Ruzivo online which can be accessed at www.ruzivodigitallearning.co.zw. Learners can even access those websites and fetch more information as way of making the mathematical concepts understood using smartphones. Mhlanga (2018) describes Ruzivo as an online interactive application aiming to assist primary and secondary pupils in Zimbabwe to improve their performance. Ruzivo online platform like Microsoft Math developed digitalized academic content in all subjects in the Zimbabwean syllabus, including interactive lessons, exercises and tests conducted by the learners on their smartphones.

Walls and Rogers's study, as cited in (Polly, 2015) indicate that applications might be integrated in teaching and learning to improve learners' achievement in Mathematics. They further argue that when learners are learning in the classroom, the teacher provides them helpful, timely and accurate feedback. This is also applicable when learning with applications. Applications also provide meaningful and helpful immediate feedback (Mhlanga, 2018). They allow learners to request assistance or an explanation when they cannot answer a question or cannot progress to the next level on their own (Fallon, Keren and Kolb's study, as cited in Polly, 2015). This was evident in the Microsoft Math application used in the study.

Having the above information on Mathematics and technology, there is need to expose attitudes on the use of smartphones in Mathematics. Students are used to smartphones and they accept and perceived web-based learning. These computerized gadgets speak to another age of innovative apparatuses that offer striking access to content, and open doors for imaginative utilize even by youthful kids (West, 2013). While they can be shortages of textbooks in the schools, smartphones and cellular networks can avert the situation. West and Chew (2014) expose that a survey by UNESCO, in collaboration with Nokia and the World Reader to examine the habits, preferences and attitudes of mobile smartphone readers in Ethiopia, Ghana, India, Kenya, Nigeria, Pakistan and Zimbabwe discovered that people study and read more when using their smartphones.

On the part of the educators, initially, the use of smartphones in class has been met with more criticism than support. As mobile phones have become more prevalent in society, smart phone usage in educational settings has increased. According to studies, each instructor has a unique opinion on using smartphones in the classroom (Stachowski *et al.*, 2020).

Parents have often a mixed feeling on the use of smartphone in the classroom by their children. They are mainly afraid of destructions that they can cause in their children's learning. Indeed, it is true that the use of mobile devices on a regular basis is frequently linked to behavioural issues in children (Hosokawa and Katsura, 2018).

The above information indicates that smartphone can be viewed differently by different people; although there are obvious advantages of using smart phones in the teaching and learning of Mathematics, shortfall cannot be denied.

2. Statement of the Problem

Although the use of smartphones in the teaching of Mathematics is known for its positive impact (Fabian, 2018), some educators and stakeholders are still sceptical on its use, especially in the developing countries such as Zimbabwe where challenges belittle technology use. This situation has stimulated debates and even bans in the use of smart phones in Zimbabwe (Doyle, 2021). This means that the benefits that other Mathematics instructors and learners enjoy elsewhere, may not be enjoyed in Zimbabwe. This may negatively impact the pass-rate in Mathematics in the country. This study focuses on the following research questions:

3. Research Questions

1. What are the school heads, teachers, parents and learners' perceptions towards the use of smartphones in the teaching and learning of Mathematics at "O" Level in Chegato Cluster, Zimbabwe?

2. What can be done to maximise the utility of smartphones in the classroom?

4. Literature Review

Although technology integration has currently undergone advances, reshaped our society and fundamentally altered how people think, work and live (Ghavifekr and Rosdy, 2015), there are still some substantiative factors that cause education stakeholders to have mixed feelings on this matter. The literature review below tried to address this phenomenon.

4.1. Perceptions on the Use of Smartphones in Teaching and Learning Mathematics

Studies showed that learners have positively embraced the use of technology in their learning activities; Woodcock *et al*. (2012) stated that, in their study, learners felt that smartphones had increased their productivity, which finally led to better learning outcomes.

Different teachers have different perspectives on the use of ICTs in the classroom. Most teachers believe that using smartphones is important for learning and teaching at all levels because it allows for the continuation of the learning process even when there are movement restrictions or even during off-hours with traditional classroom learning (Mawere *et al.*, 2022). This means that, with access to smartphones, our current learners are easy to communicate with and instruct. While different teachers may have different perspectives on the use of ICTs in the classroom, there seems to be consensus regarding the benefits of these resources for both teaching and learning.

Although the potential benefits of smartphones for teaching and learning are becoming more widely acknowledged, especially by teachers, there are still certain restrictions on the factors that influence teachers' adoption of mobile technology (MacCallum, 2014). More explanation has been given by MacCallum *et al*. (2014) who suggest three additional variables to the Technology Acceptance Model (TAM), that is, Information and Communication Technology (ICT) teaching self-efficacy, digital literacy, and anxiety. Two perspectives have been predicted to continually influence how teachers use technology in relation to trust and the skills needed to use digital technology. According to their study, perceived usefulness, anxiety, digital literacy and teacher self-efficacy were the main factors influencing instructors' behaviour in regards to using mobile learning. Again, many educators continued to be resistant to employing technology in the classroom. Another factor that worries teachers is the distractions in the classroom that is brought in by pupils misusing their smartphones (Shrivastava *et al.*, 2014).

Studies indicate that many teachers agree that employing smartphones for teaching is a good idea (Zhong *et al.*, 2022). They assert as well that ICTs have the ability to enhance students' academic results if employed appropriately, as in past studies (Paton *et al.*, 2018). However, many schools in the developing world lack the infrastructure that is required to implement suitable technologies for educational purposes. This is worrisome to teachers, school heads, learners and parents. The system which is used in many countries, including Zimbabwe, that is, "bring your own devices" has burdened the parent, students and even some teachers leading to a "digital gap" although it has a potential of developing the nature of education in less developed countries (Raghunath *et al.*, 2018).

4.2. Why Smartphones can be Celebrated in Mathematics Instructions

It has become fashionable and essential to teach Mathematics using both technology and conventional techniques in light of recent advancements in both the globe and technology. The use has been also necessitated and become mandatory due to outbreak of pandemics, such as COVID 19. Bray and Tangney (2017) highlight that the use of digital tools and technology-assisted Mathematics education to enhance learning experiences are major study fields. When viewed from this angle, it means that technology aids students in concentrating and better comprehending Mathematical

ideas (Khouyibaba, 2010). The integration of smartphones into Mathematics classes is growing, and technology in the classroom can aid both students' learning and teachers' delivery of the subject (Doan, 2012). New learning opportunities are made possible by technology-assisted learning settings, which also allow educators to experiment with cutting-edge teaching techniques.

With the use of technology, learning can go beyond the classroom. Kali (2018) purports that expanding instruction beyond the classroom can promote inquiry-based learning across a range of disciplines and the current use of smartphones can further the benefits by supporting seamless learning, particularly between settings. The seamless learning environment serves as a link between learning in various contexts, including formal and informal, in and out of the classroom, and in particular and general learning environments that are triggered through individual or group activities (Looi *et al.*, 2010). Knowledge may be gained whenever and wherever it is needed thanks to mobile technologies and informal learning methods (Jumaat and Tasir, 2013). Mobile devices' portability enables extending the study period and location, as well as allowing students to continue their learning experiences in various settings.

According to Fabian (2018), the presence of smartphones offers a fresh viewpoint on studying Mathematics and serves as a link between what is learned in school and what happens in the real world. Desktop computers can be replaced by smartphones to facilitate the conceptualization and depiction of Mathematical ideas. Additionally, mobile technologies can be used for extracurricular activities and to foster a collaborative learning environment (Fabian *et al.,* 2016). The capacity to extend the benefits of formal education outside of traditional learning spaces is one of the major potentials of mobile technologies. It is vital in this situation to look into mobile technologies that might link formal and informal learning environments (Bernacki, 2020). Utilizing mobile technologies to create engaging and innovative new environments benefits various learning styles in Mathematics (Polydoros, 2021).

From elementary school to higher education, research evaluating Mathematics achievement through smartphone methodologies and tools has concentrated on various grades and disciplines. Studies on smartphones have shown that mobile learning strategies improve students' performance in Mathematical classes, including algebra, geometry, and probability (Cai, 2020). These all demonstrate how employing smartphones in Mathematics can be advantageous for learners.

4.3. Misuse of Smartphones and Possible Mitigation Measures

In contrast to earlier generations' perspectives, which propagated unfavourable attitudes regarding ICT, current school going age people have a positive attitude toward these technologies (Kibirige, 2011). This is why they are termed "digital natives". However, misuse of smartphones by these learners is a real issue in the schools where this gadget is permissible. Rollnick and Mavhunga (2016) purports that smart phones can be quite distracting to some people and was of the view that clear policies are needed to regulate their use. According to research, when students create their own rules for self-regulation, they feel compelled to follow them (Mncube and Harber, 2013). It therefore means that they can enforce such laws which they help to craft in order to teach peers appropriate behaviour. Nelson (2016) emphasises this point saying that involving students in law crafting gives them the chance even to recommend remedial measures if regulations are broken while they policing themselves. It can be concluded that, if students are involved in creating a policy, they are able to control whatever capabilities they choose to use for academic purposes.

Some studies highlight the drawbacks of smartphones as well as mobile learning varying from the growing amount of time spent using digital devices on children's health to the general misuse of these gadgets; Hosokawa and Katsura (2018) argue that the use of mobile devices on a regular basis is frequently linked to behavioural issues among youths. As a result, screen time must be monitored when children use mobile devices, whether in the classroom or at home (Cai *et al.*, 2020).

On a similar note, McQuiggan *et al.* (2015) say that while using mobile devices can increase educational success, there is also a risk that they can be utilized in distracting or unethical ways, a problem that needs to be seriously considered. They went on to say that learning performance can be impacted by the following factors: loss of concentration when using mobile devices for learning, increased cognitive load due to rich information from the real and digital worlds, limitations of touch screens as well as the allure of social networking software and inappropriate learning designs. This is why while researching on how to employ mobile devices in educational settings, it is also critical to consider their potential drawbacks and restrictions (Hwang and Wu, 2014).

5. Research Methodology

This study used qualitative strategies for both data gathering and analysis. Qualitative research methodology was used for its advantage of gaining in-depth understanding of the respondents' real experiences and attitudes towards the use

of smartphones in the teaching and learning of Mathematics. Data was gathered through interviews from school heads and parents while open ended questionnaires were used to solicit data from the learners. The generated data was thematic analysed guided by the research questions. It allowed the researchers to identify themes that were common across the respondents.

6. Sample and Sampling Techniques

The sample of this study consisted of 10 Mathematics teachers, 4 headmasters, 40 students and 10 parents, totalling 64 participants, all conveniently chosen for the study.

The Table 1 shows the sample for the study and how data was solicited from them.

Table 1: Sample of the Study	
Description	Schedule
Interview (Heads)	4
Interview (Parents)	10
Questionnaires (Teachers)	10
Questionnaires (Learners)	40
Total	**64**

7. Data Collection Procedure and Analysis

Teachers and learners received the questionnaires via a variety of channels, including WhatsApp and email. Following completion of the survey, the respondents send back the questionnaires. Interviews were conducted with the parents and the school heads. With their consent, their responses were recorded using a smartphone. This was done to avoid any form of data loss. The recorded data was transcribed and then analysed thematically. Likewise, data from open ended questionnaires for learners and teachers was analysed according to themes. As instructed by Burns (2013), the researchers laid aside what they already knew about the use of smartphones in Mathematics education and focused on the participants' experiences, giving them leeway to express themselves.

7.1. Ethical Considerations

Since the study sought information from the informant, ethical considerations were at stake. The researchers mainly considered confidentiality and the right to consent. Questionnaires had no names of respondents being written on them and their responses were kept secret. The gathered information was solely used for this study.

8. Research Findings

Valuable findings were obtained from this study mainly due to high response rate of the participants as shown by the table below which shows the demographic structure of the study participants and their responsive rates.

Table 2 above shows that interviews were successfully carried out where all the planned participants were interviewed, which gives a 100% response rate. On the same positive note, all Mathematics teachers managed to return the

Table 2: Responsive Rate of Participants			
Description	Schedule	Administered	Percentage Rate (%)
Interview (Heads)	4	4	100
Interview (Parents)	10	10	100
Questionnaires (Teachers)	10	10	100
Questionnaires (Learners)	40	30	75
Total	**64**	**54**	**81.2%**

questionnaires; its only ten learners who failed to return the questionnaires. Since Chung (2022) argues that an excellent response rate is 50% or higher, the above results are considered a valuable representation of the population.

Research Question 1: *What are the teachers', school heads, parents' and learners' perceptions towards the use of smartphones in teaching and learning in secondary schools?*

In order to tackle this question, the researchers developed a number of questions that assisted in gathering the desired information. In the interviews, parents admitted that the integration of smartphones in the learning of young Mathematicians at the secondary schools in question is worthy though associated with shortcomings and challenges.

One parent said, "*Let our children learn the way others learn. Smartphones are good and bad, but we hope that the teachers will monitor the learning process*".

This concern by parents, buttresses what McQuiggan *et al.* (2015) who realized increased educational success and at the same time, risk of technological misuse, a problem that needs to be seriously considered.

Parents also agreed that smartphone is the only way to cater for their children's demand of Continuous Assessment of Learning Activities (CALLA). They tend to trust teacher that they knew what to do and how to monitor learners in the use of smartphones. For sure, some teachers had device the culture of blocking other avenues which might distract the focus of learners.

All the 4 school heads emphasized that technology is an integral part of the present culture and development because it improves the performance of learners as they interact with each other through WhatsApp groups and other social platforms that the smartphone can provide. This finding tally that by Bray and Tangney (2017) who found that the use of digital tools and technology-assisted Mathematics education enhance learning experiences.

Data gathered on teachers' open-ended questionnaires revealed that teachers had mixed views on the use of smartphones in teaching and learning of Mathematics in Chegato Cluster. Some said that smartphones can be used as media for simple topics, while others perceive that if the teacher is well equipped in Mathematics, one can solve challenging problems in almost all mathematical learning areas. This finding brings in the argument by MacCallum, Jeffrey *et al*. (2014) who suggested that teachers' technological preferences is guided by the same teacher's Information and Communication Technology (ICT) teaching self-efficacy as well as digital literacy. This means that the teacher's level of technological skill predicts the teacher's attitude and use of smartphone in a Mathematics class; less skilled teachers are limited and hardly use smartphones in their teaching.

Generally, Mathematics teachers agreed on the utility of smartphones in Mathematics teaching. They also acknowledged that the use of smartphones improved the learners' understanding of Mathematics concepts. These findings concur with those by Zhong *et al*., (2022) who found many teachers in their study agreed to the utility of smartphones in Mathematics education.

Despite realizing the usefulness of smartphones in the teaching and learning of Mathematics, all the teachers at stake complained that the school does not provide smartphones to learners. As a result, most of the student either do not have the smartphones or they use malfunctional ones. Some teachers said that they also have the same challenge as far as the gadgets are concerned which makes their work tough. Commenting on the lack of gadgets at the school, all the 4 school heads concurred that the school have no money to buy smartphones for students and worse still for the teachers. This finding agrees with that by Cha *et al.* (2020), who realized that many schools in the developing world lack the infrastructure that is required to implement suitable technologies for educational purposes. Both the school and the parents should work together to see to it that the necessary technological provisions are made for successful teaching and learning to take place.

Findings also showed that most of the teachers view smartphones as a relevant technological gadget in the learning area. For those who were using smartphones in the teaching of Mathematics, on answering the question "*From the time you involved smartphones in your teaching, did you observe any changes in terms of performance?", * most teachers agreed that they have observed an improvement on their students' performance.

At 3 schools (out of the 4 schools), the researchers learnt that teachers had installed mathematical applications on some learners' smartphones and had created some social media platforms as well as connecting the smartphones to Internet for research purposes. These Mathematics teachers enjoyed conducting online lessons when possible and when necessary, just as Fabian (2018) put it across, that the presence of smartphones offers a fresh viewpoint on studying Mathematics. This development in the use of smartphones has contributed to the improvement of student's understanding of the mathematical concepts, a finding similar to that of Hwang and Wu (2014) who realised, in their study, a positive change due to the rapid developments in mobile technologies and smartphones use by students for learning purposes.

Considering the noted improvement of the learners' performance due to the use of smartphones, it can be deduced that many factors could have been a contributing factor towards the mixed attitude of teachers in regard to the use of smartphones, for instance, the economic and connectivity challenges. To alleviate the gadgets problem, the researchers noted that some donors had intervened in the area demystifying why the 3 schools could make a remarkable use of the technology in these schools. POTRAZ, ITEZ, Huawei and UNICEF had played an important role by donating some mini laptops, desktops, some few smartphones and Wi-Fi facilities, although they are not sufficient for all the learners. The photograph below shows students at one of the schools using smartphones in the classroom.

LEARNERS USING SMARTPHONES AT ZVAVASHE SECONDARY SCHOOL
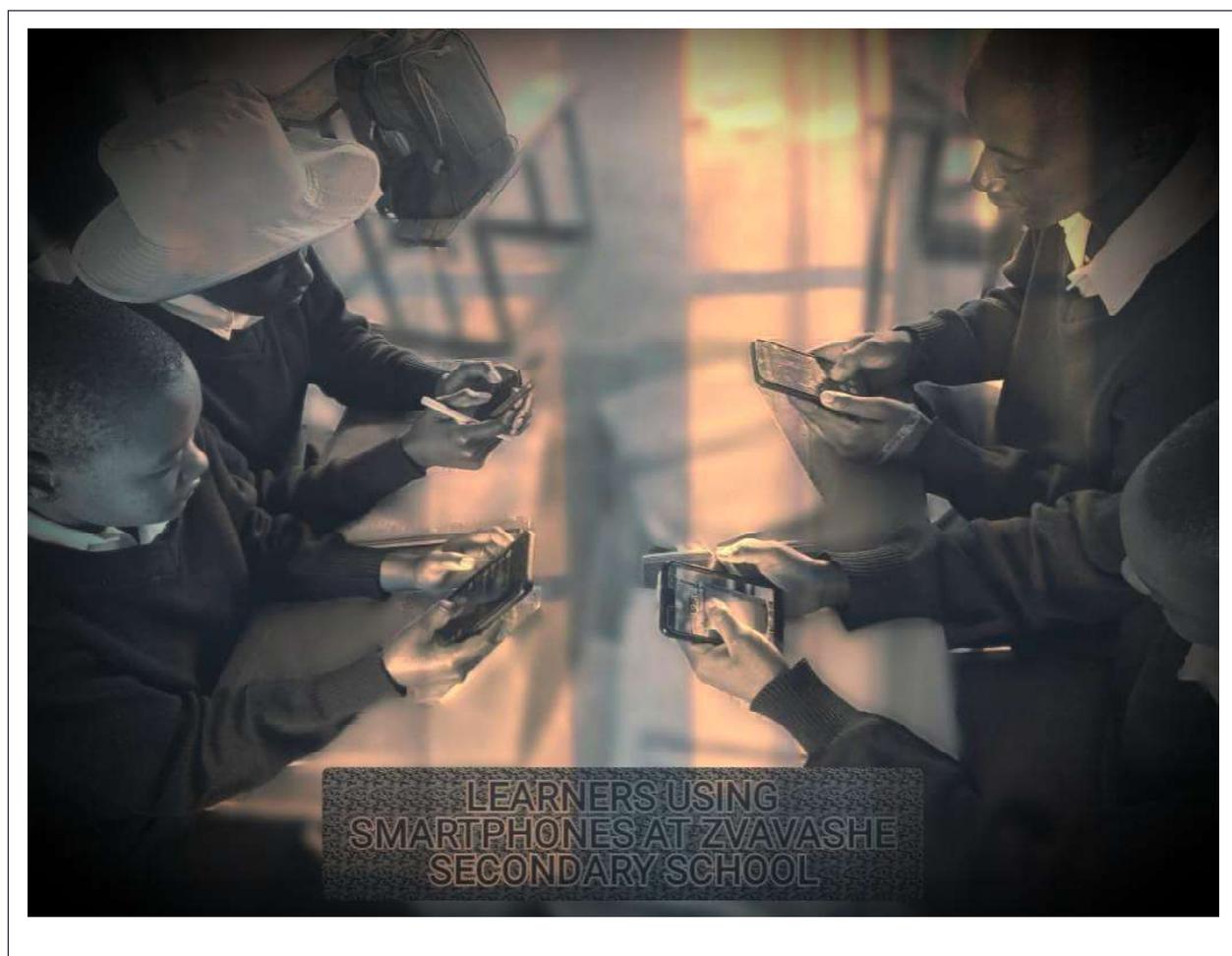
This finding concurs with that of Rwezuva (2021) who acknowledged that, as part of his presidential computer program in 2000, the then President Robert Mugabe gave computers to a number of public schools across the nation. The initiative aimed to transform the primary and secondary school levels of education through online learning.

When considering the attitudes of learners themselves, this study revealed that they welcomed the use of smartphone in the classroom as shown by the photograph above. They put effort to attend Mathematics lessons with their smartphones fully charged and some of them had gone to the extent of having power banks to ensure that their phones were ready for use. This was observed by the researchers at two of the schools at stake. The learners at the 4 schools agreed that there were rules for them in the using of smartphones at school and during lessons. They also agreed that they accepted rules these rules. Most of them acknowledged that the use of smartphones had made Mathematics lesson more meaningful and interesting. This finding agrees with what Bertoletti and Johnes (2021) observed that allowing students to use their phones in class keeps them interested in what they are learning and give them quick access to information that they need.

8.1. What can be Done to Maximise the Utility of Smartphones in the Classroom?

This study's findings clearly show that smartphones are useful to both teachers and students in addressing Mathematics concepts. It is so because there are many smartphones features that can be used which include the social media, cameras, calculators, short message services and the internet. While some of these features were not designed with education in mind, there are some features that are valuable to learners while other features hinder learning. Teachers

and school heads agreed that this is where precautions need to be taken; all the schools recommended against the use of texting, games, music, pornography as well as capturing of photos and films in class. These educators go along with Mavhunga (2016) who purported that smart phones can be quite distracting to some learners and there is need for clear policies to regulate their use. The researchers therefore concluded that, despite the usefulness of using smartphones in a Mathematics class, they are some drawbacks that need attention, otherwise, they distract the lessons.

In relation to policies to guide the use of smartphones and create a user-friendly learning environment by Mathematics learners, teachers and school heads suggested monitoring of learners' activities on their use of smartphone in a Mathematics lesson especially against visiting unworthy websites. The researchers understood these educators' suggestions basing on what they gathered from the students themselves on how they visited unworthy websites.

A number of students respondents said that, at some occasions, they accessed and view unfiltered content, including pornographic. "*I put effort to find pornography on the internet*", a number of students responded on their questionnaires. "*Nude pictures just show up on their own when I open my smartphone*", a big number of students wrote. Other students pointed out that they were disturbed in their education endeavours by adverts that forced them to visit undesired websites. A number of them showed that they occasionally, when they were using the internet for research, they were lured to watch movies and undesirable website. Some claimed to have spent considerable time, especially their study time at home, on their smartphones watching movies and listening to music. This means that unworthy content is either searched on purpose by the students or they accidentally pop-up. One knowledgeable teacher respondent suggested the use of Mikrotik Hotspot Blocker software applications to block students from accessing unsavoury internet sites.

In line with what the students say, one school head exposed a scenario at his school where some students were caught downloading and circulating unacceptable videos in class. These students were punished as a way of deterring other students from following suit. This finding is related to that by Hosokawa and Katsura (2018) who realised that the use of mobile devices on a regular basis was frequently linked to behavioural issues among youths of their study. The school head went on to say that this incident of misbehaviour by students prompted the school administrators and responsible teachers to introduce stringent measures to control students' access to Wi-Fi facility at the school as a measure to minimize abuse.

Again, the students were then introduced to a password to access Wi-Fi learners from two of the 4 schools indicated that they now have certain software and applications that can prevent them from accessing unsuitable sites. "*The use of individualised student passwords*", one teacher explained, "*ensures that the activities of each student on the internet can be tracked and any attempt to visit undesirable sites can be easily detected*". One very much worried teacher said that, in a form of warning, if learners are not careful with their use of smart phones, they can become victims of satanism. She was however not clear on who this unfortunate situation can come by.

It can be said that, to protect students' effective usage of smartphones, the teachers have proposed several security measures that schools may implement with effectiveness. In two schools out of the four, the researchers found that students were involved in crafting smartphone use regulations. On school head commented that they found it useful to involve students in policy making because the students were respecting and adhering to the policies that they had contributed in their making. This finding is similar to what Nelson (2016) suggested that involving students in law making gives the students chance even to recommend remedial measures if regulations are broken while they police themselves.

One other prominent challenge that both the students and the teachers talked about is the cost for smartphone which was beyond reach for a number of students and even some teachers. The researchers were shown some dilapidated gadgets in the name of smartphones. This problem was also realised by Cha *et al*. (2020) who realised that many schools in the developing countries experiences shortage of necessary infrastructure for technological applications. In the four schools of the study in Chegato Cluster, this challenge has been addressed to some extent by some parents who bought smartphones for their children. Also, in 3 out of the 4 schools, some donors had intervened by purchasing some needed gadgets to the schools. Availability of useful gadgets and the necessary infrastructure is vital for the creation of a user-friendly environment for successful technological application.

As an epitome of this section, the illustration below summarises the enhancement strategies that the researchers garnered in this study.

The challenges that are met in the use of smartphones in the teaching and learning of Mathematics at "O" Level in Chegato Cluster have possible solutions, which, when followed, can remarkably enhances smartphone use effects.
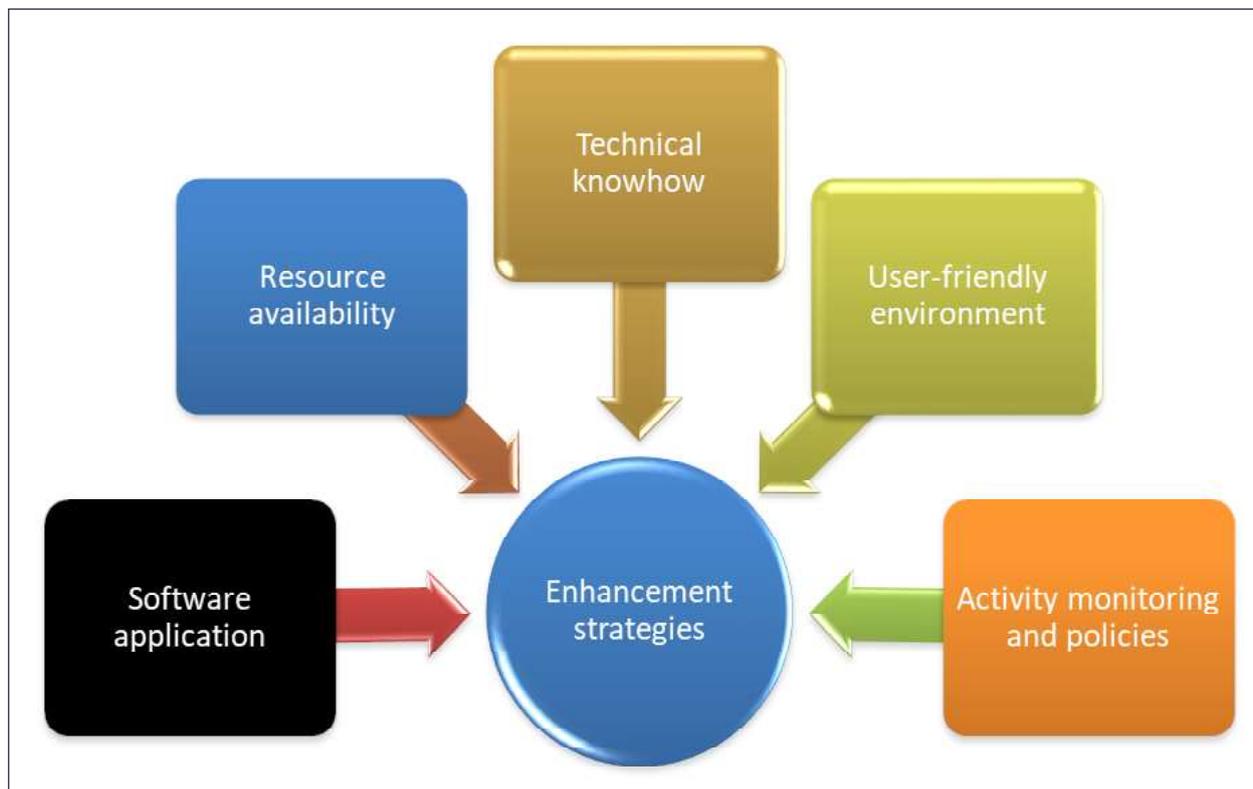
Source: Raw Data (2023)

9. Conclusion

The study concluded that "O Level Mathematics teachers, school heads, parents and students themselves have generally realized the utility of smartphones in the teaching of Mathematics in Chagato Cluster; thus, opening doors for their uses in the classroom. A few of the above categories of people seem to doubt the benefits of using smartphones due to either lack of knowledge and skills as well as resistance to change. Although there are drawbacks, such as the risk of using mobile devices in distracting or unethical ways by learners, there are always effective ways of controlling that, thus, maximising the benefits of using smartphones in the teaching and learning of Mathematics at "O" Level in Chegato Cluster.

10. Recommendations

This study recommends that learners, educators and all the parties involved in smartphone use in the teaching and learning of Mathematics should appreciate more and encourage the use of smartphones in schools. The responsible ministry should make the academic use of smartphones mandatory making it part of the education policy at secondary school level for this level of learners, when monitored well, can benefit much from smartphone usage. Parents who have not yet seen the usefulness of smartphones need to be educated so that they willingly provide funding for the purchase of smartphones for their children. Workshops for Mathematics teachers must be held to empower these teachers with the necessary technological skills. Mathematics learner seminars should be done for learners to embrace the necessary technological skills as well as the necessary related ethics. The government and well-wishers should be encouraged to donate the mandatory resources in secondary schools, especially those in rural area in order to achieve the goal of the new curriculum in the country.

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