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Understanding Learning Outcome Divide in the Learning Process from a Teachers Perspective: A BYOD Case Study

Janak Adhikari

School of Science, Technology & Engineering
Open Polytechnic of New Zealand
Wellington, New Zealand
Email: Janak.Adhikari@openpolytechnic.ac.nz

Anuradha Mathrani

Institute of Natural & Mathematical Sciences
Massey University
Auckland, New Zealand
Email: A.S.Mathrani@massey.ac.nz

Chris Scogings

Institute of Natural & Mathematical Sciences
Massey University
Auckland, New Zealand
Email: C.Scogings@massey.ac.nz

ABSTRACT

Technology-mediated learning has established itself as a valuable pathway towards learners' academic and social development. However, within the adoption stages of ICT enabled education further questions have been raised in terms of equity of information literacy and learning outcomes. For the last four years, we have been working with one of the earliest secondary schools in New Zealand to introduce a Bring Your Own Device (BYOD) policy. In earlier research we explored how the BYOD policy has influenced existing divides in the learning process across three levels, namely digital access, digital capability and digital outcome. The earlier result sheds light on key issues affecting the learning process to contextualize factors in the three-level digital divide for the BYOD technology adoption process in classroom settings. In this paper, we extend our analysis on how the key constructs (digital/information literacy, computer self-efficacy and nature of technology usage) are transforming school and classroom curriculum practices. Our analysis reveals changes in boundaries between formal and informal learning spaces with one-to-one devices providing the link between school and home, teachers being transformed to facilitators as students take more ownership of their own learning and how technology is shaping classroom activities which further influence learning outcomes which are known to result in digital outcome divides.

Keywords

BYOD Classrooms, Digital Divide in Learning, Classroom Curricular Practices, Digital Outcome Divides

1. INTRODUCTION

The rise in adoption of information and communication technologies (ICTs) into modern life has altered the way we perceive information literacy skills among the general population. Digital skills are now considered important after two other life skills, numeracy and literacy (DfES, 2003; Johnson, Levine, Smith, & Stone, 2010). In recent times, transformation in pedagogical approaches in formal education has been made possible by integration of digital learning technologies and strategies into existing learning practices (Anderson, 2009; Prestridge, 2007) to provide potentially valuable resources for learners' academic and social development. This has led to setting of new learning activities, engaging learners via media-rich collaboration tools which introduce more visual stimulants to the subject content, and defining novel assessment models which align with the curriculum (Demiraslan & Usluel, 2008; Meyer, 2015). Teaching methods when assisted by appropriate tools, systems and technology supported services help to transform teaching and learning practices (Sampson, Ifenthaler, Isaías, & Spector, 2014). However, earlier studies indicate that mere integration of digital learning technologies into existing pedagogical practices might end up contributing nothing more than material access to ICTs (Rivers & Rivers, 2004). Literature suggests that despite the potential of innovative learning technologies to improve learning outcomes, it could end up accentuating existing digital divides (Parr & Ward, 2004; Rivers & Rivers, 2004; Winter, 2004). Supporting the earlier argument, Wei, Teo, Chan, and Tan (2011) caution us that as adoption stages of ICTs advance, there may arise more levels of digital divides based on the equity of information literacy and learning outcomes. Therefore, digital divide is a complex issue and it is hard to understand this phenomenon within a single context and with a single definition.

In recent decades, setting of strategies for equal distribution of ICTs to achieve digital inclusion for everyone has come up as a primary concern for governments, policy makers and researchers. Therefore, to understand the phenomenon of digital divide in the current learning context, we have undertaken a longitudinal case study of the BYOD policy in one of the secondary schools in New Zealand. Some of our earlier research (Adhikari, Mathrani, & Scogings, 2016; Parsons & Adhikari, 2016) have explored how the BYOD policy has influenced existing divides within the learning process across three levels, namely digital access, digital capability and digital outcome. Those studies have shed light on key issues affecting the learning process, which resulted in few focal constructs requiring further investigation. In this paper, we extend our analysis to understand how those focal constructs (digital/information literacy, computer self-efficacy and nature of technology usage) have an effect on everyday school/classroom curriculum practices. Our analysis now focuses on understanding personal, behavioral and environmental factors which influence digital capability divide and learning outcomes which are known to result in digital outcome divides.

2. DIGITAL DIVIDE LITERATURE

The phenomenon of the digital divide have been researched and defined in many contexts, which has caused more confusion than clarification. However, the common understanding behind most of this research is that the digital divide phenomenon is a complex social, economic and academic issue and is now receiving increased attention from researchers and policymakers around the world (Dewan, Ganley, & Kraemer, 2005). Phenomenon of the digital divide is complex due to variety of economic, demographic, individual and social aspects associated with it.

The digital access divide is the divide between those who have access to digital technologies and those who don't (Cullen, 2001; Dijk, 2012; Zhong, 2011). Prior studies have established some determinants for gaps between haves and have-nots, and identify financial status, household income, educational level, type of occupation and geographical location as being the most common factors. The digital access divide is also known as the *first level* or *first order digital divide*. Digital access divide is considered one of the earliest concepts of digital divide, and research around this area continues to be relevant in understanding digital divide in different social contexts (Araque et al., 2013)

Another study on the phenomenon of digital divide has found that merely offering access to ICT to individuals may not be sufficient to ensure that they will use the medium appropriately to meet their needs and expectations (Hargittai, 2002). This study suggests that people who have been provided with access to technologies should also have proper skills to make meaningful use of available technologies. Otherwise they may not be able to take even basic advantages offered by the medium and as a result digital divide

may still persist in the form of digital skills divide (Ghobadi & Ghobadi, 2015). This is in line with an earlier study by Hargittai (2002), where digital divide has been classified in two levels: *first level* (access to ICTs) and *second level* (the ability to use ICTs properly). However, as the adoption stages of ICTs advance, new digital divides based on the equity of information literacy and learning outcomes could occur (Wei et al., 2011), resulting in a *three level divide* (Figure 1).

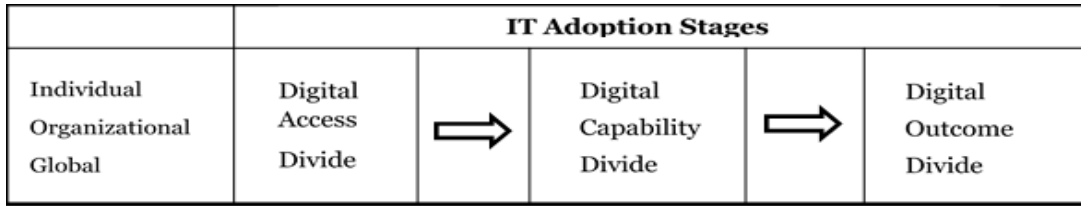


Figure 1: Three level digital divide framework (Wei et al., 2011)

Digital outcome divide is a more recent analysis and is referred as the *third level* digital divide. It looks at the inequality of outcomes achieved by users of ICTs and digital media based on factors like individual's attitude and motivation towards technology, nature of technology usage, and ability of meaning making (Brandtzæg, Heim, & Karahasanović, 2011; Gunkel, 2003; Lenhart et al., 2003; Partridge, 2003; Wei et al., 2011; Zhong, 2011). Supporting an idea from an earlier research in digital outcome divide, a recent study conducted with primary school students establishes motivational factors to have a significant impact on how digital divide is shaped in educational contexts (Ghobadi & Ghobadi, 2015).

Today we stand on the cusp of a socio-cultural and technological transformation, bringing a shift in attention towards digital divide research (Dijk, 2006). According to Pachler et al. (2010), the current situation of the world around us may be characterized as fluid (always tending to change), provisional, and unstable, where the responsibility for using technologies appropriately, meaning making and other risk taking have been transferred from institutions to individuals. Individuals make use of technologies and media more personally with more flexibility and mobility within different worldly spaces and contexts.

3. RESEARCH DESIGN

Different approaches can be used to investigate the integration of digital learning technologies and strategies in classrooms. Some of the approaches include social constructivist perspective (Khalid et al, 2014) and experimental approach using pre- and post-tests (Martin & Ertzberger, 2013). Cheung and Hew (2009) suggest research designs to include surveys, interviews or observations when investigating technology enabled learning and similar initiatives.

The case study method is suitable when the objective is to learn about the environment in more detail (Dubé & Paré, 2003). In general, a case study examines a phenomenon in its natural setting, using multiple methods of data collection to gather information from one or more entities. Case studies are common research designs for exploratory (theory building), explanatory (theory testing) and descriptive (description of the context) in social science research (Yin, 2003). In this study, a descriptive case study has been used to present a longitudinal case of a secondary school implementing the BYOD policy. Surveys and interviews are used as main methods for data collection. According to Yin (2003), case study design with a single case is suitable when the study represents a unique, revelatory or critical case. Our study follows an in-depth single case study research design with continued investigation over a period of time. The case chosen is representative of the research problem and field of enquiry we are investigating since the said case is one of the earliest adopters of BYOD in New Zealand.

4. SOCIOCULTURAL ANALYSIS FRAMEWORK

Drawing on further from our previous research (Adhikari, Mathrani, & Parsons, 2015; Adhikari, Parsons, & Mathrani, 2012; Parsons & Adhikari, 2016), we have focused our investigation next on the influences of digital/information literacy, computer self-efficacy and nature of technology usage with the aim to increase understanding of how personal, behavioral and environmental factors influence learning outcomes which are known to result in digital outcome divide. The focal constructs identified for further

investigation impacts learning activities not only on formal spaces like classrooms but also in informal spaces, such as home environments. Therefore, a sociocultural approach is adopted to investigate the learning process within formal and informal learning spaces mediated by one-to-one ICTs. Our framework (Figure 2) adapted from Pachler et al. (2010) analyses interrelationships between three components, namely structures, agency and cultural practices. Learning using one-to-one devices in and around different learning spaces is further influenced by a triangular relationship spread across structures (imposed by curricula, communication, technology), agency (such as self and other users/actors) and cultural practices (or social interactions in everyday life) (Pachler, Bachmair, et al., 2010; Pachler, Cook, & Bachmair, 2010).

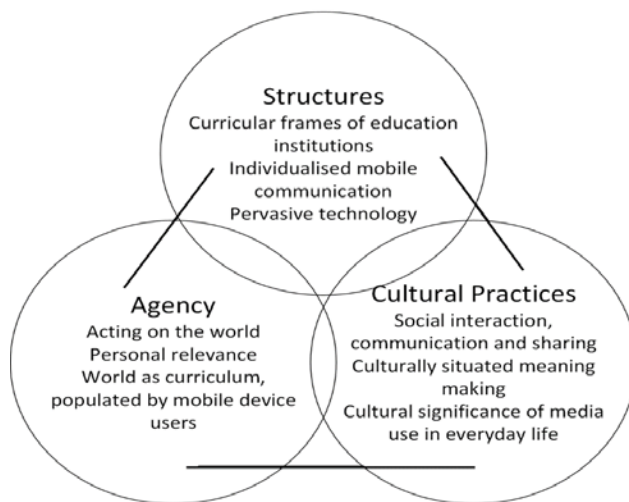


Figure 2: The sociocultural framework used in our analysis (adapted from Pachler et al, 2010)

Our analysis aims to identify data related to the focal constructs (digital/information literacy, computer self-efficacy and nature of technology usage) informed from our previous research, and possible relationships with specific enablers within each of the three concepts of the sociocultural framework where possible. For the purpose of this paper, we use narrative storylines from teacher interviews to reveal insights in learning outcomes divides existing over the course of the policy implementation starting from the inception to mature stage.

Four research questions were posed to teachers to probe the learning outcome divide aspect based on the three level digital divide framework:

1. How has the BYOD policy contributed towards the transformation of digital skills and literacy to enhance the student experience?
2. What challenges were encountered in the overall learning process with BYOD policy?
3. What changes did the BYOD policy bring to computer self-efficacy among learners?
4. Did the BYOD policy bring any change in knowledge acquisition, attitude, behavior and progression towards learning? How?

5. DATA AND METHODS

The source data for answering these questions comes from a set of semi-structured interviews conducted with five teachers involved in the BYOD policy after obtaining appropriate ethics approval. All interviews were anonymous and voluntary. Teachers who had been with the school since the start of the BYOD policy were selected for this study.

The interviews conducted with teachers provided rich insights into the BYOD policy. Thematic analysis of data was approached followed by qualitative coding of the interview data. As Saldaña (2009) notes, coding of qualitative data has potential to be influenced by a number of factors shaping the interpretation of the data. In this case, the focal constructs identified for further investigation in the previous research

(Adhikari et al., 2015) are used as main constructs for qualitative coding. The main constructs of the three components from the sociocultural framework (Figure 2) have been used as the units of analysis.

6. CASE ANALYSIS AND FINDINGS

6.1 Qualitative Coding

Semi-structured interview data were analyzed in NVivo, coded using emergent themes (developed from repeated ideas) and subsequently gathered together under predefined focal constructs for investigation. Following a simple content analysis of repeated ideas, the broad emergent themes are outlined in Table 1, cross referenced by three components of the sociocultural framework for mobile learning.

Focal Constructs for Investigation	Structures Themes	n	Agency Themes	n	Cultural Practices Themes	n
Digital/ Information Literacy	Classroom curricular practice	13	Improved access to resources	8	Student learning practices	11
	Suitability of technology used for learning activities	9	Digital skills and agency of learner	19	Support from parents and teachers	12
	Technological and other support from School	9				
Challenges in BYOD Policy	Availability/affordability of learning technologies	9	Student attitude and behavior	22	Skills and motivation of teachers	27
			Impacts on student learning activities	14		
	Curricular framework and teaching practices	10	Acceptance of BYOD	8	Student Motivation	30
Learner Self-efficacy	Teaching and learning strategy within classroom	27	Ability of meaning making in the context of BYOD	10	Learning support between formal and informal spaces (Extension of formal learning).	15
	Giving agency to students	31	Student learning outcomes	25		

Table 1 : Qualitative coding of teacher interviews data

From the number of themes identified under three main constructs, we found that teachers tended to address themes related to challenges in BYOD as either positive or negative. Furthermore, their responses had higher number of reactions related to cultural practices in and around school and at home. Teachers focused strongly on the agency of the learners as strong contributor for challenges in BYOD policy. In contrast, there was less mention of the information literacy construct. This may be because teachers are now at an advanced stage of ICT skills and hence do not consider this to be an important issue anymore. The coding of data also shows some obvious observations about their concerns like, acceptance of BYOD by all stakeholders with the availability and affordability of technology. This was considered one of the biggest concerns at the beginning of our study (Adhikari et al., 2012); however, now does not seem to be a major issue with the BYOD initiative having progressed to a mature stage. The following sections will provide the analysis of data based on each individual construct used for qualitative coding.

6.2 Digital/Information Literacy

Information literacy is the most important construct from a student's point of view in achieving better learning outcomes. Better digital/information literacy leads to improved skill development and knowledge

acquisition, which in itself is an evidence of better learning outcomes. In terms of information literacy among students, data shows mostly positive comments about the school structures that include classroom curricular practices, school infrastructure and other support, and suitability of technology being used for teaching. Change in structures with the classroom curricular practices is revealed as:

“It has changed my whole approach from being at the front of the class to being alongside the students. I would not say I have become one of them, but I am definitely alongside them now”

In reference to school infrastructure and support, the following comment shows level of determination from the school in terms of equipping disadvantaged students with learning technologies:

“School did a really good job in managing that by having laptops to help students whose family couldn’t afford devices”

Some of the comments from teachers show that school has been equally committed towards staff development by recognizing the importance of changing circumstances:

“Because all of the professional development, our journey has been easy so far. Even the training around Ultramet¹ has been fantastic. So I found it a really good journey.”

However, few concerns regarding technological infrastructure were expressed. Comments referred to quality of internet connectivity and a lack of unified approach to support overall learning activities. The following comments being typical:

“If I talk about our school, we need to improve on the connectivity and bandwidth we have. We have improved a lot over the years but it needs more of it.”

“I think the other challenges we have is not having the appropriate method of submitting large assessment files to teachers. We don’t have a universal system that works electronically for everything. We have to use different applications for different tasks.”

Despite some concerns, there seems to be considerable effort by school in setting of curricular structure to nurture and support the digital/information literacy among students. Majority of the teachers interviewed had trust and belief that student learning practices are going in the right direction.

“I don’t think all of my kids are on task all the time but I do think they are able to flip between things, and still produce really good quality work within the timeframe available.”

As long as better information literacy skills are on the making, changes in student learning practices will contribute to skill development, knowledge acquisition and overall learning outcomes.

“I think we are in a position where we are able to focus on merit and excellent rather than achieve. That’s because students have resources at their fingertips and don’t have to spend time here and there (like computer labs, library) and can invest that time on higher order thinking”

To summarize the analysis of the digital/information literacy construct, the data shows reasonable amount of evidence to conclude that the existing practices among students, teachers and school are steps in the right direction to achieve the goal of improved learning outcomes among students.

6.3 Challenges in BYOD Policy

This is the most talked about topic in the whole life of the BYOD initiative and attracted a lot of debate and disquisitions at the beginning from media, parents and the wider community. So much so, in fact the first two years of our research focused into identifying challenges in BYOD policy (Adhikari et al., 2012). Any challenge that appears on the part of either student, teachers or school is not a good sign for student learning as it is of paramount concern to every stakeholder, and defines the success and failure of the whole BYOD policy. This construct has been analyzed through qualitatively coded interview data as various themes associated with each component of the sociocultural framework emerged.

¹ Ultramet is a learning management system used by the school.

One of the biggest concerns of the BYOD policy during first few years was the availability and affordability of the learning technologies among students. However, recent comments from teachers show that this is now reduced to nominal level. The following comment shows extent of this issue currently:

“These issues are still there to a certain extent. I have had one student this year that’s been most of the year without device. And she got a device later in the year. So, instead of three or four at the beginning of BYOD policy, it is now minimal and down to one or two”

Despite few concerns around affordability and availability of one-to-one devices among students, the school has a good system to support disadvantaged students. Students without their own devices are provided devices in school. Further, teachers also work to ensure uninterrupted student learning.

“We do have some students that those don’t have access to Wi-Fi at home. So to get around that, we tell them to download all the learning materials at school.”

In reference to another most talked about topic of discussion as a part of the challenges was student and teacher motivation towards teaching and learning in BYOD classrooms. What we noticed from teacher responses is, despite the effort from school and peers, some of the teachers haven’t changed much. This can potentially restrict their ability to contribute more to the emerging new teaching and learning environment. The following comment shows some lack of interest in leveraging technology for maximizing of their teaching delivery.

“My style unlike other teachers in the school hasn’t changed radically; devices are just means to an end”

Teachers are the most important stakeholders in the whole BYOD policy and are key strategic enablers or differentiators in bringing change. Teachers have the potential to make BYOD a strategic part of the student learning process and are at the forefront of this change, as is evident from the comment below.

“The most important thing is, if you don’t upskill you will fall behind. And when you fall behind, it obviously means your students fall behind. We have got 100 teachers in the school and if 10 of them are step behind, that’s going to affect those 10 teachers and their 20/30 students in each class. And that’s a lot of students to be affected by that.”

Overall, findings reveal students to be more engaged in leveraging technology to up-skill themselves. Despite few negative comments, majority of teachers agreed on the positive changes in students’ behavior. The following comment reflects the positive impact on students:

“As far as I am aware, we haven’t had many changes apart from more positive changes with kids, that a disengaged being more engaged.”

This discussion would not be complete without some assessment on student learning activities and their attitude and behavior. Data shows mixed feelings with some concerns around students’ attitude and behavior. Despite recognizing positive changes in student motivation, teachers are concerned about their behavior in the way one-to-one devices are being used. One teacher says:

“In a negative point of view, the changes we have seen is some of the inappropriate behavior using their one-to-one devices.”

Another teacher goes even deeper into the issue and confirms one of the worst fears of parents.

“I think because they have got access to internet 24x7, they are exposed to a lot of things, which they wouldn’t have otherwise, like pornography. When I walk past kids iPads, I don’t know how to deal with it because I quite often get objectionable materials being opened. And that of course changing their attitudes, they are not as innocent as they should have been.”

However, student also seemed to amaze teachers with positive changes in their learning activities somehow, despite some concerns here and there like poor handwriting skills. The following comments shows students acceptance of BYOD policy.

“Nobody has complained over the last few years for the fact that having to use the devices have an impact on their learning. I think it has improved their learning capabilities.”

"I love the fact that students are not so much consumers as they used to be. They are more creators of knowledge and that for me is amazing. I love the fact that, they gather information to create something to show they have understood. They are more creators than consumers now. So I think that for me is the best thing about BYOD."

To summarize there still remain some challenges. Despite better outcome in matters like technology affordability, motivation among students and their learning activities, there needs to be a strategy to ensure positive changes in student attitude and behavior resulting into improved learning outcomes.

6.4 Learner Self-efficacy

Learner self-efficacy has its root in the three level digital divide framework (Figure 1), adopted for our research. The framework describes self-efficacy as one of the major predictors of the digital capability divide, which in turn leads to digital outcome divide in combination with some other factors. Therefore, exploring self-efficacy is very important for understanding its effects on student learning outcomes. In this analysis, we cross examine this construct using the sociocultural framework (Figure 2). In reference to the school curricular structure, teaching and learning strategy is designed to promote and maximize student engagement, benefitting them on the long term. Majority of the learning activities are designed with emphasis on being student focused. The following comment reflects this change:

"We are doing more student focused activities, rather than teacher sitting in front of the class and teach. Students are going and finding their information and that's what the devices are good for."

Another comment reveals how BYOD helped to bring a balance between the fastest and the slowest learners. Slow learners are provided an extra opportunity to learn on their own pace, without having to worry about the pace of others. One teacher says:

"It is a game changer when slowest student doesn't have to go at the same pace as the fastest student in class. Where you go with your own pace and teachers will be available to support you throughout your learning activities."

Teaching and learning strategy currently being practiced by teachers doesn't just maximize student engagement, but also gives them more freedom, responsibility and ownership of their learning. The following comments from different teachers show the change in their mindset in the new environment.

"One change we have seen is people develop into independent learners."

"On a good day, you come here and you will see students outside. They are still on task but they are choosing different learning environment for them."

"Very first thing is, let the students be and trust that they are going to take ownership of their learning."

Another thing that emerged from BYOD policy is the change in boundaries between formal and informal learning spaces. As a result of the BYOD policy, the teaching and learning process that starts in school has been extended to out of school and at home. Teachers see one-to-one devices as the link between school and informal learning spaces, like home. One typical comment about boundaries states it simply:

"I think it has extended the boundaries even when students are away, they can access Ultranet virtually anywhere in or out of the school."

The following comment explains the extension of boundaries between learning spaces in the practical context and shows how important and embedded it has become in teaching and learning.

"If the student is working on a project in google docs, I can be at home and monitor and offer my help if needed. Sometime, when I check student work, it happens to be that they are working on it on the same thing at the same time."

Thus, both of the teaching and learning strategies discussed above have a lot of scope in shaping students' abilities to meaning making and improving their learning outcome, which both impact learner's self-efficacy. One comment states it simply:

"For majority of students, they have improved on critical thinking ability."

At the same time, concerns about every student not being on the same page and not having same level of information literacy skills were raised.

“Some students are lot more confident in finding, processing and applying information they come across and others don’t. I think that’s what separates your achieved students with excellent ones, because quite often your excellent students have higher level of information literacy.”

Interestingly there were no conflicting views about improvement in student learning outcomes over the years of BYOD policy. There was a strong feeling among teachers that BYOD has definitely contributed in improving learning outcomes.

“The results that we are getting since having BYOD are improved. I definitely would be very surprised if results go down.”

“I think the critical thinking ability in majority of students have improved because I find their essays lot more detailed and with in-depth information. They have lot more insightful comments.”

Finally, everything including school curricular practices, giving students’ agency and ability of meaning making are complementary and support students to build their self-efficacy in the context of BYOD policy. This in turn has a positive effect in achieving better learning outcomes among students.

7. CONTRIBUTIONS

This paper utilizes two main frameworks to analyze and investigate the relationships between the various sources of social cognitive abilities related to individual’s information literacy, learning activities and computer self-efficacy levels. This in turn affects their knowledge acquisition, skill development and brings about changes in attitudes and behaviors, which impacts learning outcomes. This paper has integrated the three level digital divide framework applied to the context of teaching and learning with sociocultural framework for mobile learning. We have used constructs from the three level digital divide framework and cross referenced it by three components of the sociocultural framework for mobile learning. This has led to some interesting findings and has been helpful in identifying certain key themes emerging from the study.

First, there has been a sense of satisfaction in terms of ability of students and teachers to access information instantly, resulting into critical thinking ability among students. The speed and ease of accessing any kind of learning resources have helped students to engage into critical thinking to meaning making. And at the same time, it has helped teachers to be able to change their classroom curricular practices to transform themselves to facilitators from teachers in front of the class. Second, data indicates that extension of boundaries between formal and informal learning spaces through different methods and activities resulted into improved student motivation. That in turn has helped teachers change their whole classroom curricular strategy to maximize the benefit of BYOD policy. Third, we have seen a growing enthusiasm in teachers in providing more agency to students by giving them more freedom and responsibility over their learning. This definitely has helped students take ownership of their learning and keep them motivated. It might have also relieved teachers from excessive workload as this analysis found no comments from teachers regarding challenges around workload. This was a huge improvement as this was identified as major challenge on the teacher’s part in early stage of our research. Fourth, analysis found a theme emerging from data, that the whole BYOD policy and school curricular practice lacks a unified approach to teaching and learning. This has probably caused a sense of dissatisfaction among students as they adapt to the teaching styles of various teachers. Teachers are aware of this situation and recognized the amount of effort students require to cope with different teaching methods by different teachers. However, individual teachers are not in a position to set a universal approach of teaching and learning. There is a scope for school to fill this gap and develop a teaching and learning strategy with one-to-one devices, which fits across the various subjects and school year levels.

Last but not the least, parents and teachers have expressed concerns over the 24x7 unsupervised access of internet by students. Data from the teacher interview shows concerns about the safety of students from the risks imposed by unsupervised access to internet. Some of the comments from teachers show that students are already exposed to risks like pornography and cyber bullying. And to some extent, this might be one of the reasons for some non-improvement in student attitudes and behaviors.

8. CONCLUSIONS AND LIMITATIONS

This study has offered new insights into our research through new themes that emerged during the qualitative analysis of the coded interview data. Data indicates some improvements in school and classroom curricular practices in a bid to achieve success of BYOD policy. Whereas, there have been some issues that stayed stagnant and which haven't improved as much, despite the problem being visible quite clearly, and that too from early stage of the BYOD policy. These include issues like student attitudes and behaviors and digital safety of students through exposure to internet. However, all in all the data has provided a fresh look into the research study.

The views expressed in this study are from five teachers which is a limitation of this study. However, these five teachers have been with the school since the start of the BYOD policy and hence their views are representative of the overall changes which occurred over the years.

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