

# Bridging Digital Divides in the Learning Process: Challenges and Implications of Integrating ICTs

**Janak Adhikari**  
Doctoral Student,  
Information Technology  
Massey University  
Auckland  
[J.Adhikari@massey.ac.nz](mailto:J.Adhikari@massey.ac.nz)

**Dr. David Parsons**  
Associate Professor,  
Information Technology  
Massey University  
Auckland  
[D.P.Parsons@massey.ac.nz](mailto:D.P.Parsons@massey.ac.nz)

**Dr. Anuradha Mathrani**  
Lecturer, Information  
Technology  
Massey University  
Auckland  
[A.S.Mathrani@massey.ac.nz](mailto:A.S.Mathrani@massey.ac.nz)

## ABSTRACT

This paper investigates an initiative by a New Zealand School to integrate one-to-one ICTs into the learning process, called 'bring your own device' (BYOD). Prior to embarking on the BYOD initiative, similar past initiatives have been studied and some persistent issues have been identified. Before starting with the detailed investigation of BYOD, a preliminary analysis of the public response data from different sources has also been conducted. From the past initiatives and preliminary analysis of public responses, we have been able to form general research questions for the study. A socio-cultural ecological approach to mobile learning has been considered appropriate as a means of analysis for this study.

## Author Keywords

ICT integration, learning outcomes, digital divide, one to one digital devices

## ANALYSIS OF PREVIOUS ICT INTEGRATION INITIATIVES IN NEW ZEALAND

Recent trends in education emphasize the integration of information and communication technologies (ICTs) to the existing pedagogy to transform the learning process. The introduction of ICTs provides potentially valuable resources for learners' academic and social development (Demiraslan & Usuel, 2008). However, previous digital opportunities projects in New Zealand indicated that ICT integration into the learning process might end up contributing nothing more than just an effort to facilitate material access to ICTs (Rivers & Rivers, 2004).

The Digital Opportunities Project was an initiative by the New Zealand government in collaboration with participating schools and associated businesses. This model was the combination of four different projects conducted in different parts of the country. The digital opportunities projects were first implemented during the 2002 and 2003 academic years. The aim of these projects was to assist in bridging the digital divide in low decile schools (i.e. schools in areas of low socio-economic status) by providing (a) material access to ICTs for students and teachers (b) professional development training for teachers, and (c) infrastructure to promote collaboration between teachers and students from different schools. However, despite very good strategy and infrastructural support, evaluation of the digital opportunity model and its four different projects showed that the overall goal of bridging the digital divide was not achieved (Parr & Ward, 2004; Rivers & Rivers, 2004; Winter, 2004).

From the analysis of the four different projects, two major limitations of the digital opportunities model have been identified. First, during the planning and implementation of the projects, the meaning of equity was understood only as a matter of material access and digital skills. However, the outcome of the projects indicated that equity in these two aspects may be a necessary first step, but is not sufficient. To address the issue of digital divide in learning, there must also be equality in learning outcomes beyond just access and skills. According to different researchers in the field, equity of students' learning outcomes depends on factors like: (a) the attitude and motivation of students towards technology, (b) the nature of technology usage by students and (c) students' capability of meaning making (Jones & Issroff, 2007; Van Dijk, 2006; Wei, Teo, Chan, & Tan, 2011). A second limitation was the lack of detailed forethought by planners and policy makers in understanding how learning activities and environments are affected by the introduction of ICTs. According to Salomon (1993), "*Introduction of ICTs redefines the whole activities and interpersonal relationships inside and outside of the classroom*". Integration of ICTs into the learning process has the potential of redefining the learning activities in formal as well as in informal learning spaces; therefore activities in both of these learning spaces can have a significant impact on learning outcomes. So, investigation of the integration of ICTs into the learning process should include both formal learning spaces like classrooms and informal learning spaces like outside of the school and home.

## AGENDA FOR STUDY

The results and experiences of the digital opportunities projects raised several implications for future projects with similar aims. The evaluation of the digital opportunities projects has also confirmed that there is a need to rethink the educational aims underpinning the concept of ICT initiatives and the process by which such concepts are translated into practice in schools.

In response to this, the New Zealand Ministry of Education developed an ICT strategic framework for education in 2006. The goal of the ICT strategic framework was to develop a more learner-centered service culture where education agencies and organizations focus on the outcomes rather than the technology through improved connectivity (access to

ICT infrastructure for education), content (digital content from variety of sources), and confidence & capability (skills needed to turn information into knowledge). Currently there are eleven different digital opportunities projects on-going around New Zealand, aiming to contribute towards bridging the digital divides in learning. However, after analyzing all current projects it has been found that even current digital opportunities projects are unsuccessful in fully embracing the vision and goals of the ICT strategic framework for education and taking into account the lessons learned from the previous initiatives. Despite the lessons learned from past projects, all of the currently on-going projects are still focusing either on the access or the capability aspects, which is not much different than in the previous digital opportunities pilot projects.

Results and outcomes of the past and current initiatives show that not every aspect has been taken into account during the implementation of the initiatives. Each of the past initiatives either focused on the access or skills aspects. However, while ensuring equal access and skills is necessary first step, ensuring improved and equalised learning outcomes is also an important aspect towards bridging the digital divide in the learning process. From the analysis of the past and current digital opportunities projects, we have identified some of the potential factors which might affect the process of learning in the context of integrating ICTs, and may also impact the quality and equality of learning outcomes either positively or negatively. These factors are:

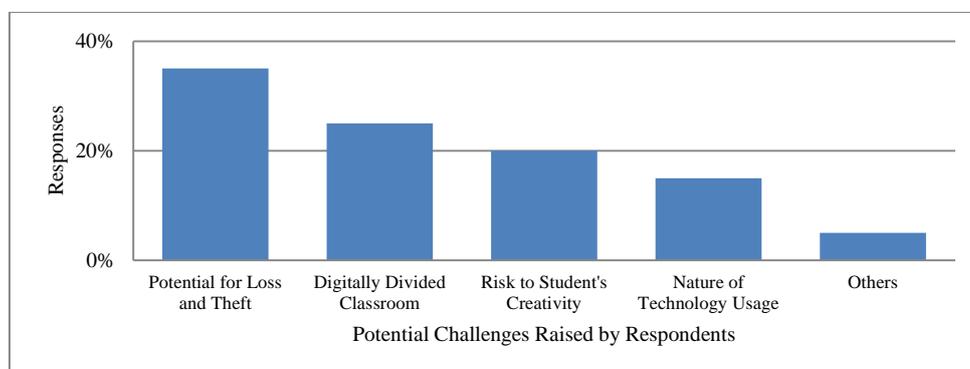
1. Learner Dependent Factors (attitude and motivation of students towards technology, nature of technology usage by student, students' capability of meaning making)
2. Learning activities in formal spaces
3. Learning activities in informal spaces

Studies on how learning outcomes could be affected in the context of ICT mediated learning and how this may impact the digital divide in the learning process are not well represented in the literature. So, those factors which have been identified as the potential factors and which might affect the quality and equality of learning outcomes need to be investigated in a relevant context.

#### PRELIMINARY ANALYSIS OF BYOD PROJECT

A New Zealand school has decided to fully integrate ICT into the learning process in the form of 1 to 1 learning devices for all students in a cohort. The school informed all parents and students, that they were expected to bring a 1 to 1 digital learning device (preferably an iPad2) into the classroom in year 9 (students aged 13-14) for the 2012 academic year. The most controversial and unique aspect, which makes this initiative different from most others, is that the parents have been told they must cover the full cost of the required digital learning devices for their children, whereas similar projects in the past (like the digital opportunities projects) have provided devices through the schools. The bring your own device (BYOD) project at this school provides us with an appropriate context to investigate the integration of ICTs into the learning process and to make an attempt to address some of the issues which previous digital opportunities projects have raised.

The school's decision resulted in a high profile news story in the New Zealand Herald, a national newspaper, triggered by a complaint from a parent about being asked to buy a digital device for their child. This triggered a huge public and media response, leading to news stories on TV and radio, and online debates on various news sites and forums. This led us to focus our initial research on the public debate, in an effort to identify important themes and concepts that could inform our research questions for the whole study. We therefore collected data from as many relevant public forums as we could identify, then qualitatively coded this data and analysed it using NVivo 9. Although many of the contributions to the debate were not considered because of the very general nature of the comments or, in many cases, because the comments were simply offensive, analysis of debate highlighted some of the possible challenges for the BYOD project as shown by the themes summarized in Fig. 1.



**Figure 1: Analysis of the Public Debate over BYOD Project**

Almost 40% of the responses were concerns regarding the potential for loss, theft and damage of the device, but this is not relevant for the study. In fact, 6 months into the trial, only 2 devices had been damaged and none had been lost or

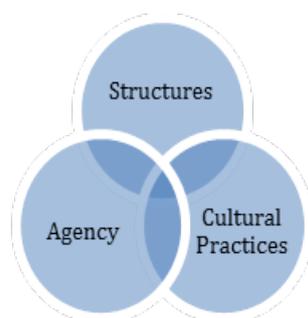
stolen. Another widely expressed view was related to inequality in terms of device ownership. Nearly 20% of the respondents expressed their concerns that the classroom may become digitally divided. As some students may enjoy the benefits of the device or regard it as a status symbol within the classroom, students who do not have the recommended device, or any device at all, could possibly feel disadvantaged, which could result in unequal learning outcomes. About 20% of the contributors expressed views about meaningful use of the technology by the students. Some contributors who introduced themselves as parents said that even if they could afford the device they were more concerned about the unsupervised access to resources which their children will be exposed to via the internet and think some of the resources might not be useful for them or may even be harmful.

From the analysis of the digital opportunities project and findings of the analysis of the public response data we have been able to form some general research questions for the study. The main research question for our study is: *How does one-to-one integration of ICTs into formal and informal learning spaces impact the digital divides?*

1. *Which factors could impact either positively or negatively on equality of learning outcomes?*
2. *How can the positive or negative impact on the learning outcomes be increased or reduced respectively?*

### **A SOCIO-CULTURAL ECOLOGICAL MODEL AS A MEANS OF ANALYSIS**

There are many theories and frameworks which have been used as a means of analysis to study learning with mobile devices and technology mediated learning process, but the socio-cultural ecological approach to mobile learning has been adopted for this study. This framework has been developed in response to the perceived need for a coherent theoretical framework to address the limitations in the existing theories to investigate the learning process within the formal and informal learning spaces mediated by one-to-one ICTs. Three main components (Agency, Cultural Practices, and Structures) characterise the ecological approach to learning with mobile learning technologies (Cook, Pachler, & Bachmair, 2011). This framework sees learning through mobile devices in and around different learning spaces and is governed by a triangular relationship between socio-cultural structures, cultural practices, and the agency of learners, represented in the three domains in Fig. 2 (Pachler, Bachmair, Cook, & Kress, 2010).



**Figure 2: Socio-cultural ecological approach to mobile learning (Pachler et al., 2010)**

- **Agency:** Agency in the framework refers to the capacity of the individual to act and interact within educational and sociocultural settings to make their own free choices. In our study, agency is appropriate to analyse how the learner adapts or appropriates technologies into their learning processes based on the capacity and expertise they have. It can be used to analyse the learner dependent factors like attitude and motivation of students towards technology, the nature of their technology usage, and their capability of meaning making.
- **Cultural Practices:** Refers to the media use inside and outside of educational institutions and media use in everyday life. In our study, cultural practice is appropriate to investigate learners' ICT usage within different learning spaces and analysing and linking their learning activities both from formal and informal learning spaces.
- **Structures:** Structure is something which governs learners in and around different learning spaces. This can be appropriate to analyse the curricular frame of the school and the social norms of the education system and wider society which govern the activities of the learner.

### **RESEARCH METHODS**

This study has been divided into two different phases and each phase of the study is employing different research methods. A case study approach has been considered appropriate for in-depth investigation of the one-to-one integration of ICTs into the learning process to see how this might impact the quality and equality of the learning outcome in phase one. This research is planned to introduce some form of ICT intervention in the technology mediated learning process in the second phase, aiming to reduce negative impacts and improve the positive impacts of ICT integration in the learning outcomes. Therefore, the research method in second phase will change into a combination of case study and action research.

### **FINDINGS FROM THE BASELINE DATA ANALYSIS**

The baseline stage of collecting data has already begun, through classroom observation, online surveys and individual interviews with students, teachers and parents. Some important findings have emerged from the analysis of the survey and classroom observation data, which provides us with insights into the different aspects of the study.

- Although the student survey response rate was only around 30%, data indicates almost every student has access to the computers and internet at home and school. This indicates there is not a significant gap in terms of material access.
- The student survey data shows significant variation in the level of digital skills. Only a small percentage of students have reported that they have an advanced level of ICT skills. However the majority of the students said they have a competent or intermediate level of skills. The survey revealed that there are still some students who have only basic or beginners' level of digital skills. This disparity in the digital skills among students could become a barrier for some to make meaningful and efficient use of the one-to-one ICTs in their learning process.
- The survey data also revealed a number of skills and capability issues with the teachers. Only around 65% of teachers reported that they have competent digital skills. The rest said they have either intermediate or basic digital skills. This variation in the digital skills of teachers may emerge as one of the challenges for teachers in successfully integrating ICTs into their instructional activities. In another question, only 15% of teachers reported that they don't have sufficient skills (capability). Though 15% is not a very big proportion, for the successful integration of ICTs for bridging the digital divide into learning, this is still likely to become a barrier.
- The survey shows that more than 50% of students usually spend most of their time on-line in social media activities, entertainment, and gaming, though there are also significant numbers of students who spend most of their time on-line in educational activities. Since the majority of students are spending most of their time in non-educational activities, this may affect the quality and equality of learning outcomes between those who use ICTs for mainly educational purposes and those who use it for non-educational purposes.
- Teachers reported mixed feelings about the improvement of students' performance by integration of one-to-one ICTs in learning. 62% of the teachers believed that this initiative will be helpful to improve the academic performance of students, but there were around 25% of teachers who have said that this will make no difference in students' performance.

Data from interviews and observations is still being collated and analyzed. We expect that this will provide further insights into the current state of the BYOD initiative.

## CONCLUSION

When ICTs are integrated into the learning process in the form of one-to-one digital learning devices, various factors dependent on learners like motivation and attitude towards technologies, nature of technology usage, and learners' capability of meaning making, could affect learning activities in formal as well as informal learning spaces. These effects beyond just access and skills could impact either positively or negatively on learning outcomes.

The BYOD project and the theoretical framework adapted for the study allows us to generate a comprehensive research agenda to investigate integration of one-to-one ICTs into the learning process from different aspects, to find how it affects formal and informal learning activities and impacts the phenomenon of digital divides in learning. At this stage, we have only completed the base line data collection. End of the year data collection will be completed in December 2012. With this data we will be able to assess the evolution of the project and propose new interventions to support its aims. The results of this study may inform policymakers, school administrators, and teachers about how to conduct successful integration of ICTs into the learning process.

## REFERENCES

- Cook, J., Pachler, N., & Bachmair, B. (2011). Ubiquitous Mobility with Mobile Phones: A Cultural Ecology for Mobile Learning. *E-Learning and Digital Media*, 8(3), 181-196.
- 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.
- Jones, A., & Issroff, K. (2007). Motivation and Mobile Devices: Exploring the Role of Appropriation and Coping Strategies. *Research in Learning Technology*, 15(3), 247-258.
- Pachler, N., Bachmair, B., Cook, J., & Kress, G. R. (2010). *Mobile learning : structures, agency, practices*: New York : Springer.
- Parr, M., & Ward, L. (2004). *Evaluation of the digital opportunities project FarNet: Learning Communities in the Far North*. Wellington.
- Rivers, J., & Rivers, L. (2004). *A Summary of the Key Findings of the Evaluations of the Digital Opportunities Pilot Projects (2001 - 2003)*.
- Salomon, G. (1993) *On the nature of pedagogic computer tools: the case of the Writing Partner* (pp. 179-196). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Van Dijk, J. (2006). Digital divide research, achievements and shortcomings. *Poetics*, 34(4-5), 221-235.
- 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.