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Technology and Mathematics Community: A Case Study

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Abstract

Mathematics education is now focusing on the application of technological instruments. The sudden change in the learning environment during COVID-19 may need more attention. Hence, this study aims to investigate how mathematics teaching communities in Taman Negara Pahang contribute to mathematics education. This study employed purposive sampling to interview four teachers from Taman Negara, Pahang (Malaysia). This study utilised a case study design to collect data, which provides insights into their teaching practices. Specifically, they shared how they lead a learning community for the development of mathematics education in their schools. The findings revealed that the teachers had used Information and Communications Technology (ICT) as the sole ICT tool for the development of mathematics education. Furthermore, they found that getting the parents communicated is the most important matter to guide the students since parents play an important role in monitoring their children in the mathematics community. The success of communication contributes to the student's development in learning mathematics. Therefore, a frequent reminder to the parents is needed to assist the students. Particularly, this study suggests that parents and teachers should focus on giving motivation to the students by maximising the usage of WhatsApp and teachers' efforts to make video recordings to guide the parents in guiding their children.

Keywords: Parents, Mathematics Community, Teachers, Technology.

Introduction

Advanced communication devices and the internet has challenged teachers to apply Information and Communications Technology (ICT) tools in the classroom and manages their tasks. Teachers have a strong desire to apply advanced tools in line with the introduction to 21st-century skills in education. The desire to equip students with 21st-century skills has prompted teachers to find an alternative way, such as using blended learning, to promote fun learning in mathematics (Sachdeva, 2022). This collaborative effort for the development of

mathematics with 21st-century skills is now viewed as a best practice among the mathematics communities in Malaysia. Many schools are working on equipping students with 21st-century skills using advanced technological tools for more interactive instruction and learning (Shafie et al., 2019). They are moving toward providing quality educational inputs and assisting students with online interactive learning experiences. However, feedback from the mathematics community, especially teachers in Taman Negara (Malaysia), suggests that employing high-quality interactive tools is not always reliable due to the instability of internet connectivity, flexibility, and high costs, among other factors (Cheok et al., 2017). Their voices need to be listened to since the mathematics community is an important entity in the development of mathematics education. Without heeding the opinions of the mathematics community, the aim of applying advanced tools in teaching may lack substance and become unsuccessful. However, teachers must still equip students with 21st-century skills as specified in the curriculum (Charleston et al., 2011). This condition may become unpleasant among schools in remote areas such as the Taman Negara in Pahang. Hence, this study aims to investigate how technology plays a role in the learning of mathematics in the mathematics community.

Literature Review

Learning mathematics is a complex process, yet it is important for students' cognitive development. Recent mathematics educational studies have been fueled by students' poor performance in mathematics tests and the related factors to the problems (Chand et al., 2021; Malibiran et al., 2019; Puteh & Khalin, 2016; Sulistiowati et al., 2019; Suryadi & Santoso, 2017). The success of going through the complex process depends much on efforts from many parties. Hence, creative teaching practices need the involvement of various parties within the community. In other words, the community has become the backbone of developing 21st-century skills. The desired outcomes of mathematics learning interpret students' confidence in the high-engagement learning environment (Teoh et al., 2021). It is acknowledged that creating high engagement to learn mathematics in a rural setting is challenging. The teachers in rural schools have difficulties accessing advanced facilities and technology. Hence, it is crucial for teachers to find alternatives to make it a success.

Technology and Mathematics Education

In this digital era, Information and Communications Technology (ICT) is an important component for conducting lessons in and outside of classrooms. All teachers are urged to implement an affordable amount of ICT in their teaching and learning process (Ng, 2016). They use creativity to engage students, such as by implementing flipped classrooms (Ramadhani et al., 2019). Investigation of the use of ICT in teaching and learning is widely shared in studies such as studies done by (Mwapwele et al., 2019; Tiba, 2021). It provides opportunities for students to enhance 21st-century skills through classroom exposure and daily activities using ICT.

Besides, intellectual participation harnesses thinking ability which leads to the necessity of possessing the current knowledge, either in terms of technical skills of using ICT or virtue from internet searching. The easy search for getting additional and new knowledge has also motivated students to gain more knowledge. To students, the application of ICT assists their learning in many ways, such as making learning possible anywhere and anytime, getting more information for solving any difficult questions for their learning, as well as getting themselves

connected. On the other hand, teachers can take the opportunity to guide the students in the right direction in the application and at the same time make ICT more effective teaching and learning tools, hence overcoming the obstacles and becoming successful technology users. While it is evident that ICT is important in society, there are, however, possible challenges to integrating these technologies into schools. Schools in remote areas may have difficulties applying ICT fully. They may encounter fewer ICT users among the students or their family members. They may face difficulties in using ICT as a communication tool, especially during the Movement Control Order (MCO).

Teachers' Roles

Teachers play an important role in developing students' skills and in building 21st-century skills among students (Tandas, 2020). These skills include creative learning skills, information management and life skills (Partnership for 21st Century Skills, 2004). All the skills are essential in developing mathematical knowledge. Thus, the teaching of mathematics is attached to the application of technological tools. Furthermore, in many educational settings, experts and resources are required to assist the parents and community in engaging students in mathematics education (Teoh et al., 2020). Hence, teachers play two vital roles in mathematics education. In this matter, reliable teachers play multiple roles. Within their responsibilities in teaching, they need to show leadership skills to lead the community. Depending on only one party to go through the process of learning is tough. Moreover, many schools depend on technology to develop students' knowledge. Therefore, teachers as leaders may find alternatives to replace advanced technology in teaching if the implementation of the technology is poor.

Alternatively, teachers take on various roles to lead the community to contribute to mathematics education. Hence, they become leaders in the community. The community includes people who engage in mathematics education, namely students and parents. Teachers who take responsibility as a leader may gain community support, which helps to address some problems in applying advanced technological tools as well as students' engagement in learning. Nevertheless, the support to the leadership skill is built by setting up a good rapport among their students through frequent contact with parents and students. Under their leadership, opportunities to create a cooperative learning environment for students to experience successful learning in mathematics are provided (Ross, 1994). Among the efforts are providing good materials, guiding parents to assist their children, and becoming an expert for any consultation in mathematics education.

Building up good rapport among teachers, parents, and students also provides opportunities to shape good attitudes in learning. It is believed that students' attitudes are influenced by good relationships with their peers and family (Grootenboer & Zevenbergen, 2008). Hence, under this direction, teachers can foster meaningful and creative learning by successfully engaging students in mathematics activities and setting up mathematics communities (Bartell et al., 2019).

Parents' Roles

Parents need to be responsible for their child's learning from their first day of attending school. Hence, parents are responsible for their child's learning development. In the learning process, their children spend about five hours in school learning. Thus, teachers in the school

have more learning connections with the children. Parents who are concerned about their children's development tend to make efforts to communicate with the school. Many studies have reported the advantages of collaboration between parents and teachers. Among the advantages are fostering positive attitudes and engagement among students (Civil & Andrade, 2003; Sirvani, 2007; Smith & Sheridan, 2019).

Methods

A case study was designed to collect data from interviews by making telephone calls and conducting video conferencing using the Google Meet platform. The sample was made up of four teachers who were directly or indirectly involved in the teaching of mathematics in Taman Negara, Pahang (Malaysia). Their ages are around 30 to 35 years old, and each of them has at least 5 years of experience in teaching Mathematics. The teachers were purposively selected from three schools, namely School A, School B, and School C. For anonymity, the names of the schools are kept confidential. The schools are in a rural and remote area, far from an accessible town in Taman Negara, Pahang. The distance between the two schools is at least 20 kilometres. The interviewees were labelled as T1, T2, T3 and T4.

Findings

This study aims to investigate how the mathematics community develops mathematics education with their current existing technological tools. The following results are based on the analysis of the data from the interviews conducted.

Research Question One

To what extent do the teachers apply ICT in teaching mathematics?

In the interviews, the teachers shared their experience of implementing Information and Communications Technology (ICT) in the teaching of mathematics. The finding was derived from the teachers' experience throughout their service in the school and during the pandemic of COVID-19 period. The teachers provided some scenarios about their ICT facilities in the schools. The majority of the schools were less equipped with ICT for teaching and learning. Here, T3 provided the situation. T3 teaches science and mathematics. She shared some insights on the teaching and learning of science and mathematics. Basically, her concern is the lack of facilities available in her school. She expressed this as below.

> *T3: The major challenge is facilities. For example, in the laboratory, many tools are not enough. LCD is also unavailable. It is quite difficult to teach science and mathematics without a projector. ….. the limited internet access. ….Internet access depends on the situation. Sometimes, there's no internet access for the whole day. In addition, there are times when the electricity supply is cut off.*

The teachers' good experiences have drawn attention to their roles as important entities in the mathematics learning community. Overall, the teachers who taught mathematics agreed on their optimum usage of ICT. All of them frequently used WhatsApp to communicate with parents. Nevertheless, the less responsive feedback from the parents, as replied by T3 and T4, has made them find other ways to engage the students in learning.

> T4: *Not all responded to the teachers' messages on WhatsApp. About 50% will cooperate with teachers.*

T3: *We communicate with the parents through WhatsApp, but not all parents are cooperative. The student's attendance rate has a problem too. In our case, we are not like schools in the city, …as city schools use a laptop or even mobile phones. We can't use Google Meet or Google Classroom, but we can still do PdPR. Like I said, to update the attendance, we will do it through the WhatsApp group, ….. their homework, some will send fast while some will be sent later.*

T4: *The challenging part… not all students have handphones… They sometimes have connectivity problems.*

T3: *Before Covid, teaching and learning run as usual. During Covid, we shared online quizzes together, the same notes, on our YouTube Channel or through WhatsApp.*

For knowledge development, hardcopy materials were still important. Therefore, the teachers mentioned they had made printed materials for the student's learning during Movement Control Order (MCO). Hence, parents' cooperation in delivering the materials to their children has shown parents' cooperation in the community. Therefore, until now, the teachers feel satisfied with the parents' reaction, as stated below.

T4: We also made copies of the module… left it at the guard house… the parents picked them up...

Besides, the teachers perceived more guidance in the form of tutoring needed to be conducted face-to-face for more interaction to stimulate logical thinking. Learning mathematics is not limited to getting an answer to the question but more to eliciting reasoning for the understanding of mathematical concepts. T3 emphasised the importance of face-to-face activity from the perspective of group work among the students and their roles in the activity as a stimulus.

T3: We have a tuition class. There are gaps among the students. We will divide the students according to their abilities. Many are not well exposed. They need teachers' guidance. For example, I asked them to make a model system planet. They need a lot of guidance. We are trying group discussion. Teachers need to trigger their thinking (provide stimulus). In the syllabus, we have many questions about higher-order thinking. Teachers need to put more effort into providing clear situations to develop their thinking. (sic)

Alternatively, they found it was a need for them to communicate face-to-face with some parents. Some of the parents were not easily reached using handphone or WhatsApp facility. On the other hand, the community was just within reachable areas. They found that communicating face-to-face was also a strategy to get closer to the parents and understand their children well. Through the interaction, the relationship between teachers and parents was strongly built. The teachers communicate formally and informally with the parents passionately. They also take the initiative to visit their students for not coming to school.

> *T4: ….my students did not turn up to the school, I directly asked the parents…definitely, I want to ask directly to the parents. Last time, together with the students' affairs principal, the form teacher and I visited the students.*

Their full responsibility for the pupils' learning and motivating students to learn mathematics has brought them the highest respect among the community members. The parents' cooperation has made the teachers motivated to go further on utilising any facilities in helping them. Some teachers were putting effort into creating useful ICT materials, such as using WhatsApp videos to guide the parents (not the students) who would like to assist their children in learning mathematics. Respondent T4 provided a very impactful statement about her experiences of creating and applying videos, as below.

> *T4: I shared my video, I made a video like YouTube. I also provided examples in the activity book; I also explained. I used my video to teach them during the MCO (movement control order)…but this is limited to a few students because not all of them can join. If I use Google Meet, they also cannot join. They do not have an internet connection...*

The finding on the issue of application ICT in teaching Mathematics is clearly depicted in extracts T3 and T4 when the WhatsApp platform was used in group discussion, although there were some limitations and lack of participation among parents and students because of the connectivity problems and unable to buy a handphone. Record and sharing notes on WhatsApp groups is part of the online teaching and learning to explain difficult mathematical concepts. The relationship between teachers and communities becomes close and allows students to ask questions. On the other hand, the teachers have the initiative to utilise ICT in teaching and learning. They wished the schools to move forward with ICT facilities for teaching and learning purposes. Although the facilities are less available, the application of ICT remains crucial. This condition becomes critical during the period of MCO. The teachers stood a strong view that a mild and limited usage of ICT could also assist the development of mathematics education. Withstanding the strong efforts among the teachers, the ICT might turn into a secure gain of mathematics learning by engaging the parents in the mathematics community. Hence, the teachers successfully engaged some parents with the parents' volunteerism in guiding their children. The cooperation between parents and teachers has shown a warm success in using ICT smartly in mathematics education.

Research Question Two: *How do the teachers lead the mathematics learning community with ICT?*

The teachers made extra effort to guide the parents in teaching their children mathematics. The parents could be the supportive community in mathematics education. They were willing to spend some time listening to the effortful teachers demonstrating their teaching. This experience was shared by T4 as below.

> T4: …*WhatsApp. About 50% will cooperate with teachers. For example, some parents did extra such as guiding their children in learning. Only pupils whose parents are active in guiding their children, their children engage themselves in learning.*

As a leader in the community, teachers react by providing information and instruction to the parents regarding the student's work. Teachers did inform any assigned work and requested parents to monitor their children. T4 provided good input on how she became an instructor. She emphasised that teachers should know ICT to assist the parents.

> *T4: …parents took a photo of their children's work and sent it to me. I need to reply one by one. I also explained to the parents…but not 100% sent…teachers need to know ICT so that they can guide the parents.*

The parents have put a lot of effort into helping their children. Their practice of assisting and putting concerns on their children's mathematics learning is consistent before COVID-19 and during COVID-19.

> *T4: ….same before COVID-19 and during COVID-19…Students are not good at mathematics. They need their parents' help too. Parents always' responded to teachers' messages…many parents monitored their children.*

The finding shows that teacher T4 did the preparation and explored the appropriate technology tools to develop mathematics content before posting it to students. This is how teachers incorporate ICT technology. The finding also shows that teachers could only assist parents in guiding their children if the parents showed cooperation in the mathematics community. The cooperation includes parents' resourcefulness in assisting their children in applying ICT for work submission to their teachers. On the other hand, the finding provides insights that parents are expecting the teachers to assist them in monitoring and assisting their children in learning mathematics.

Discussion and Conclusion

All the teachers in this case study have underlined the limitation of applying Information and Communications Technology (ICT) in teaching and learning. However, the application of WhatsApp is popular among teachers in teaching mathematics. This scenario was held among dedicated teachers in some areas in South Africa (Madge et al., 2019). Therefore, it is believed that the minimum usage of WhatsApp may open opportunities for the mathematics community to develop mathematics education. In this study, the students depend much on the community to transform their educational journey since they are not well exposed to many categories of 21st-century skills, such as the Internet of Things (IoT). On the other hand, the teachers depend much on WhatsApp as a communication tool to get parents' cooperation to deliver the message and learning materials to their children. Hence, the students depended much on the community to transform their educational journey since they were not well exposed to many categories of 21st-century skills, such as the internet of things.

In this study, the students needed parental support. Hence, the parents and teachers were an important entity in the mathematics community. The close relationship has enlightened the development of students' mathematics knowledge. Thus, parents have retained themselves as part of the mathematics community. On the other hand, the teachers in this study were aware of the importance of ICT and utilised the availabilities in assisting students, yet they found it is important for them to lead the parents to assist their own children. Therefore, it was revealed that teachers are an important entity in the mathematics

community. Their roles as a leader have also been shared by (Tandas, 2020). Their successful way of using ICT and proper selection of utilities has made them successfully react as a leader in guiding the parents.

In this study, the teachers lead the mathematics learning community with ICT by utilising recording videos or direct WhatsApp videos to guide the parents (not the students) who would like to assist their children in learning mathematics. It was convinced that the application of ICT, especially the inclusion features of videos, tremendously improve students' learning (Dewi, 2019; Gon & Rawekar, 2019). Nevertheless, the studies focused on the learning of learning subjects other than mathematics, such as science-based and language-based content (Dewi, 2019; Grover et al., 2020). Therefore, this study has added some value to applying WhatsApp in teaching mathematics.

On the other hand, the strong supportive community has been getting attention among the teachers. The parent's willingness to lead their children to communicate with their teachers in completing their homework as well as accepting the teachers' guidance has accomplished the aim of the mathematics community. The good practice provides insight into strengthening the mathematics community's roles. Thus, more future work needs to be undertaken to suggest creative ways to engage parents in a mathematics community. The community holds a major responsibility to create an adaptive mathematics learning environment. The proper way of managing the learning environment involves components of the physical environment, instructional strategies, communication, students' behaviour, and many more factors in the context (National Research Council, 2015).

This study revealed that the mathematics community (teachers and parents) was experiencing frequent communication and focusing on the minimum usage of ICT to promote a good attitude toward learning mathematics among the students. It is hoped that creativity may promote alternative ways to optimise the use of technology for achieving the nation's aims towards harnessing 21st-century skills among the future generation. On the other hand, the parents have played their roles in education. Even though they are aware of all challenges, they are trying alternative traditional ways to assist the students in such they are still hoping for opportunities of any advanced technologies for the development of education.

In conclusion, this study revealed that the teachers had used ICT as the sole ICT tool for the development of mathematics education. They found that getting the parents communicated is the most important matter to guide the students since parents play an important role in monitoring their children in the mathematics community. The success of communication contributes to the student's development in learning mathematics. Particularly, a frequent reminder to the parents is a need to assist the students. Here, the parents and teachers focus on giving motivation to the students by maximising the usage of WhatsApp and teachers' effort to make video recordings to guide the parents to guide their children.

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