**QUEEN'S
UNIVERSITY
BELFAST**

Evolving digital divides in information literacy and learning outcomes: A BYOD journey in a secondary school

Adhikari, J., Scogings, C., Mathrani, A., & Sofat, I. (2017). Evolving digital divides in information literacy and learning outcomes: A BYOD journey in a secondary school. *International Journal of Information and Learning Technology*, 34(4), 290-306. <https://doi.org/10.1108/IJILT-04-2017-0022>

Published in:
International Journal of Information and Learning Technology

Document Version:
Peer reviewed version

Queen's University Belfast - Research Portal:
[Link to publication record in Queen's University Belfast Research Portal](#)

Publisher rights
Copyright 2017 Emerald. This work is made available online in accordance with the publisher's policies. Please refer to any applicable terms of use of the publisher.

General rights
Copyright for the publications made accessible via the Queen's University Belfast Research Portal is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy
The Research Portal is Queen's institutional repository that provides access to Queen's research output. Every effort has been made to ensure that content in the Research Portal does not infringe any person's rights, or applicable UK laws. If you discover content in the Research Portal that you believe breaches copyright or violates any law, please contact openaccess@qub.ac.uk.

Evolving Digital Divides in Information Literacy and Learning Outcomes: A BYOD Journey in a Secondary School

Author 1

Author2

Author 3

Author 4

Abstract

Purpose: This study seeks answers to questions on how equity of information literacy and learning outcomes have evolved with the ongoing technologies advances in teaching and learning across schools. We report on a five year long BYOD (Bring Your Own Device) journey of one school, which was one of the earliest adopters of one-to-one learning devices in New Zealand.

Design/methodology/approach: Using a socio-cultural ecological lens for analysis, a longitudinal study has investigated aspects of how digital/information literacy, computer self-efficacy, and nature of technology usage are transforming school and classroom curriculum practices.

Findings: Study findings reveal a significant shift in social and academic boundaries between formal and informal learning spaces. One-to-one learning devices provide the link between school and home, as students take more ownership of their learning, and teachers become facilitators. Curricula changes and proper technological support systems introduced in the school structures have given agency to students resulting in greater acceptance of the BYOD policy and extensions to learning beyond formal classroom spaces. Digital divide amongst learners has evolved beyond equity in access and equity in capabilities to become more inclusive, thereby paving the way for equity in learning outcomes.

Research limitations/implications: This study has been conducted in a school which is located in a relatively high socio-economic region. To achieve a more holistic view, there is a need for further studies to be conducted in schools from low socio-economic communities.

Originality/value: This paper adds to existing literature by sharing teacher reflections on their use of innovative pedagogies to bring changes to classroom curricular practice.

Keywords

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

1. Introduction

Immersion with information and communication technologies (ICTs) in our lives has altered the way information literacy skills are being perceived among the general population. Media-rich collaboration tools having more visual effects such as animations, drag, drop and click events are being used to engage young and old. These tools in turn have transformed how formal education is being delivered as novel learning activities are being designed and assessment models are being aligned with the current teaching curriculum (Demiraslan & Usluel, 2008; Mardis & Everhart, 2013). Teaching methods when assisted by appropriate technical tools, systems and services help to transform teaching and learning practices (Mardis & Everhart, 2013; Sampson, Ifenthaler, Isaías, & Spector, 2014). Individuals (in this case, teachers) based on their defined profession (namely teaching) create their own context-adapted approaches (or teaching delivery styles) in their attempt to control chaos within their work domains (or classroom spaces), thereby making a more inclusive learning organization (Örtenblad, 2015). Or, in other words, teachers experiment with rich digital technologies as they integrate them into their existing teaching deliveries, thereby enabling innovative pedagogical practices in their schools. Further, with advances in technologies, opportunities to search and retrieve information have improved immensely, especially among learners who can explore themselves. The penetration of mobile, handheld devices and 24/7 access to the internet have created more prospects for both educators and learners to collaborate on learning activities from anywhere (Newhouse, Lane, Cooper, & Twining, 2014). Having said that, only the availability of technologies and ability to operate those devices are less than likely to improve the learning experience and outcomes (Bailey, Schneider, & Ark, 2012). Information literacy skills are key to make learners make proper use of available material resources and is crucial for learners to realize their potential in future endeavors (Mardis & Everhart, 2013; Meyers, Erickson, & Small, 2013).

Earlier studies about the integration of technology in learning environment indicated that mere integration of digital learning technologies into existing pedagogical practices might end up contributing nothing more than physical 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, 2005; Rivers & Rivers, 2004; Winter, 2004) within the teaching and learning environments. Supporting the earlier argument, Wei, Teo, Chan, and Tan (2011) too 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 by using a single definition.

Over the last two decades, technology has transformed the way we communicate and collaborate with people around us, and also in the way we learn. Because of that, ensuring strategies for equal distribution of these technological opportunities would help everyone to achieve digital inclusion. As a result, digital division (or, we could also say, digital inclusion) has become a primary concern for governments, policy makers, and researchers.

Therefore, to understand the phenomenon of the digital divide in the current learning context, a longitudinal case study of the BYOD policy was undertaken in one of the secondary schools in New Zealand. This provided us an opportunity to evaluate the use of teaching and learning technologies, curricular structure of school and ability of learners to gain the better learning outcome in the form of digital/information literacy in the single context. Some of our earlier research (Adhikari, Mathrani, & Scogings, 2016; Adhikari, Parsons, & Mathrani, 2012) has 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 focuses on understanding personal, behavioral and environmental factors that influence digital capability divide and learning outcomes, which are known to result in digital outcome divides.

2. Evolution in Digital Divide Literature

The phenomenon of the digital divide has been studied in many contexts, which has resulted in multiple variations to our perceptions of this phenomenon, causing more confusion than clarification. However, the

shared understanding behind most of the studies are that the digital divide phenomenon is linked with many socio-economic issues, involving individuals and community groups; and this is now receiving increased attention from academics, researchers and policymakers around the world (Dewan, Ganley, & Kraemer, 2005).

The most common understanding of the digital divide phenomenon is the digital access divide. It is the division between those with access to digital technologies and those who do not (Cullen, 2001; Dijk, 2012; Zhong, 2011). Earlier studies on the division of access to technologies established some determinants for gaps between haves and have-nots, and identified financial status, household income, educational level, type of occupation and geographical location as being the most common factors. The digital access divide (also known as the *first level* or *first order digital divide*) is considered to be one of the earliest concepts of digital divide. Research around this aspect of the digital divide continues to be relevant in understanding the phenomenon in different social contexts (Araque et al., 2013).

Further study on the phenomenon of digital divide has revealed 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). The study suggested that people who have been provided with access to technologies should also have proper skills to make meaningful use of available technologies (Bailey et al., 2012; Eynon, 2009). Without proper digital skills, these people will not be capable of taking even the basic advantages offered by the medium, as a result of which, digital divide could still persist in the form of digital skills divide (Ghobadi & Ghobadi, 2015). This supports 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).

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 *third level* of 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 differences in the outcomes achieved by users of digital technologies determined by 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 digital inclusion and equity in learning outcomes in educational contexts (Ghobadi & Ghobadi, 2015).

In these present times, we stand on the cusp of a socio-cultural and technological transformation, bringing a shift in attention towards how digital divide is being steered with adoption in ICTs (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 digital 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. With the widespread diffusion of the internet, individuals often work towards developing digital skills by exploration and experimentation by trial-and-error or do-it-yourself approach in the safety of their homes (Matzat & Sadowski, 2012). Moreover, this immersion with technologies extends across a spectrum of age groups in areas related to education, social media, gaming environments, and professional work practice amongst others.

3. Descriptive Case Design

A number of 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. The school we have used for the purpose of our study is co-educational, state funded and ranked at the decile¹ 9 in the New Zealand school system.

According to Yin (2003), case study design with a single case is suitable when the study represents a unique, revelatory or critical case. 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. 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.

Our study is based on the longitudinal analysis of a single case of a secondary school over a five year journey. In this paper, we probe the learning outcome divide aspect based on the three level digital divide framework (Figure 1). Four research questions are posed:

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?

The source data for answering these questions comes from a set of semi-structured interviews conducted with five teachers involved in the BYOD policy. The criterion for selection of teachers was that they should have been with the school since the start of the BYOD policy. Proper ethical approval for sought before conducting teacher interviews. All interviews were voluntary and teachers were assured of their anonymity. The interviewees provided rich insights into the BYOD policy. Thematic analysis of interview 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 (digital/information literacy, computer self-efficacy, and nature of technology usage) identified in our previous research are used as main constructs for qualitative coding (Adhikari et al., 2016). Further, the three components from the sociocultural framework (Figure 2) have been used as the units of analysis. Our analysis aims to identify data related to the focal constructs informed from our previous research, and possible relationships with specific enablers within each of the three components of the sociocultural framework where possible. Narrative storylines regarding learning outcomes divides existing over the course of the BYOD policy implementation starting from the inception to mature stage obtained from teacher interviews are shared.

¹ Deciles are a measure of the socio-economic position of a school's student community relative to other schools throughout the country.

4. Socio-cultural Analysis Framework

Drawing on further from our previous research (Adhikari et al., 2016; Adhikari et al., 2012; Parsons & Adhikari, 2016), we have focused our further investigation on the influences of digital/information literacy, computer self-efficacy and nature of technology usage. Our aim is to increase understanding of how personal, behavioral and environmental factors influence learning outcomes that are known to result in digital outcome divide. The focal constructs identified for further investigation have potential to impact learning activities not only on formal spaces like classrooms, but also across informal spaces, such as homes and anyplace outside the school premises. Therefore, a sociocultural approach is adopted to investigate the learning process within formal and informal learning spaces mediated by one-to-one digital learning devices. Our framework (Figure 2) adapted from Pachler et al. (2010) analyses interrelationships between three components, namely structures, agency and cultural practices. Engagement with learning activities using one-to-one digital learning devices in and around different learning spaces is further influenced by a triangular relationship linking structures (imposed by curricula, communication, mobile technologies), 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). Each of the three components of the socio-cultural framework aligns with the BYOD case study being investigated and helps to scaffold the interrelationships between key stakeholders, practices and structures governing the teaching and learning.

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

Figure 2, above shows the various points of reference within each component that relates it to our study. One of the component, agency is all about the ability of acting on the world. In the context of our study, agency is having adequate digital/information literacy skills for using digital tools, thinking critically to be able to process and apply available information knowledgeably. Cultural practices on the other side emphasize the areas that can benefit learning, as they relate to collaboration, meaning making, situational knowledge and media use. However, there is a chance that student learning are influenced by the psychological variables such as beliefs, attitudes and perceptions of teachers in the context of BYOD classrooms, as result of the social interactions (Salleh, 2016). Cultural practices in the context of BYOD are evolving based on student agency as social interactions over the digital world are enabled by the communications network. At the end, structures relate to the digital learning technologies, school infrastructure to facilitate BYOD classrooms, and the curriculum within which they are applied. Overall, digital environments are internalizing behaviors and transforming learning and meaning-making in a positive direction.

5. Case Analysis and Findings

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 various learning spaces and settings. Teachers focused strongly on the cultural practices and agency of the learners as strong contributors for challenges in BYOD policy. In contrast, there was less mention of the information literacy construct on the same themes. 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 increased availability and affordability of technology. Availability and affordability of technologies was once 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 interview data based on each individual construct used for qualitative coding.

6.1 Digital/Information Literacy

Information literacy is the most important construct of our study since the start of the BYOD journey. With the greater integration of technologies into every aspect of teaching and learning, it is critical that learners have appropriate level of digital/information literacy to be able to achieve better learning outcomes (Bailey

et al., 2012). 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 construct, interview data shows that the comments related to the school structure were generally of positive nature. Themes that emerged from the qualitative coding in this construct include classroom curricular practices, school infrastructure and other support, and suitability of technology being used for teaching. Undoubtedly, transition to the BYOD was a big shift for school, teachers and learners, and majority of teachers seemed to have embraced the opportunity to make positive change from their part. Change in the curricular structures within the classroom practices is revealed as exciting by teachers. Comments from teachers highlighted how teachers are putting their individual efforts to make the BYOD policy successful. One teacher's comment below shows how technology in classrooms has changed their approach of teaching.

"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 planning to support the policy, following comment shows level of determination from the school to ensure the equity of access to digital learning devices for learners.

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

With the huge shift in the school's pedagogical approach, school has done exceptional work in the professional development for teachers through conferences, seminars, mentoring programs and peer support. Comments from teachers actually reflect the professional development commitment from school towards staff development. The following comment reiterates the supportive transition to BYOD classrooms.

"Because all of the professional development, our journey has been easy so far. Even the training around Ultramet² has been fantastic. So I found it a really good journey."

However, some issues were reported regarding technological infrastructure support by the school with the sudden shift in pedagogical approach. Teachers expressed concerns over some issues they faced related to their teaching. Majority of comments about technical issues referred to the quality and reliability of internet connectivity.

"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."

Other concerns which were reported related to the technological infrastructure was a lack of a unified approach around the learning management system and other tools (software) to support overall learning activities. Even after going to digital delivery of learning resources, there seemed an absence of a common workflow model related to the submission, marking and feedback. The following comments being typical:

"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 facilitating teachers and learners to participate into BYOD classrooms. This includes nurturing and supporting the digital/information literacy among students. 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"

² Ultramet is a learning management system used by the school.

Regarding cultural practices, generally the teachers expressed trust over the classroom learning practices and believed that student-learning practices to be 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.”

To summarize the analysis of the digital/information literacy construct, there is a 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.

6.2 Challenges in BYOD Policy

This is the most talked about topic since the beginning of the BYOD initiative at the school we are working with, and attracted many debate and disquisitions led by 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, Mathrani, & Parsons, 2015; Adhikari et al., 2012). We were quite open in our approach on those initial days of the BYOD policy journey and our strategy was to let the discourse of the initiative guide the direction of our research. After the initial stage of denial, the debate/discourse on the topic took a sharp turn to some other key issues like information literacy, effective teaching methodologies and collaborative approach towards learning. No doubt, there have been new challenges appearing along the way, the discourse started to focus more on the solution. No matter what, any challenge that appears either related to student, teachers or school, is not helpful to achieve the overall objective of better learning outcomes through greater level of digital equality. After all, student learning is of paramount concern to every stakeholder, and defines the success and failure of the whole BYOD policy.

It is of no surprise that one of the biggest concerns that came out of first few years was the availability and affordability of the digital learning technologies for students. A positive indication on the success of the BYOD initiative can be gauged from recent comments made by teachers, which unveils a narrowing of the gap for access/availability to technologies. It is fair to say now, that this has now reduced to a nominal level. The following comment presents the current state of this issue:

“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”

To address the issue of access to learning devices within the classroom, school has a good system to support the students coming to school without any devices. The school maintains a pool of devices which can be loaned during school hours to support learning in classrooms. The issue of access comes in a range of variations like students without any devices but internet and computer at home, and students with devices but no internet at home. Therefore, teachers have to deal with the variety of issues within classrooms and so have come up with a solution to that. The following comment shows a simple solution for students with devices but no internet at homes.

“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.”

Despite few concerns for access and affordability of one-to-one digital learning devices, acceptance of the BYOD classrooms have increased among students, teachers and parents.

Second aspect of the current construct is the attitudinal, behavioral and motivational issues associated with the students and teachers. As we are aware, the school had to face a backlash from all of the stakeholders at the time of launching BYOD classroom initiative. The denial in transition to BYOD classroom was present within classroom for a while and appeared in the classroom in the form of behavior and motivation problems. Many teachers expressed challenges in classroom management during first two years. The following comments reveal some issues regarding attitude and behavior within classrooms:

“Yes. Initially when students came in with parents misgivings and saying well that’s not how I have been taught so why should we change things. They will come in without realizing with pre-conceived ideas. Those were the challenges you would have to breakdown.”

“Well, what makes people learn is interest and engagement. And that’s what the technology gives them. That makes learning interesting and engaging. I am you could be the brilliant and intelligent person

in the world with the best information literacy. But if you are not interested in something you are not going to be bothered, are you? So that's what these do, they make you interested."

"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."

Overall, findings reveal the positive change in student engagement in leveraging technology to up-skill themselves. Despite few issues, many teachers agreed on the positive changes in students' behavior:

"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."

On the other side, interviews with teachers revealed that some of the teachers (specifically the older teaching staff) were not buying in the whole idea of BYOD classroom and taking this as just the introduction of another stationary item and think that it will just add extra work load to the teachers (Selwyn, Nemorin, & Johnson, 2016). Because of that, there was a 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 to bring positive change. However, if there are individual teachers with lack of interest in leveraging technology for maximizing benefits of the BYOD classrooms, it directly affects the students and their agency for learning activities.

"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."

With the presence of few teachers not so keen on the BYOD classroom even after the years of implementation, there seemed some dissatisfaction among other fellow teachers within school. One typical comment sums up the feeling:

"I think it depends on the teacher expectations to some extent. Like, I don't entertain any of that grumbling. And if they start going on like that, I say you have right to choose another school and this is the way we do things here. There is no other option and you have to participate and cooperate if you choose to be here. It might be exempt in few situations if there is a reasonable excuse on why they can't do it."

Regarding the changes in motivation, students 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."

The positive change in the motivation was not just limited to the students. Majority of teachers are also very enthusiastic and enjoying the BYOD classroom.

"I think, looking at it and thinking totally invigorated teaching. I have been teaching for 25 years, and the first time we are not talking this naughty or that naughty one, but about what everyone tried in their teaching and all the positive things."

To summarize, despite better outcomes in access and affordability of technologies and the positive changes in motivation among students and teachers, there remain some challenges. Most importantly, there needs to be a strategy to ensure positive changes in student attitude and behavior within the classrooms.

6.3 Learner Self-efficacy

Learner self-efficacy is relatively new aspect of our investigation and 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 (Wei et al., 2011). Therefore, exploring self-efficacy has become very important for understanding its effect on student learning outcomes. Analysis in this section will cross-examine this construct using the sociocultural framework (Figure 2). In reference to the school curricular structure, teaching and learning strategy has been developed to promote and maximize student engagement. Majority of the learning activities are designed with emphasis on student-led learning with greater responsibility for their on their part. 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."

Teaching and learning strategy being practiced by teachers does not just maximize student engagement, but also gives them more responsibility. Responsibility in this context has been given through learning designed to 'lead by' learners. There can be a range of learners within the same classroom in terms of their pace and ability of learning and therefore, giving extra responsibility to students through student-led learning might seem unfair in the first instance. However, it has worked quite nicely to bring the balance between the fastest and the slowest learners. The student-led learning approach has provided an extra opportunity for students to learn and understand 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."

Apart from the greater responsibility for their learning, literature suggests giving more agency to the learners as an integral part of the process in the technology enhanced teaching and learning context (Pachler, Bachmair, et al., 2010). This has been found to be practiced in the context of our case study by giving more freedom and ownership of their learning (Wei et al., 2011). Teachers have embraced the idea of giving more autonomy and ownership to students in many different ways. The following comments from teachers show the change in their mindset in the evolving BYOD 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."

One of the most significant change that emerged from BYOD policy is the disappearance of boundaries between formal and informal learning spaces to allow for participation into learning activities and collaboration. Effectively, the learning activities that start in the classroom can still be completed and collaborated from anywhere (i.e. out of school). With one-to-one devices now becoming the norm, the help of appropriate apps and good quality internet can extend the scope of participation in learning activities, thereby linking formal and informal learning spaces. 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 in the context of our case.

“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.”

Combining all of the innovative and positive changes discussed above, there is a lot of scope in shaping students' ability of meaning-making to improve their learning outcome. That in turn has potential to shape the self-efficacy of the learners. One comment states the positive changes experienced simply:

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

At the same time, where it worked very well for people with adequate level of digital/information literacy, there have been some concerns about those without the same level of digital/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.”

Based on the themes emerged during the analysis of data, it is evident that everything including transformation of school curricular practices, greater agency to student and improved ability of meaning making are supportive to build self-efficacy among students. This in turn has a positive effect in achieving better learning outcomes in the context of BYOD classrooms.

6.4 Learning Outcomes

The most obvious question that comes in the mind after the implementation of BYOD policy is that, did it bring any changes to the student's learning outcomes in any ways? The answer to this question is not simple, because the changes introduced by BYOD policy altered the traditional teaching and learning landscape. It transformed the role of teacher within the classroom, changed the way students and teacher communicate and expanded the way learners collaborate on learning activities. We can categorize the outcomes of the BYOD policy into two major areas, one is motivation, knowledge acquisition and progression towards learning and other is transformation in attitude and behavior of learner.

In terms of the motivation, knowledge acquisition and progression, the analysis shows positive outcome. Following comments from teachers indicate towards the success of BYOD policy in terms of access to information and ability to think critically and use available information in a meaningful way.

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

“I am marking essays at the moment and they have done more than five paragraphs of writing on an average. For the same task students used to come up with just a paragraph or so. Therefore, we know that they are more engaged and motivated towards learning.”

At the same time, whereas majority of students are doing well and are more motivated and engaged, some of the students are not. The real point of difference between them is the ‘information literacy’, which one group has and other does not. The following comment explains the real reason for that difference.

“Some students are lot more confident in finding, processing and applying information they come across and other 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.”

Despite few challenges and difficulties, the feeling from all the stakeholders and overall outcome in the motivation, knowledge acquisition and progression is positive, as explained in the following comments.

“As I said earlier, digital skills are improving among students for sure. They are getting better at operating the learning devices every day.”

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

“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.”

In terms of the other category related to the attitude and behavior, the results are not as positive as the earlier one.

“But then some kids they seem to be on task may not necessarily be on task. You are still catching them in facebook and they are still playing game.”

“You are never going to stop students going off task. It’s the way you manage that’s important.”

“Although we put responsibilities to the kids, they don’t always take their responsibilities. They will be the kids no matter what and they like saying no and being rebellious sometimes.”

“In a negative point of view, the changes we have seen is some of the inappropriate behaviour using their one to one devices. And I think that’s always going to be a problem. You are trying to crack down as hard as you can with putting them off the internet connection, but the students are very clever to hide things and work around loopholes.”

The other thing is, the hype of it is coming down and students are getting comfortable using it, as I have said earlier they are getting better in finding loopholes and there is an increase in students going off task.

Overall, there seem to be a positive trend in terms of the knowledge acquisition and critical thinking and still some issues around the attitudes and motivations. The feelings from the teachers indicate that they are not too much concerned with student attitude or behavior issues, as long as students are satisfying the minimum standards in their learning activities. With the increased agency being offered to learners in their learning process, the views from teachers’ looks rather relevant, as one of the important condition of offering students more agency is to have trust in them. A comment from one teacher sums up the expectations between the teacher and learners in and around BYOD classrooms.

6. Contributions

This paper combines two frameworks to cross-examine the relationships between the various sources of social cognitive abilities related to individual’s information literacy, learning activities and computer self-efficacy levels. 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 three main constructs used to investigate social cognitive abilities identified from our earlier research (Adhikari et al., 2016) and cross-referenced it with socio-cultural framework for mobile learning (Pachler, Bachmair, et al., 2010) to explore how each of the three component govern the student learning activity in the BYOD classroom. We have been able to establish that self-efficacy level in learners can potentially affect their knowledge acquisition, skill development and brings about changes in attitudes and behaviors, which in turn has a greater impact on the learning outcomes. This has led to many interesting findings and has been helpful in identifying certain key emergent themes over the five year BYOD journey.

First, there has been a sense of satisfaction in terms of better access to information enabled by personalized digital devices, resulting into improved critical thinking ability among students. The speed and ease of accessing any kind of learning resources have helped students to engage into critical thinking and meaning making. This led to teachers feeling confident to introduce innovative pedagogies to change their classroom

curricular practices and become facilitators from teachers in front of the class. Second, analysis clearly shows the gradual disappearance of the boundaries between formal and informal learning spaces through different methods collaborative activities, resulted into improved student motivation. That in turn has helped teachers change their whole classroom curricular strategy to maximize the potential 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 the responsibility over their learning. This has certainly helped students take ownership of their learning and keep themselves motivated. There was no theme emerging from the analysis about the workload, but greater responsibility and ownership of learning by students, relieved teachers from excessive workload in some ways. This was a huge improvement as excessive teacher workload was identified as major challenge at the 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 because of this. However, individual teachers are not in a position to set a universal workflow approach to address the issue. There is a scope for school to fill this gap and develop a teaching and learning strategy to fit across the various subjects and school year levels to support the BYOD classroom.

Last but not the least, parents and teachers have expressed some 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.

7. Conclusions and Limitations

Schools have a societal perspective with their core business in educating future citizens of the world. Using a socio-cultural lens, this study investigates how integration of one-to-one devices influenced teacher and learner experiences within a secondary school context near the end of a five year long BYOD journey. Rich insights on digital divide aspects related to information literacy and learning outcomes are shared after qualitative analysis of the empirical data collected. Abundant quotes from interview data have illustrated teachers' viewpoints in their own words and added contexts to digital learning strategies they have adopted.

We can categorize the findings into three main areas, namely curricular structures of the school, agency of the learners, and their cultural practices. The findings indicate the positive improvements in school and classroom curricular practices in a bid to achieve success of BYOD policy. This has been possible with the combined effort of school management, teacher efforts to implement the BYOD classrooms, and support from the stakeholders like parents.

Another area that have seen a very good progress within the BYOD policy is that, the teaching and learning practices/methods have been designed in such a way that the learner gets greater freedom and flexibility in participating into learning activities. This has contributed to learners being more independent learners with even greater responsibility of their learning.

At the same time, there have been some issues around the cultural practices that stayed stagnant and 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, motivation, behaviors and have a lasting effect on the ability to learn among learners. This may lead to poor student performance, increased outcome gap among the learners and sometime may well threaten the digital safety of students through exposure to internet. However, all in all the data has provided a fresh look into the research study

A limitation of this study is generalizability, since the secondary school where the study has been conducted is located in a reasonably high socio-economic region. Further similar studies need to be conducted in schools surrounded by low socio-economic communities. Another limitation of this study are that the views expressed in this study are from five teachers only.. 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 that occurred over the years.

8. References

- Adhikari, J., Mathrani, A., & Parsons, D. (2015). *Bring your own device classroom: Issues of digital divides in teaching and learning contexts*. Paper presented at the Australasian Conference on Information Systems, Adelaide.
- Adhikari, J., Mathrani, A., & Scogings, C. (2016). Digital Divide, BYOD Classrooms, Digital Divide in Learning, Formal and Informal Learning Contexts. *Interactive Technology and Smart Education*, 13(4).
- Adhikari, J., Parsons, D., & Mathrani, A. (2012). *Bridging Digital Divides in the Learning Process: Challenges and Implications of Integrating ICTs*. Paper presented at the 11th World Conference on Mobile and Contextual Learning Helsinki, Finland.
- Araque, J. C., Maiden, R. P., Bravo, N., Estrada, I., Evans, R., Hubchik, K., . . . Reddy, M. (2013). Computer usage and access in low-income urban communities. *Computers in Human Behavior*, 29(4), 1393-1401. doi: <http://dx.doi.org/10.1016/j.chb.2013.01.032>
- Bailey, J., Schneider, C., & Ark, T. V. (2012). Funding the Shift to Digital Learning: Three Strategies for Funding Sustainable High-Access Environments: Foundation for Excellence in Education.
- Brandtzæg, P. B., Heim, J., & Karahasanović, A. (2011). Understanding the new digital divide - A typology of Internet users in Europe. *International Journal of Human Computer Studies*, 69(3), 123-138.
- Cheung, W. S., & Hew, K. F. (2009). A review of research methodologies used in studies on mobile handheld devices in K-12 and higher education settings. *Australasian Journal of Educational Technology and Society*, 25(2), 153-183.
- Cullen, R. (2001). Addressing the digital divide. *Online Information Review*, 25(5), 311-320.
- Demiraslan, Y., & Usluel, Y. K. (2008). ICT Integration Processes in Turkish Schools: Using Activity Theory to Study Issues and Contradictions. *Australasian Journal of Educational Technology*, 24(4), 458-474.
- Dewan, S., Ganley, D., & Kraemer, K. L. (2005). Across the Digital Divide: A Cross-Country Multi-Technology Analysis of the Determinants of IT Penetration. *Journal of the Association for Information Systems*, 6(12), 409-431.
- Dijk, V. (2006). Digital divide research, achievements and shortcomings. *Poetics*, 34(4-5), 221-235.
- Dijk, V. (2012). The evolution of the digital divide. In J. B. e. al (Ed.), *Digital Enlightenment Yearbook 2012* (pp. 57-75). Amsterdam, Netherlands: IOS Press.
- Dubé, L., & Paré, G. (2003). Rigor in Information Systems Positivist Case Research: Current Practices, Trends, and Recommendations. *MIS Quarterly*, 27(4), 597-636.
- Eynon, R. (2009). Mapping the digital divide in Britain: implications for learning and education. *Learning, Media and Technology*, 34(4), 277-290. doi: 10.1080/17439880903345874
- Ghobadi, S., & Ghobadi, Z. (2015). How access gaps interact and shape digital divide: a cognitive investigation. *Behaviour & Information Technology*, 34.4, 330-340. doi: 10.1080/0144929X.2013.833650
- Gunkel, D. J. (2003). Second thoughts: toward a critique of the digital divide. *New Media & Society*, 5(4), 499-522.
- Hargittai, E. (2002). Second-Level Digital Divide: Differences in People's Online Skills. *First Monday*, 7(4).

- Lenhart, A., Horrigan, J., Rainie, L., Allen, K., Boyce, A., Madden, M., & O'Grady, E. (2003) *Pew Internet and American Life Project report*. Washington, DC: Pew Internet and American Life Project.
- Mardis, M., & Everhart, N. (2013). From Paper to Pixel: The Promise and Challenges of Digital Textbooks for K-12 Schools. In M. Orey, S. A. Jones & R. M. Branch (Eds.), *Educational Media and Technology Yearbook* (Vol. 37, pp. pp 93-118). New York: Springer New York.
- Martin, F., & Ertzberger, J. (2013). Here and now mobile learning: An experimental study on the use of mobile technology. *Comput. Educ.*, 68, 76-85. doi: 10.1016/j.compedu.2013.04.021
- Matzat, U., & Sadowski, B. (2012). Does the "Do-It-Yourself Approach" Reduce Digital Inequality? Evidence of Self-Learning of Digital Skills. *The information society*, 28(1), 1-12. doi: 10.1080/01972243.2011.629023
- Meyers, E. M., Erickson, I., & Small, R. V. (2013). Digital literacy and informal learning environments: an introduction. *Learning, Media and Technology*, 38(4), 355-367. doi: 10.1080/17439884.2013.783597
- Newhouse, P., Lane, J., Cooper, M., & Twining, P. (2014). *Redefining education: sustaining 1 to 1 computing strategies in Western Australian schools*. Paper presented at the Australian Computers in Education Conference (ACEC).
- Örtenblad, A. (2015). Towards increased relevance: context-adapted models of the learning organization. *The Learning Organization*, 22(3), 163-181. doi: doi:10.1108/TLO-06-2014-0027
- Pachler, N., Bachmair, B., Cook, J., & Kress, G. R. (2010). *Mobile learning : structures, agency, practices*: New York : Springer.
- Pachler, N., Cook, J., & Bachmair, B. (2010). Appropriation of Mobile Cultural Resources for Learning. *INTERNATIONAL JOURNAL OF MOBILE AND BLENDED LEARNING*, 2(1), 1-21.
- Parr, M., & Ward, L. (2005). *Evaluation of the digital oppertunities project FarNet: Learning Communities in the Far North*. Wellington.
- Parsons, D., & Adhikari, J. (2016). Bring Your Own Device to Secondary School: The Perceptions of Teachers, Students and Parents. *Electronic Journal of e-Learning*, 14(1), pp66-79.
- Partridge, H. (2003). Moving beyond the digital divide: Developing a psychological perspective of digital inequality. *Information Technology and Organizations: Trends, Issues, Challenges and Solutions, Vols 1 and 2*, 508-511.
- Rivers, J., & Rivers, L. (2004). *A Summary of the Key Findings of the Evaluations of the Digital Opportunities Pilot Projects (2001 - 2003)*.
- Salleh, S. (2016). Examining the influence of teachers' beliefs towards technology integration in classroom. *International Journal of Information and Learning Technology*, 33(1), 17-35. doi: doi:10.1108/IJILT-10-2015-0032
- Sampson, D. G., Ifenthaler, D., Isaías, P., & Spector, J. M. (2014). *Digital Systems for Open Access to Formal and Informal Learning* (D. G. Sampson, D. Ifenthaler, P. Isaías & J. M. Spector Eds.). Switzerland: Springer International Publishing.
- Selwyn, N., Nemorin, S., & Johnson, N. (2016). High-tech, hard work: an investigation of teachers' work in the digital age. *Learning, Media and Technology*, 1-16. doi: 10.1080/17439884.2016.1252770
- Wei, K. K., Teo, H. H., Chan, H. C., & Tan, B. C. Y. (2011). Conceptualizing and testing a social cognitive model of the digital divide. *Information Systems Research*, 22(1), 170-187.

- Winter, M. (2004). *Digital Opportunities Pilot Project (2001-2003) Evaluation of Generation XP*. Wellington.
- Yin, R. K. (2003). *Case Study Research: Design and Methods* (3rd ed.). Newbury Park: Sage Publications.
- Zhong, Z. J. (2011). From access to usage: The divide of self-reported digital skills among adolescents. *Computers and Education*, 56(3), 736-746.