Obstacles to technology use when addressing Saudi primary students' mathematics difficulties

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***Abstract*— Despite the potential positive effects of using technology with students who have difficulties in mathematics in the Kingdom of Saudi Arabia and the great efforts made by the Saudi Government to improve the education system of the nation, which has included a continuous rise in the educational budget, there still remain some obstacles for some teachers when using technology, and while some of these teachers overcome these barriers, others do not succeed in this the challenge. This paper will investigate the barriers that teachers face when using technology in their classroom in primary schools, and why some overcame obstacles while others did not. Semi-structured interviews and observations were used in this research, which were undertaken with three mathematics teachers from school A which used technology, and the other three from school B, which did not use technology. We found that the major obstacle teachers face when using technology included the teachers' negative attitudes and beliefs about teaching mathematics using technology, the lack of training in using technology, and the lack of technical support. The head teacher's attitude also had a great effect on managing the challenges teachers faced, which affected teachers' decisions to use or not use technology in school.**

Keywords— Obstacles; Reasons to overcome/ not overcome

I. INTRODUCTION

There are some students who have difficulties with mathematics subjects at primary schools in the Kingdom of Saudi Arabia. Mathematics learning difficulties is a generic term referring to those pupils "who learn but misconceive, find prescribed steps hard to understand, pattern development, visualizing as well as misunderstanding structures" [6]. It is therefore not surprising to note that many students perceive mathematics as a difficult subject, as it consists of many areas that continue to develop in an increasingly complex way [22]. However, when technology is integrated with teaching techniques, it can promote the translation of mathematical concepts from one mode into another, thereby making ideas more tangible [21].

The Saudi Government has made significant efforts made to improve the education system of the nation, with one of the goals more effective use of technology in mathematics education. These efforts have included a continuous rise in the educational budget with SR210 billion ($56 billion) for educational development in the 2014 budget, which was double the budget of SR105 billion ($28 billion) in 2008 [11].

However, there are still some teachers who face obstacles in using technology, and some of these teachers try to overcome these barriers, whilst others do not succeed in this the challenge. Overall the results are not as impressive as expected by the officials, which has been demonstrated in a number of ways. For example, according to the study of TIMSS (2007), Saudi Arabia got an average score of 4 along with 8 science samples was about 403 less than the international average and also below many other countries that have almost similar cultural and economic context [13]. In addition, the country has been experiencing a vigorous debate on the educational crisis that is related to the learning process and teaching quality and has been contributing to the overall results and ranking in TIMSS research.

Therefore, the aim is to improve the system of education in Saudi Arabia through investigating and understanding the barriers that teachers face when using technology in their classroom in primary schools, and particularly why some overcame obstacles and why others did not. Thus, there are two key questions:

1. Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students?
2. Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students?

II. THEORETICAL FRAMEWORK

The theoretical frameworks adopted to undertake this research include the Concerns-Based Adoption Model (CBAM) (CBAM: [9]; [16] and the Technological Pedagogical Content Knowledge (TPCK) ([17];[19]). To understand the challenges those teachers face when use technology, CBAM is adopted. The term TPCK is used to describe the knowledge that is required by the teachers for effective integration of technology into educational practices. This study uses TPCK as a framework to understand mathematics' teachers needs so that they can overcome the hurdles of introducing technology in classes.

III. LITERATURE REVIEW

A. Barriers to Using Technology for Teaching and Learning Mathematics

In the light of the use technology, researchers have found that teachers seldom use technology in the school classroom.

For instance, in a large-scale survey of teachers, students and administrators by the Gates Foundation, Abbott [1] shows that more than 53% of teachers do not use technology regularly to help their students in the classroom. In 2005, another survey (by CDW-G) found that 80% of teachers use computers for administrative tasks only [14]. In this section, we examine certain researches in order to gain a better idea of some of the barriers to adopting and using technology for teaching and learning mathematics, with the ultimate aim of breaking down those barriers among teachers and technology in schools.

A study in the Kingdom of Saudi Arabia by [2], which used semi-structured interviews and observations with four mathematics teachers and 12 students at an elementary school, sought to build a picture on the effects of applying technology to the mathematical problem-solving abilities of primary school students who have dyscalculia. The study found evidence to suggest that there were positive effects using technology on the mathematical learning of Saudi primary grade students with dyscalculia. These include technologies which can give meanings to numbers, which can remove any necessary barriers to learning and enhance strengths for students with dyscalculia, boosting students' confidence, or which helps students to remember what they learned (because the brain can more easily understand and remember visual information). Although this study has confirmed the positive effects of technology on student learning, one of these teachers did not use it with his students for three reasons. First, the teacher simply needed to be trained to use the technology. Furthermore, there is no reward system in place for innovative teaching. Additionally, he thought that the traditional blackboard would make complicated problems more solvable. But now he has changed his mind about the value of technology and began using it. Therefore, further study could focus on the obstacles of using technology on primary schools to help students with dyscalculia in the Saudi Arabia because this study found evidence to suggest that there are a variety of obstacles, including the lack of teacher training in using it, especially with those pupils who have dyscalculia, both through the workplace and in training institutions.

Another barrier originates from a lack of technical support in school. [12] indicates a scarcity of on-site support as a reason quoted by teachers for not using technology in the classroom. According to [7], there is a lack of technical support available in schools generally, leading to equipment remaining out of use for long periods of time; this seriously inhibits the widespread use of technology. An example of this is highlighted in [5]; it took three weeks to replace an expired projector bulb. [18] discovered that teachers who attempted to perform a function on a computer failed as a result of technical issues, and that they would then not use a computer for a number of days. Sharing a similar view, [10] reported that there is a close relationship between technical assistance and barriers; barriers in this case represent a lack of technical support, and teachers will be discouraged from using technology if they know that no one will be on hand to offer immediate technical support.

Another study, by [15], investigated the reasons why mathematics teachers do not use technology in their teaching in order to support students; their research was conducted at a school where mathematics teachers rarely use technology with their students, despite the availability of hardware and software. According to the findings of the study, the resistance of individual teachers was linked to their beliefs about the teaching and learning of mathematics and their existing pedagogies. This involves their ideas about tests, apprehensions about time restrictions, and preference of certain text resources. The study also concluded that teachers with transmission/absorption views of teaching and learning, and pedagogy focused on the educator and the content, had an obscured view of the prospects of using computers in the area of teaching and learning mathematics. By way of comparison, a teacher who holds a view of teaching methods in line with the social constructivist learning theory and learner-focused education displayed a broader view of the computers' prospects in the teaching of mathematics.

In the viewpoint of teachers, the attitudes of school headmasters on technology play an extremely significant role in the encouragement of technology incorporation into school [3]. [4] examined the effect of seven aspects linked to school technology (planning, leadership, curriculum alignment, professional development, utilisation of technology, teacher open attitude to change, and teacher use of computers outside school). Powerful leadership in technology was found, through interviews with teachers and administrative staff, to have an impact in students' acquisition of content. Moreover, when headmasters had a positive stance on technology, this promoted the integration of technology into the classroom and spurred teachers and students to utilise technology more often [4].

Overall, many teachers face a variety of challenges when trying to effectively use technology into their classroom. The first barrier to using technology in teaching and learning mathematics is the lack of training courses for teachers on how to use technology effectively. This barrier was demonstrated in a study in the Saudi Arabia by [2]. The second barrier is the lack of technical support; this was addressed in [12], [7], [5], [18] and [10]. The third barrier that affects the use of technology with these students is the negative attitudes and beliefs of teachers towards the use of technology generally. This barrier was investigated in a study by [15]. The last barrier is the school leadership' attitudes toward technology: this was demonstrated in [3] and [4].

IV. METHODOLOGY

A. Data Collection Method

As suggested by [20], a case study is a term that is broadly used in relation to the investigation of a person, a group of individuals or phenomenon. In the view of [8], the term of case study is related to research work that is aimed at probing a small number of cases in great depth. Therefore, this case study was conducted at two primary schools in Saudi Arabia, with three male mathematics teachers in school A, who use

technology with their students who have mathematics difficulties, and three other teachers in school B do not use it with their students.

Each one of these six teachers were interviewed and asked general questions about the use of technology (Part 1). Each was then observed in their classrooms and, finally, every teacher was individually interviewed and asked specific questions to address the research questions (Part 2). Interviews and observations were chosen as techniques for the purpose of this research and because data collected through interviews and observations can be compared. In addition, observations are crucial to see the effect of technology on the students' mathematical learning. However, the observations may not be enough, as there remain the need to investigate and understand the barriers that teachers face when they use technology, and why they overcame obstacles or why not.

B. Ethical Considerations

The study was conducted in accordance with the British Educational Research Association Revised Ethical Guidelines for Educational Research (2004) with ethical approval given by the School of Education's Research Ethics Committee at Durham University.

C. Data Analysis

Firstly, all interviews were recorded and transcribed verbatim after each session. The each transcript, interview data and observation notes were read and re-read. Secondly, thematic coding was used, underlining the text in different colours, and matched data in categories separately which allowed reduction and synthesis of large quantities of information. Thirdly, all the identified commonalities were divided into themes, and supported with quotes.

V. RESULTS

We found from the interviews' responses of all six teachers and the consequent observations, that the head teacher was the main reason behind their decision to overcome or not overcome the obstacles they face when using technology to help students with difficulties in mathematics. The principals of both schools played a great role in managing the challenges they faced with technology. This became evident when the head master of school A helped the teachers in overcoming the obstacles they faced when using technology by training teachers and through technical support, which reflected positively on teaching and learning mathematics, leading to a continued and enthusiastic use of technology. On the other hand, the head teacher in school B did not help or support his teachers in providing technology in school, nor help with overcoming the challenges they faced with technology because of his attitude towards technology in general, which reflected negatively on their enthusiasm to continue to overcome barriers such as the provision of technology in the school, and the lack of training and technical support, in spite of their belief that technology has a positive impact on teaching and in the learning of students who have difficulties in mathematics.

In addition, we can also find three subset reasons for these three teachers in school A being enthusiastic to overcome the obstacles they faced in the use of technology.

The first reason given by teacher one was his desire to take advantage of recent technological developments in his teaching practice. Throughout his teaching career, teacher two had used various methods to attempt to address the difficulties his students faced while learning mathematics. He found that teaching with technology facilitated learning through making the lessons more enjoyable and the topics easier to understand. According to teacher three, as technology is now so widely used for entertainment purposes by students in their daily lives outside of school hours, technology should be harnessed and applied to engage the students' interest within the classroom environment which would help stimulate their interest in the subject of mathematics, and also help them absorb the information more easily as a consequence.

The second is the way of structuring the topics after the development of the mathematics curriculum, which requires teachers to use technology to help them deliver and simplify information for students, as technology has now become an integral part of the curriculum.

The third is the teachers' belief that the technology has a positive effect on teaching and learning students with mathematics difficulties; this was proved through the interview responses and the researcher's observations.

However, it is interesting to find that the help and support of the head teacher is critical for these three teachers to achieve all the three points above easily. These include the provision of technology in each classroom through communicating with the Ministry of Education, encouraging teachers to use technology, giving assistance and support to overcome all the obstacles that prevent their use of technology, such as offering relevant training and technical support. The head teacher in their school was extremely supportive and enthusiastic towards technology; he was very creative in offering ideas to help his teachers exceed the challenges and make the most of the possibilities offered by the technology. For instance, making part of the teachers' evaluation scores on attending the necessary training, and providing technical support in the school. All these factors led these three mathematics teachers to continue successfully in the use of technology.

In regard to the other three teachers in school B, we found that there were reasons why they did not succeed in overcoming the obstacles they faced with technology. To identify these we need to revisit the previous chapter, which appeared in three positions as follows:

Firstly, we can find this in first dimension, when all the three teachers mentioned the reasons for not using technology with their students. These included the lack of a reward system

from their head teacher for innovative teaching through technology, the lack of support from the principal in providing technology, appropriate training and technical support. Moreover, teacher three found that the advanced age of his head teacher was a barrier; also not receiving in-service training reduced the head teacher's enthusiasm for providing technology in his school, which impacted negatively on this teacher's decision to use the technology.

Secondly, we can see from the third dimension that all three teachers mentioned that the main reason behind their decision not to use technology to help students with mathematics difficulties was solely due to the school itself. By the term, school only, they were referring to the attitude of head teachers towards technology with regard to provision, integration and use within the classroom.

Thirdly, each teacher mentioned the meaning of the attitude of head teacher according to his own belief and experience. We noted that they agreed on certain points, such as when teachers four and six mentioned the advanced age of the head teacher and the lack of the director's knowledge regarding the positive impact of technology on students with mathematics difficulties, which are critical factors affecting negatively technology integration and use in schools, but they disagreed on others. This appeared when teacher five mentioned the attitude of the head teacher in general without further detail, and when teacher six added that the fact that the principal who had not graduated in any computer subjects would influence his belief and attitude toward technology.

However, it is clear from all the three points above that the attitude of their head teacher was the main reason for the teachers' own reluctance to overcome these barriers.

VI. DISCUSSION

It is interesting to mention the theoretical framework that has been selected for conducting this research, which included the Concern Based Adoption Model (CBAM) ([9]; [16] and the Technological Pedagogical Content Knowledge (TPCK) framework ([17]; [19]); neither of these is sufficient to explain the use and non-use of technology. Although these models were helpful they were not enough to look at the whole picture of how to achieve better use of technology. In this study, the TPCK model helped us think about content and the match between pedagogical content, but does not help us on teacher beliefs, concerns and motivations. In addition, the CBAM model helped us to identify teacher concerns but not school problems such as if a teacher does not have any technology, so we were still stuck.

This means in this study the researcher needed to take account of school level concerns and teacher level concerns and then use the TPCK framework. In other words, if the researcher only sorted out school concerns and teacher concerns (beliefs), then we can move to the TPCK model. This gives a really important explanation of why TPCK is only useful if you have other things sorted. Therefore, this model will be great if we work with a school that already has technology and support by the head teacher, such as school A, but not with school B which does not have technology. The following figure below illustrates when we can use CBAM and TPCK frameworks.

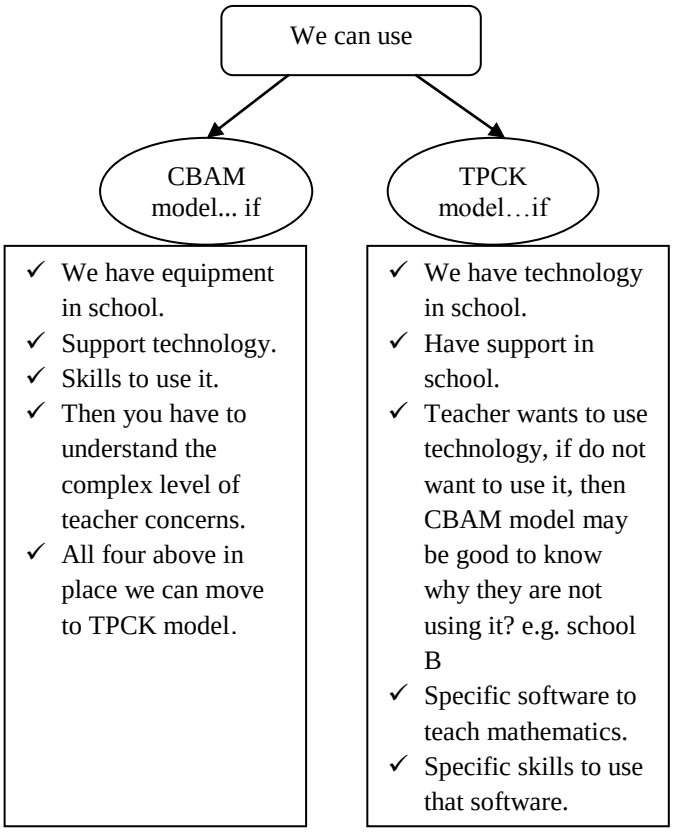

Figure 1. When we can use CBAM and TPCK frameworks

When we look at the figure above and the two school cases, we find that school B does not have technology, the head teacher does not support the teachers in terms of providing, integrating and using technology within the classroom, and finally teachers four and five do not have the skills to use it. This means we cannot address teachers' concerns because the technological support is still one of the main concerns. This also gave us an indication that in this case we cannot use the TPCK model, because there is no technology in this school. While in the case of school A, they have technology in school, the head teacher supports and encourages them to use it, and the teachers want to use it. This means the researcher can use the TPCK model with them to understand the needs of those three teachers for effective pedagogical practice in technology to help those students with mathematics difficulties. On the other hand, this model does not help us to know about teacher beliefs and concerns. Therefore, in this study the researcher needs to use both of these models, CBAM and TPCK, and also look at school problems. In addition, it becomes clear in this study that there is a hierarchy in models; school comes first and we need to understand teachers' concerns and then move to a TPCK framework (see Figure 2).

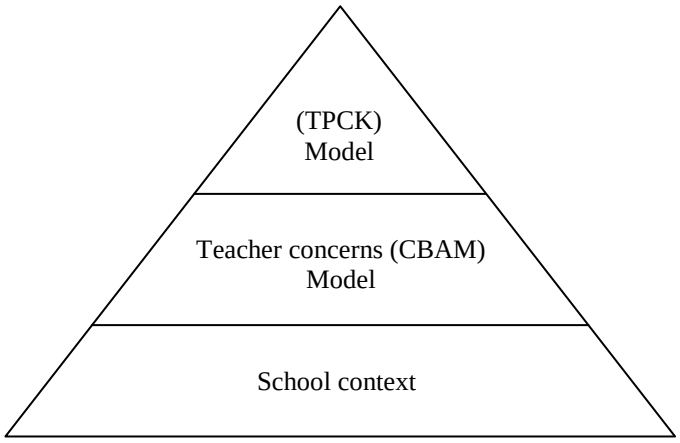

Figure 2. The hierarchy of the models

It is also interesting to mention that we can offer something that is very specific in my study. We can say that all the studies in the literature review confirm that, if we want to achieve teaching and learning with technology fully, these kinds of things have to be in place: head teacher support, training for teachers to use technology, technical support, and positive attitude towards technology. All these were important and my study confirms this, and these all need to be in place (head teacher support, training for teachers to use technology, technical support, and positive attitude towards technology), but the researchers stop at these barriers, which did not include the subject knowledge, this means we have to make a stronger mathematics connection. In other words, teachers have to use specific software to teach multiplication and subtraction, for example, well; and they need the software that leads them to represent multiplication and subtraction and they need to know how to teach multiplication and subtraction. We need good software and good knowledge, because even if we give teachers good software and they still are not able to use it, because their mathematics knowledge is not sufficient, this will lead them to not using it. All of these need to be in place for a successful use of technology.

Even specialists when devising the Tatweer project in Saudi Arabia, started to overcome these barriers quite well in most Tatweer schools and teachers, but they did not cover the subject knowledge development, and some teachers may be doing this by themselves. Because the project designed to support general teaching with technology but did not think about subject knowledge. In other words, the project did not design to support excellent mathematics teachers with technology. We think that, if we want to support teachers to develop their mathematics subject knowledge, we do not necessarily have to do a separate course on mathematics subject knowledge development, we can provide one training course about the ways of using technology to teach mathematics well, and at the same time, we will teach the teachers the mathematics.

VII. CONCLUSION

We found from the interviews' responses of all six teachers and the consequent observations, that the head teacher was the main reason behind their decision to overcome or not overcome the obstacles they face when using technology to help students with difficulties in mathematics. The principals of both schools played a great role in managing the challenges they faced with technology. This became evident when the head master of school A helped the teachers in overcoming the obstacles they faced when using technology by training teachers and through technical support, which reflected positively on teaching and learning mathematics, leading to a continued and enthusiastic use of technology. On the other hand, the head teacher in school B did not help or support his teachers in providing technology in school, nor help with overcoming the challenges they faced with technology because of his attitude towards technology in general, which reflected negatively on their enthusiasm to continue to overcome barriers such as the provision of technology in the school, and the lack of training and technical support, in spite of their belief that technology has a positive impact on teaching and in the learning of students who have difficulties in mathematics.

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