# Bring Your Own Device to Secondary School: The Perceptions of Teachers, Students and Parents

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**Abstract:** This paper reports on the first two years of a Bring Your Own Device (BYOD) initiative in a New Zealand secondary school, using data derived from a series of surveys of teachers, parents and students, who are the main stakeholders in the transformation to a BYOD school. In this paper we analyse data gathered from these surveys, which consists primarily of qualitative data from free text questions, but also includes some quantitative data from structured questions, giving insights into the challenges faced by teachers, students and parents in moving to a BYOD classroom, and the potential benefits for teaching and learning, and preparing students for a digital world. We frame our analysis from a sociocultural perspective that takes account of structures, agency and cultural practices and the interactions between these domains. Thematic analysis was performed by considering these domains from the responses of the three stakeholder groups. We found that there were some tensions in these domain relationships, with contexts and practices having to be renegotiated as the BYOD classroom and the structures within which it operates have evolved. On the surface, it appears that many of the changes to cultural practice are substitution or augmentation of previous activities, for example using one-to-one devices for researching and presenting material. However, when we look deeper, it is evident that apparently straightforward adoption of digital media is having a more profound impact on structure and agency within the classroom. While the structural impact of digital infrastructures does raise some concerns from all stakeholders, it is clear that it is the curricular structure that is the most contentious area of debate, given its impact on both agency and cultural practice. While the majority of respondents reported positive changes in classroom management and learning, there were nevertheless some concerns about the radical nature of the change to BYOD, though very rarely from teachers. If there is an area where agency may be most problematic, it is in the responses of parents, who may feel increasingly alienated from their children's learning activities if their own digital skills are lacking. These findings will be of interest to anyone who is engaged in BYOD projects, particularly those who are planning such initiatives or in the early stages of implementation.

**Keywords:** BYOD, secondary school, survey, sociocultural framework

## 1    Introduction

Since 2011 we have been gathering data from the first secondary school in New Zealand to introduce a Bring Your Own Device (BYOD) policy based on recommending the iPad. Over this time the initiative has moved from initial controversy in the local press over the proposals, through a pilot year, to an ongoing process of full implementation throughout the school. This process has gained national interest and the school has run two conferences to share their experiences with other schools and interested parties. Our own research has employed a number of methods, including surveys, interviews, observations and workshops. Some previous work has been published relating to the early stages of the project (Adhikhari, Parsons & Mathrani, 2012; Parsons, 2013.) However, this particular paper focuses on the results of three surveys that were carried out between 2012 and 2014 to record the perceptions of teachers, parents and students from the school. It should be noted that this data is a snapshot of the first phase of the rollout of BYOD. From 2016 the school was fully BYOD across all years.

### 1.1    BYOD

The move towards BYOD in schools is driven by a number of factors. First, there is the recognition that education must adapt to technological changes in wider society. As the everyday use of digital tools by school students grows, so does the need for schools to integrate digital technologies to remain relevant (Engelhard and Seo, 2012; Collis and Moonen, 2008.) Second, there is the drive towards making digital tools available as an integral part of education rather than just episodic interaction in a computer lab. The extent to which this impacts on the curriculum depends on the ambition of the educators. Integration of digital tools may be the simple substitution of digital text books (Mardis & Everhart, 2013) or a more fundamental redefinition of the

curriculum (Twining, 2014). Third, there is the financial pressure on schools that are unable to provide every student with a device. Thus the onus is increasingly being put on parents to provide such devices, though different funding models are required for different contexts (Bailey, Schneider & Vander Ark, 2012.)

Along with potential benefits, such as improved learning outcomes in some contexts (e.g. Cristol & Gimbert 2013), come some concerns, such as disruption in the classroom (Sharples, 2002) and concerns about a lack of inclusivity and an increase in cyber-bullying (Sangani, 2013). There may also be digital divides in learning outcomes (Wei et al, 2011.) Themes that have emerged from other research in a similar context (BYOD in New Zealand secondary education) suggested that the main positive outcome was a shift towards student centred learning, while the main challenges were change management and student management (Baker, 2014.) Another New Zealand study, this time in primary education, highlighted the importance of collaboration between the key stakeholders of teachers, students and parents (Falloon, 2015.) Ackerman & Krupp (2012) also stress the role of collaborative stakeholders in a successful BYOD implementation, in particular the forging of new partnerships between students and teachers in the classroom, emphasising the change in classroom relationships brought about by BYOD. Bruder (2014) emphasises the need for certain structures to be put in place to promote equity, security and appropriate curricula, to ensure that BYOD programmes achieve their potential benefits rather than introduce risks.

It is important not to view BYOD in isolation, not to focus only on the device. BYOD can only take place within the context of certain enablers, such as a suitable wireless broadband infrastructure, with supporting policies and procedures for secure and appropriate use, such as those outlined by UNESCO (2013), and may be associated with other initiatives such as a move towards cloud based resources (Lennon, 2012.) In addition, it does not operate independently of the teaching and learning process, driving changes in curriculum and pedagogy (Cochrane et al, 2014.)

## 1.2 Investigating digital device use in the classroom

There are a number of different approaches that may be used to investigate the use of digital devices in the classroom. For example Khalid et al (2014) applied a social constructivist perspective and grounded theory, identifying available knowledge and adoptable practice, advantages and adoption barriers as core topics of analysis. In contrast, Martin and Ertzberger (2013) took an experimental approach using pre-tests and post-tests, focusing on achievement and attitude. Cheung and Hew (2009) identified a number of methodological approaches used by different researchers, concluding that surveys are the most common method, with interviews, observations and focus groups also regularly used.

## 1.3 Analysis framework

Our analysis focuses on the broad spectrum of contexts within which a move to digital teaching and learning operates. Because our study looks at a BYOD initiative, this impacts not only on activities within the classroom but also those that take place in informal spaces and in the home. Therefore we adopted a sociocultural approach that takes account of structures, agency and cultural practices (Pachler et al, 2010.) This framework recognises the interrelationships between its three main components. (Figure 1.)

The role of agency, which is particularly powerful in a BYOD context, where learners have already appropriated their own devices, means that the presence of digital devices is only the starting point. The way that learners operationalize their own agency defines the actual role of these devices in the classroom; "a tool is what it is used for" (Bannon & Bodker, 1991, p. 238). On a similar theme, MacKenzie and Wacjman (1985) note that that specific technologies succeed or fail for a number of contextual reasons that derive from both structure and culture. For example we have noted how teachers of different subjects utilise mobile devices in their classrooms in very subject specific ways, and that these devices are not ideal for every situation (Parsons, 2013.)
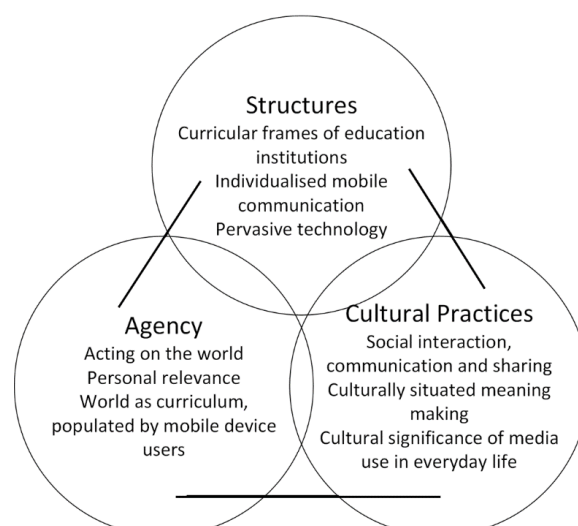
**Figure 1:** The sociocultural framework used in our analysis (adapted from Pachler et al, 2010)

Once digital tools are adopted, over time there is a two-way process through which the use of these tools changes the learning activities where they are applied. The structure within which this happens is important, but the tools can, in turn, impact on that structure. In our model, for example, using digital tools within the curriculum impacts on that curriculum. This concept has previously been referred to as the "coevolution" of tasks and artefacts (Carroll et al., 1991), and the "reciprocal shaping" of technology and society (Brosveet & Sorensen, 2000). There are also echoes of McLuhan here, where we ourselves are extended by technology use (McLuhan, 1964.)

In our analysis, we seek to identify data that relates to the specific items within each of the three concepts of the sociocultural framework and, where possible, the relationships between them. Our data is gathered from the perspectives of three different stakeholder groups; teachers, students and parents. Thus our analysis is focused on these differing perspectives, and we formulated the following research questions, based on the framework and our stakeholder groups.

- How have stakeholders responded to structural change as a result of the BYOD initiative?

- How has the agency of stakeholders evolved as a result of the BYOD initiative?

- How have the cultural practices of stakeholders evolved as a result of the BYOD initiative?

- How have structures, agency and cultural practices interacted during the period of the BYOD initiative?

## 2    Methods and materials

The source data for this article comes from three sets of online surveys administered in mid 2012, early 2013 and mid 2014. There were three separate sets of questions administered in each of these years, to teachers, parents and students at the school. There were no sampling criteria to include or exclude any members of these groups. We did not record any demographic data, but the students concerned were primarily from year 9 (first two surveys) and some from year 10 (third survey), so were aged 13-14. The gender balance at the school is approximately equal. As part of the low risk ethics process under which the research was undertaken, the surveys were all anonymous and voluntary, and publicised though the usual school communication channels (e.g. school newsletters.) The researchers designed the surveys but were not involved in publicising them. The questions were not identical in each survey, because we aimed to address a range of issues over time. The numbers of fully completed responses to each of the surveys are shown in Table 1. The school roll is approximately 2,000, but only one year group was involved in the pilot year (2012), and the programme has only slowly expanded through other year groups (there are seven in total.) Our 2012 and 2013 results therefore represent roughly 25% of the initial cohort of students and almost all the relevant staff. The number of parent and student responses dropped in 2014. This may just be due to 'survey fatigue' but we can only speculate about this. Despite these limitations, the amount of data gathered in these surveys is substantial, and combines both quantitative (multi choice, ordering, Likert scale) and qualitative (free text) data.

**Table 1:** Numbers of respondents to each survey

|  | 2012 | 2013 | 2014 |
|---|---|---|---|
| **Teachers** | 14 | 40 | 63 |
| **Parents** | 4 | 71 | 50 |
| **Students** | 56 | 98 | 41 |

The qualitative data provides a number of insights into various aspects of the BYOD project. The thematic analysis of data was approached using axial, hierarchical coding. As Saldaña (2009) notes, the approach taken by the researcher to coding qualitative data may be influenced by a number of factors that will shape the interpretation of the data. In this case, the main constructs for the analysis were drawn from the sociocultural framework (Figure 1), while the units of analysis within these constructs were the stakeholder groups. Thus the constructs and groups were pre-emptive of the data analysis. Repeated ideas and themes that emerged from the data were linked to the appropriate constructs and groups.

## 3    Results

Our results are presented under the main concepts of the framework, namely structures, agency and cultural practices, addressing each of the first three research questions in turn. This analysis is primarily qualitative, but some quantitative results have been included where they relate to the themes of analysis. Qualitative data has been analysed in groups based on respondent type, that is, the three teacher surveys were analysed together, then the three student surveys, then the three parent surveys. This allowed us to identify variations in themes between these three stakeholder groups. In the qualitative analysis, in an attempt to identify core themes across the BYOD initiative, data from the three surveys has been analysed as a single data set. However, in the quantitative data we have also sought to identify any changes that are evident over time. These comparisons have to be interpreted with the proviso that we did not ask exactly the same questions in each survey, and we do not know to what extent the same parents, teachers and students answered the surveys.

### 3.1    Qualitative Coding

Free text survey questions were analysed in NVivo, coded using emergent themes (developed from repeated ideas) and subsequently gathered together under predefined broader constructs (Auerbach & Silverstein, 2003.) Following a simple content analysis of repeating ideas, the broad emergent themes are outlined in Table 2, cross referenced by construct and stakeholder role. We drill down further into these themes when we discuss each stakeholder group in later sections.

**Table 2:** Constructs and themes by stakeholder role from the qualitative data analysis

| Construct | Teacher Themes | n | Student Themes | n | Parent Themes | n |
|---|---|---|---|---|---|---|
| **Structures** | Classroom (curricular) practice | 15 | Technology Affordances | 22 | Devices in school | 13 |
|  | Technology limitations | 19 |  |  |  |  |
| **Agency** | Classroom roles | 10 | Enabling | 83 | Student agency (positive) | 34 |
|  | Equity | 11 | Restricting | 66 | Student agency (negative) | 23 |
|  | Giving students agency | 24 |  |  | Parent agency | 20 |
| **Cultural Practices** | Digital pedagogy | 21 | Interactions with others | 14 | Family dynamics | 31 |
|  | Student practice | 6 |  |  |  |  |

From the rather general themes identified within the three main constructs of our analysis, a few observations can be made. The teachers tended to address a broader set of themes in their responses across all three constructs. Further, their negative experiences were confined only to the structural limitations of technology (e.g. occasionally unreliable wireless connectivity) rather than to any fundamental misgivings about the BYOD innovation as a whole. They also focused strongly on various aspects of the changes taking place in classroom practice; the changing roles of teachers and students in a classroom where student agency was increased through the use of digital devices, and the potentials of new digital pedagogies. In contrast, the students reported primarily within the agency construct, with little reference to cultural practice and, like the teachers, a structural focus on the technical infrastructure of the BYOD learning environment. Although a majority of student responses reported that BYOD was an enabling innovation, there were also many concerns expressed around the potential restrictions on agency. These ideas will be explored in more detail later in this article. Parents' views on structures, given that they had no direct experience of the wireless infrastructure or device use in the classroom, focused more on the provision and value of the learning devices within the curriculum. In

focusing on agency, like the students, there was a split between both positive and negative views of the effects on learning, though once again, positive views were in the majority. Another major issue was parental agency. Many parents felt excluded from the digital experience of their children in various ways, as discussed later. Impact on the family was the key concern in terms of cultural practice, and many parents chose to reflect on the perceived impact of the change in learning styles on the way their children behaved at home. Again, this will be discussed later.

Overall we can see that the teachers responded the most positively to the BYOD innovations, and parents had the most reservations. Students provided a range of views, both positive and negative, but all of which can give insights into the impact of the BYOD programme. In all three of these stakeholder perspectives, we see the power of agency. Teachers, who have the most agency, were the most positive about the move towards BYOD, while parents, who have the least agency, had the most reservations.

## 3.2    Structures

Structures are the most straightforward of the three concepts encompassed by the model. Simply put, they relate to the BYOD devices, the technological infrastructure within which they are used, and the curriculum within which they are applied. Table 3 shows the repeated ideas in the structural themes.

**Table 3:** Themes and repeated ideas from the 'structures' construct

| Structures | Themes | n | Repeated Ideas | n |
|---|---|---|---|---|
| **Teachers** | Classroom (curricular) practice | 15 | Changes in delivery of learning | 10 |
| | | | Differing approaches by different teachers | 5 |
| | Technology limitations | 19 | Connectivity issues | 6 |
| | | | Software problems | 7 |
| | | | Layers of complexity | 4 |
| **Students** | Technology Affordances | 22 | Network infrastructure | 3 |
| | | | Device affordance | 12 |
| | | | Non-digital curriculum | 7 |
| **Parents** | Devices in school | 13 | Device support | 6 |
| | | | Curriculum in society | 7 |

Teachers' responses around the construct of structure focused on either classroom (curricular) practices or technology limitations, since the curriculum had been impacted by the introduction of digital devices, with a knock on effect on infrastructure dependency. In terms of curriculum structure, classrooms were more devolved, collaborative, group based and student centric. Teachers here tended to express very similar views, the following comment being typical:

> "*The focus in the classroom has changed, very student centred. Inquiry learning style is the norm and sharing is an important component of the class environment. Front of the room instruction is less important, in fact there is not really a front of the room. Have been experimenting with different classroom set outs.*"

Reference to different approaches by other teachers were more equivocal. Some teachers were evidently somewhat resistant to change:

> "*Big gaps in pedagogical practice showing between those with devices and who are using them and others who aren't.*"

There were several comments that related in some way to the layers of complexity introduced by digital tools. One example was;

> "*Remembering a plethora of passwords.*"

When students commented on structural elements, a few referred to some issues with the wireless infrastructure, but a larger number expressed concerns about the affordances of different devices, with an emphasis on the relative merits of iPads and laptops. Some commented about the disruption of being in classrooms with a mix of devices. Another significant set of ideas related to the non-digital curriculum, in the sense that there was a keenness not to let digital devices take over all teaching and learning activities. This example is indicative:

> "*Occasionally I think we should be able to make big awesome projects with crafts and stuff without the iPad.*"

When it came to the parents' responses, most of the comments relating to device support were around the provision and maintenance of the devices themselves. One other comment in this theme related to a somewhat different aspect, that of equity, an issue highlighted by Bruder (2014).

"*The homework set was assuming that everyone had broadband which we didn't because I couldn't afford it as I was paying off a tablet (we now have it).*"

The other repeated idea in this theme was the role of a digital curriculum as it relates to 21$^{st}$ century society. The following comment was typical:

"*I think it's the way of the future, and when they leave school they will need to know this technology.*"

The quantitative data from the surveys also provided some useful insights into structural components. In terms of pervasive technology, the wireless infrastructure turned out to be more problematic than was first anticipated. In the 2012 survey, only one member of staff expressed concerns about network connectivity. Having actually experienced device use in their classrooms, twenty teachers expressed issues with network connectivity in the 2014 survey. Thus we note how structures may act as constraints to agency.

When analysing individualised mobile communication, one interesting finding from the data was that the proportion of students who were using a non-iPad device actually appeared to increase between 2012 and 2014, from 4% to 19%. Most of this change was due to students using laptops. One reason given for this by a parent was due to the different handling of the laptop; some iPads were carelessly exposed to accidental damage by other students.

"*He has a laptop now as his iPad kept cracking*"

Another motivation, again expressed by a parent, was the greater power of a laptop.

"*We had no problems with the iPad but now he is getting more specialised it appears we may need a Mac to accommodate his learning requirements.*"

This time we see a more positive relationship between structure and agency, with choices being made from the perspective of potential benefit.

Looking at the curricular frame of the institution, most of the curriculum in New Zealand schools is driven by the National Certificate of Educational Achievement (NCEA), which is the main national qualification for secondary school students. NCEA results are recognised by employers and by higher education institutions both nationally and internationally. In most subjects, students sit externally assessed examinations. Within this external constraint, it is clear that the in-school curriculum cannot freely evolve. Thus the changes we have seen within the curriculum are confined to changes in the way that the existing content is delivered. The most common change to curriculum delivery within the school is that work has become more research based. When asked what changes students had noted in their learning (2014 survey) around 25% of the students referred to benefits for research, some explicitly. For example

"*I have noticed that research is a lot easier for classes*", and "*faster to do work and better access to information*"

Despite these positive effects, some parents, teachers and students were concerned about the dissonance between digital teaching and learning and traditional written exams.

"*It concerns me that NCEA is seemingly lagging behind with assessing our students.*" (Teacher, 2014)

Although the future strategy for NCEA includes at least some online assessment (NZQA, 2013), in the short term the school has to prepare its students for written exams. This is a major constraint by structure on both agency and cultural practice.

### 3.3  Agency

One of the core components of agency is the ability to act on the world. In the context of BYOD this means having a suitable skill set for making optimum use of digital tools, thinking critically and processing and applying the information to create new knowledge. Table 4 shows the repeated ideas in the agency themes.

**Table 4:** Themes and repeated ideas from the 'agency' construct

| Agency | Themes | n | Repeated Ideas | n |
|---|---|---|---|---|
| **Teachers** | Classroom roles | 10 | Changing the teacher role | 7 |
| | | | Resistance and dissent | 3 |
| | Equity | 11 | Enabling individual attention | 6 |
| | | | Students assisted by devices and peers | 5 |
| | Giving students agency | 24 | Not digital natives | 6 |
| | | | Directing learning | 9 |
| | | | Devices enabling agency | 9 |
| **Students** | Enabling | 83 | Higher productivity | 13 |
| | | | More enjoyment of learning | 9 |
| | | | Better learning outcomes | 12 |
| | | | Ease of access to resources | 45 |
| | | | Ease of communication with others | 4 |
| | Restricting | 66 | Off-task behaviour (self) | 18 |
| | | | Off-task behaviour (others) | 9 |
| | | | Reduction in skills | 33 |
| | | | Physical impediments | 6 |
| **Parents** | Student agency (positive) | 34 | Increased motivation | 14 |
| | | | Improved performance | 6 |
| | | | Digital skills development | 6 |
| | | | Improved self-management of learning | 4 |
| | | | Benefits for students with learning difficulties | 4 |
| | Student agency (negative) | 23 | Impact on reading and writing | 4 |
| | | | Difficulties migrating to digital teaching and learning | 15 |
| | | | Lack of visible agency | 4 |
| | Parent agency | 20 | Homework is hidden | 8 |
| | | | Lack of digital skills to support students | 5 |
| | | | Unwillingness of students to give parents agency | 7 |

Teachers noted that their agency in the classroom had undergone a change, usually in terms of progressing towards new roles within the classroom. The following quote indicates an example of this change.

> "*As a 'non-techie' I was keen to be involved but terrified. As the year has progressed I feel I have become far more competent, confident and really ready to take things further.*"

However another aspect of teacher agency was the tendency of some to resist and dissent, opposing imposed changes of practice. One teacher questioned the level of consensus within the staff:

> "*Consensus on the popularity of the BYOD program within school is much more varied than I believe the school realizes.*"

Equity was explored from two dimensions; teachers being able to be more equitable in their teaching, and students gaining a more equitable agency in the classroom due to the support of devices and peers.

While many teachers appear to want to give students more agency in the classroom, it appears that there are several barriers. One is that teachers have found that many of their students are not 'digital natives' and cannot naturally work effectively with technology without considerable guidance.

> "*Students not being the digital natives they are purported to be. They are VISUAL natives rather than digital.*"

As a result, a greater level of teacher agency is required to direct the digital classroom than some teachers expected.

> "*Biggest unexpected so far has been the amount of explicit instruction and direction students have needed to both drive the device and their own learning using it.*"

Notwithstanding these issues, teachers also reported various ways in which they could transfer agency to students through the support offered by digital tools. For example podcasts and the physical mobility of learning offered by the devices.

Students reported several repeated ideas around positive aspects of their own agency. By far the most common idea was the ease of access to learning resources. Students also expressed that they felt they were more productive in class, were better able to communicate with teachers and peers, enjoyed learning more, and had improved their learning outcomes. One student comment encapsulates a number of these ideas together:

> "*We are able to access information from the internet much easier. Our learning has advanced because of this. We can record and present our projects in a creative way. We are able to communicate with our teachers through email, iMessage and other apps. We can hand in work faster and not have to waste printing ink or even be at school to hand in work.*"

There were however a number of ideas that reflected more negative aspects of student agency. These focused around the off-task behaviour of themselves and others. Some students reported a perceived drop in certain skills, mostly related to handwriting. The following, one presumes, was written tongue in cheek, but was not unrepresentative:

> "*Cant rite az gud.*"

A few students also reported physical issues such as headaches, eye strain and poor posture.

Parents reported a number of positive effects on student agency. The most frequently mentioned was motivation, for example:

> "*We have found that our son has been thoroughly motivated by the iPad, there seems to be a huge benefit in terms of his willingness to complete tasks via the device*"

Improvements in learning performance were noted by some, often with a specific mention of agency:

> "*My child has become a more independent learner. I noticed in the last 12 months that my child's performance improved…achieving better grades.*"

A side effect of using digital tools for learning also enabled students to develop digital skills, for example

> "*My child is quite computer literate since using the iPad.*"

Better self-management of learning was also noted as a feature of student agency:

> "*He is well-organised and up-to-date with his homework often completing it early.*"

Parents of students with learning difficulties were particularly impressed by the increase in their agency:

> "*Having a child with ADD - the difference is huge. It engages her in a way that normal teaching doesn't.*"

Of course not all reflections from parents about their children's agency were necessarily positive. Some parents felt that the use of digital devices has impacted in their children's ability to read and write in the traditional way. The majority of comments however focused on various aspects of students seeming to have difficulties transitioning to the new teaching and learning environment. These often reflected back onto parental perceptions of their children's preferred learning styles:

> "*My daughter feels due to no longer writing out her work she often does not retain information as well as she used to.*"

Some other comments suggest that their children lack agency in the digital context. These covered several related ideas but this comment is indicative of some students' lack of agency using digital tools

> "*My daughter just gave up and went back to pen and paper and refused to present work on the tablet.*"

The other theme identified by parents was their own agency, which many believed had been diminished in terms of their ability to engage with their children's schoolwork. They either felt that the homework was hidden from them, either deliberately or because it was all electronic and so not as easily visible as written homework, or they felt that their digital skills were inadequate to help their children. A feeling of lack of agency coupled with feelings of exclusion are summed up in this comment:

> "*Didn't seem to have much work to be done at home - that he told me about*"

From the quantitative data, there are some insights into digital skills, which can have a major impact on agency. We note that the overall skill levels of staff appeared to be slightly lower in the 2014 survey than in 2012 (Figure 2, top). However it should be noted that the 2012 staff were early adopters who volunteered to take part in the first year of the BYOD initiative. The figures for 2014 represent a larger cohort of teachers across the school. This suggests that we cannot expect the agency of staff overall to reach its maximum potential until the BYOD approach has been fully rolled out across all school years so that all the staff have had the opportunity to fully develop their digital skills.

From the surveys of students, we note a strikingly different pattern (Figure 2, bottom), though it should be noted that we asked a somewhat different question about their levels of skill in making meaningful use of digital devices in learning. Further, the 2014 survey only had three options instead of five. Nevertheless, there is a marked increase in the perceived level of digital skills, so the potential for agency appears to have increased over time. These results for teachers and students suggest a possible skills gap, but of course the skill set that teachers need to bring to bear is more complex and demanding than the skill set needed by the

students. Nevertheless, for those who are already actively engaged in using the one-to-one devices, there is certainly skill development going on. Two responses from the 2013 teacher survey noted:

*"My skills have grown SO MUCH"*

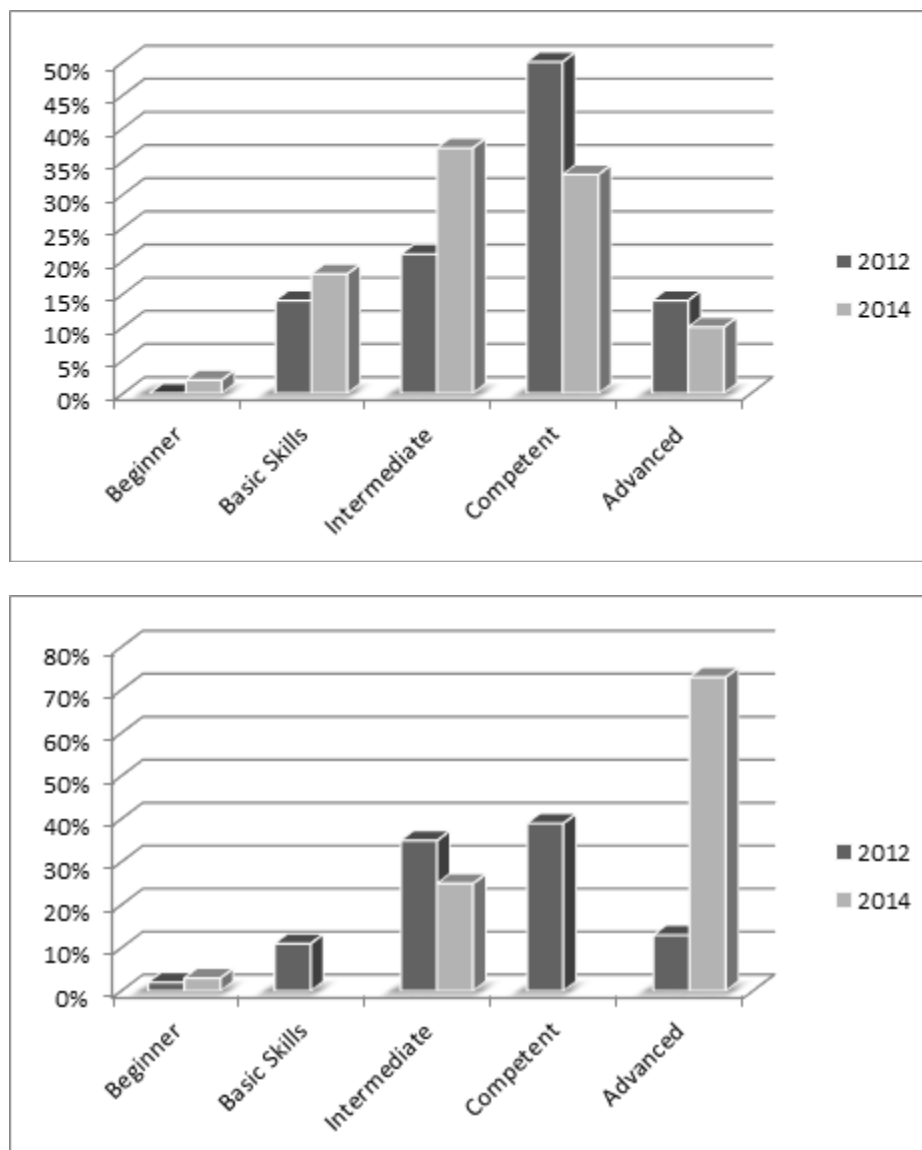*"The students and I have definitely gained some skills with using these devices"*



**Figure 2:** Staff skill levels in digital devices and computer technology (top) and student skill levels in making meaningful use of digital devices in learning (bottom) measured by self-reported percentages

As student skills and agency have evolved, students appear to have developed critical thinking about the role of technology in the classroom. In the 2014 survey, although almost all of the students were in favour of using one-to-one devices for learning, around half suggested changes in practice (Figure 3).
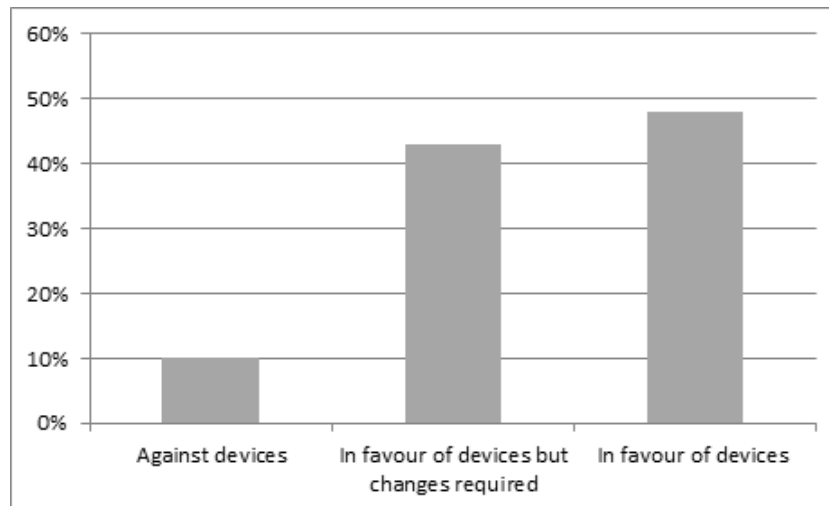
**Figure 3:** Student support for digital devices in learning measured by self-reported percentages

As indicated in the qualitative data, many of the students requested a balance between digital device use and more traditional classroom activities. Perhaps underlying these feelings is a concern that well-understood agency that students have gained through skills taught in their earlier school career, such as reading books and handwriting, are being replaced by less familiar skills. We might postulate, perhaps, that some students feel a lack of agency in the process of this skills transfer, given the results outlined in Figure 3. Compounding this, from the qualitative data, some students and parents feel that handwriting skills are declining, suggesting a diminution of agency in this area.

In their free-text responses, both students and parents occasionally referred to the students being treated as 'guinea pigs', i.e. the subject of an experiment. This response again suggests anxieties about agency; being acted upon, rather than acting on the world. We might suggest that many of these anxieties about agency are a direct result of being part of a culture in transition. Similarly, parental concerns about their own agency with regard to their children's school work often suggests an increasing sense of separation, suggesting that there may be a significant skills gap between parents and students.

### 3.4    Cultural practices

Cultural practices emphasize the areas that can benefit learning, as they relate to collaboration, meaning making and media use. Our surveys indicate positive transformations of cultural practices within both formal and informal learning spaces. Indeed, the concept of space in the digital world has moved from a sense of belonging to a physical place to a sense of belonging to a communications network (Strivastava, 2005.) Table 5 shows the repeated ideas in the themes of cultural practices.

**Table 5:** Themes and repeated ideas from the 'cultural practices' construct

| Cultural Practices | Themes | n | Repeated Ideas | n |
|---|---|---|---|---|
| **Teachers** | Collaboration | 6 | Peer collaboration | 3 |
| | | | Feedback | 3 |
| | Student practice | 6 | Student culture (positive) | 3 |
| | | | Student culture (negative) | 3 |
| **Students** | Interactions with others | 14 | Student collaboration | 8 |
| | | | Adult communications | 6 |
| **Parents** | Family Dynamics | 31 | Media use | 7 |
| | | | Reduced personal contact | 6 |
| | | | Device addiction | 3 |
| | | | Changes in social behaviour | 15 |

In terms of cultural practices, one of the most important transformations is the increase in student to student and student to teacher (and vice versa) collaboration. Peer collaboration comes as part of the pedagogical transformation, but another effect is the ability for teachers to give immediate feedback. Teachers' assessment of student culture was varied. Some comments were positive, e.g. classes being able to manage

themselves even in the teacher's absence. However there was also some evidence of negative impacts on the students' learning culture, for example:

> "*Some relationships have deteriorated in homerooms since the loss of interaction of face to face time with their peers and teachers*."

Students emphasised the communication aspects of cultural practices. Digital one-to-one devices have widened communication opportunities and provided common platforms for collaboration between students. For example, one student stated:

> "*iMessage helps kids connect with sick members of their group in group projects*".

If we consider these digital media in isolation, they might appear as somewhat one-dimensional. However, the settings and learning spaces where these communication channels are utilised, and the learning activities enabled by them, suggests that the BYOD initiative has brought a shift in the wider understanding of learning with and between contexts. In fact, it has contributed to integrating formal and informal learning spaces by extending team work and collaborative learning beyond the school gates. Students are now able to collaborate in real time to complete group tasks. Communication and collaboration between teachers and students has also improved, thus the idea of adult communication appears in Table 5. This also includes a handful of students who do claim to communicate with their parents about their learning.

Since the impact of change goes beyond the classroom, parents too noted changes in social interaction. The key theme that emerged from the data was various impacts in family dynamics. Many parents were concerned with the change in the social behaviour of their children. One parent reported:

> "*She is now constantly on the iPad, for things other than school work*"

Reference to media use tended to focus on non-educational purposes. Parents mentioned various social media sites being used at home, rather than devices being used for study. Of course it is possible that parents are just more sensitive to their children using their devices for leisure activities. One somewhat wry comment implied that perhaps learning was taking place even if this was not obvious.

> "*Well I am sure they are learning something but they are glued to the damn thing.*"

In terms of social behaviour, a number of parents stated that their children had become less communicative, more aggressive, less interested in physical activities and less willing to do things with the family.

> "*My daughter has become withdrawn and no longer talks to me.*"

Of course we have to note that the cohort for this study was aged 13-14, when these behavioural changes are not uncommon, regardless of whether a digital device is used in the classroom. Thus, while we cannot dismiss these concerns, neither can we isolate any effects of the BYOD classroom. Others commented that they now had to communicate with their children electronically rather than face to face. However, some others acknowledged the positive changes even while expressing some concerns, for example.

> "*…very secretive around their IPAD but also very switched on to learning.*"

Another concern explicitly raised by several parents was 'addiction' with respect to student relationships with their devices.

> "*Since she got her tablet, she has been addicted to it. She's been less active, usually goes to her room and plays with it rather than plays outside with friends like she used to do.*"

In a separate study, young New Zealanders suggested that a preference for cyber communication in social settings, purposeless preoccupation with a device, and feelings of anxiety when unable to use a device might be indicative of device addiction (Vacaru, Shepherd and Sheridan, 2014.) However, the authors of that study caution against using the term 'addiction', suggesting 'problematic use' is more appropriate, but such behaviour is certainly an issue of cultural practice that needs monitoring.

Looking at the quantitative data, student use of technology has, despite some concerns by parents, remained focused predominantly on educational activities (Figure 5). Media use has also extended the students' ability to express and communicate their work, as this parent reported in the 2013 survey:

> "*The quality of presentations on the device are incredible. It's great to be able to see the science assignment posted on YouTube.*"

Much of the reported media use might be seen as primarily substitution or augmentation, rather than more fundamental changes in teaching and learning. However the staff surveys reveal that the true impact is seen in teaching practice and student engagement, for example; a more informal approach to classroom teaching,

more ability to differentiate disparate learning styles and abilities, more flipping of the classroom and more engagement from boys in terms of their writing.
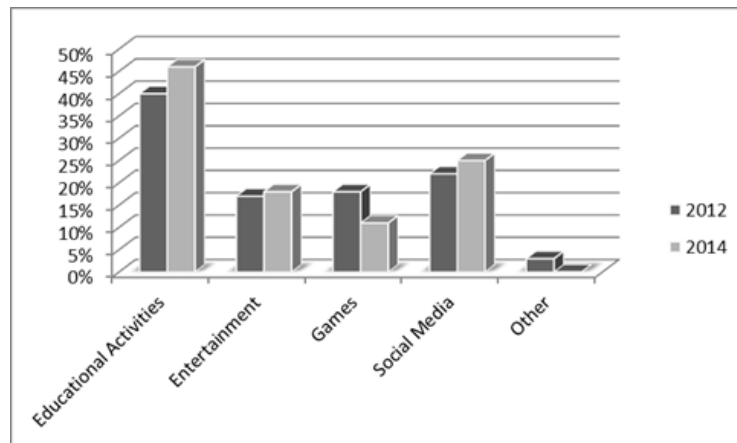


**Figure 4:** Student's nature of technology usage in school and at home (self-reported)

The structural impact of pervasive technology has of course impacted on the culture of the school, and leads to challenges for teachers such as keeping an eye on students during classes to prevent them from going off task.

## 3.5    Interaction of structures, agency and cultural practices

As described previously, structures, agency and cultural practices characterise the sociocultural framework. Most importantly, this framework sees learning through mobile devices in and around different learning spaces and is governed by a triangular relationship between the three components represented in Figure 1. Our final research question asks how these components have interacted during the period of the BYOD initiative. There are a number of aspects associated with each component and these aspects have either positive or negative impacts on each other in the experiences of students, teachers and parents in both formal and informal learning spaces.

Looking at the structure component, it contributed positively to the agency of students and teachers in terms of digital skills. The BYOD device and the technological infrastructure in school provided an opportunity for skills development. The results show that digital skills have improved in students since the BYOD initiative and also suggest a slow but positive trend in the digital skills of the teachers (Figure 2).

Other aspects of structure, however, act as constraints, in particular the curricular frame and its associated external examinations. Our results indicate that many students have included time with pen and paper, combining learning strategies to prepare for the NCEA assessment method. For example:

> *"I do think learning with devices is great but we need a balance until NCEA is done via computers as it's hard to get back into using pen and paper for exams"*

In a different context, one of the aspects of cultural practices (media use) is having an impact on structure (learning environment). There are some concerns for classroom management and distractions caused by the inappropriate usage of the one-to-one devices by students within the classroom.

One of the most important benefits of the BYOD initiative is the increase in collaboration (cultural practices) across formal and informal learning spaces. This is enabled by improved mobile communications (structure) and contributes to the development of agency in the students.

Despite some contradictions and challenges, interaction between the three components of the social-cultural framework in the context of BYOD has resulted in positive outcomes. However, there are a number of constraints caused by structure, and tensions raised by changes in culture.

## 4    Conclusions and future work

The longitudinal analysis of the BYOD project, based on the multiple surveys conducted with different stakeholders at different points in time has given us a good understanding of how the BYOD classroom has developed since its introduction. The analysis of data based on the social-cultural framework has been worthwhile to understand the relationships and interactions between the digital devices and infrastructure, the various stakeholders and the learning environment.

The majority of the quantitative results were positive, including improvement in the digital skills of students and teachers, increases in opportunity for individual mobile communications and collaboration for learning activities and also the advancement in social and personal development of students. From the qualitative data there were some persistent issues around the nature of media use by students and the impact it is having on teaching and learning activities. Qualitative data from teachers was substantially positive, while responses from parents and students were more mixed. This may suggest the impact of agency; in this context, teachers have the greatest agency, parents the least.

Our findings also suggest that students perceive their digital skills as developing rapidly, while teachers are more circumspect. From our interpretations of our qualitative data, we suggest that this is because members of staff are considering the development of their skills in the context of transformations of classroom practice, which demands a more extensive skill set than student use of one-to-one devices.

The focus of this article has been on survey data from the initial stages of a long term BYOD initiative that is not yet fully embedded. The data we have collected suggests that this is a period of transition and in many ways the BYOD initiative is being used also as an opportunity to redefine itself. There are skills that need to be developed further, dissonances between new forms of teaching and learning and traditional assessment structures, and anxieties about the unknown impacts of such major changes to schooling. There is clearly much more work to be done before we truly understand the implications of what is currently happening in the BYOD process. The next stage of our work will continue to investigate the themes introduced in the paper as the school completes its BYOD rollout.

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