Laptops for teachers' policy initiative in New Zealand:
Impacts and consequences

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Abstract: In this paper we draw on the results of the 2003, 2004 and 2005 national questionnaire, focus group and case study evaluation findings to discuss the impact of the Digital Horizons: Laptops for teachers scheme as a policy tool intended to leverage teacher use of ICT for collaboration, communication, administration, and lesson planning and preparation. The findings indicate that secondary teachers are making use of the laptops out of the classroom for communication with colleagues, reporting to parents, and the development of classroom materials. Teachers, even those who rated themselves as experts, are making less use of the laptops in the classroom for teaching and learning. Teacher commentary indicates that school technological infrastructure and access to professional development constrain and enable their use of their laptop. Drawing on Engelbart's notion of improvement infrastructure we discuss factors that have the potential to accelerate the integration of the laptop into teachers' professional lives. Initial analysis suggests these factors include school and departmental leadership and the nature of the professional development that teachers experience. Engelbart (1992) argued that it is the factors at this level that are the most important if the benefits of policy initiatives are to be maximized for teachers, schools and governments.

Keywords: Laptops, improvement infrastructure, policy, leadership

Introduction

Internationally, governments have endorsed the need for teachers to be ICT literate and there has been a significant investment in computers for teachers. There has, however, not been a comparable investment in professional development and resources to support any change in teacher practice. These initiatives appear to have been predicated on the assumption that access to a laptop will develop teacher confidence and competence in the use of ICT with flow-on effects for teaching and learning. The research literature provides very little support for this supposition (Becker, 1999; Cuban, 2001). More often than not, teachers make more use of computers and ICT technology, out of the classroom, for non-instructional purposes but in support of their teaching (Bebell, Russell and O'Dwyer, 2004). Rather than the technology transforming teaching and learning, teachers use computers to maintain their existing classroom practices (BECTA Impact2, Cuban, 2001). Selwyn (1999) argues that this is because computers have been 'inserted' into schools with very little consideration of teacher perspectives and the realities of classrooms (see also Olson, 2000) and indeed, research has implicated a range of personal and contextual factors as contributing to this situation (Jones, 2004; Scrimshaw, 2004; Zhao & Frank, 2003; Zhao, Pugh, Sheldon & Byers, 2002).

Laptops provide a different context from computers for teacher professional and personal use of ICT. Laptops are portable. They can be carried from class to class, and they can easily be taken home. Portability coupled with exclusive use means that teachers can have the same set of tools and products of work available to them throughout the school day, and at home. Thus, laptops go a long way towards meeting Means *et al.*'s (2003) proposal that, 'any given technology can support learning only to the degree that it is available for frequent, integral

use within and outside school', (p. 165). Research on the provision of personal laptops for teachers is only just beginning to explicate their impact on schools, teachers and students. The suggestion is that teachers are taking advantage of the flexibility laptops provide in terms of time and space of teacher use of ICT (Cunningham, Kerr, McEune, Smith and Harris, 2003; Windschilt and Sahl, 2002). Evidence is also emerging that teachers find a laptop affords greater access to resources for lesson preparation and provides for the streamlining of management and administrative tasks. Teachers have reported increases in ICT confidence and competence with perceived positive impacts in the classroom. From these studies a picture has begun to emerge that, just as with teacher use of computers, a multiplicity of personal and contextual factors interact to frame and shape teacher integration of laptops into their professional lives. In this paper we explore the dimensions of teacher laptop use and outline the factors the teachers considered constrain, enable and accelerate these uses in the New Zealand secondary school context.

The orientation for this paper is the use of the notion of 'outside-in' and 'inside-out' policy evaluation (Knapp, 2002), in relation to teacher response to a government-initiated evaluation of the Laptops for Teachers (TELA) scheme. For the purposes of this paper policy is considered as a vehicle for the expression of government goals and aspirations intended to guide and shape decision making by individuals and groups at all levels of the education sector. We recognise that policy makers use a range of tools including professional development and the provision of resources to build capacity as a way of leveraging the process of policy implementation (Hannaway and Woodroffe, 2003). Policy is of course interpreted, adapted and realised in different ways in different settings during its transition to the classroom. Teachers and schools can and do interpret policies in ways that lead to discontinuities between a policy as formulated and its actual practice in classroom, at least in the short term (Knapp, 2002). Moreover, any interpretation and enactment is not only dependent on the new policy but also by antecedent policies as they have become embedded in school policies and priorities, teaching materials and teaching practices (Spillane, 2004). The ways that policies can act to cumulatively reinforce or undermine each other can be a major contingency for teachers. Any policy evaluation needs to take account of this complexity.

Outside-in policy research, according to Knapp (2002), focuses on macro-systems to highlight the ways in which the original policy intention is changed, adapted and realised in response to differing contexts. A subsidiary focus is on the way multiple policies interact to cumulatively reinforce and or constrain each other. Inside-out research highlights the multiple demands on teachers working lives, the way they make sense of these demands and the conditions under which they try to engage with their professional responsibilities and student learning. The focus is on the individual circumstances of the particular school and teacher along with teacher learning and growth over time. Therefore in the terms of government initiatives to provide teachers with laptops for their exclusive use, we need to not only know how teachers are making use of the laptops but also to understand what affords and constrains these uses. In exploring this we are drawn to Engelbart's notion of an improvement infrastructure and improvement community. Engelbart (1992) posits that organizations should aspire to creating three basic levels of infrastructure: a core capability infrastructure (this is what is needed to enable people to do the core work of the organization); an infrastructure that enables the improvement of core work, and an infrastructure that enables the on-going improvement of the improvement processes. It is Engelbart's assertion that the third level is ultimately the most important to organizational effectiveness because it involves 'getting better at getting better' (Gonzales, 1998). He also notes that the improvement-of-

improvement level typically receives the least long-term strategic investment. Applying Engelbart's framework to teachers with laptops, the third level of infrastructure is what enables teachers to improve their ability to enhance their use the laptop. In this paper we elaborate on New Zealand secondary teachers' uses of laptops to explicate what afforded and constrained these uses, and those factors that have the potential to accelerate the integration of the laptops into teachers' professional lives.

The context for the study

The *Digital Horizons: Laptops for teachers scheme* [TELA] (Ministry of Education, 2003), is one component of the New Zealand compulsory school sector ICT strategy: *Digital Horizons: Learning through ICT* (Ministry of Education, 2002). The *Learning through ICT* policy document sets out goals in relation to ICT as an area of knowledge relevant to all students and indicates a government-level commitment to increasing the use of ICT in schools to help improve student achievement. The TELA laptops scheme provides full-time teachers in schools, who opt into the scheme, access to a laptop for a minimal or no cost. The stated goals of the TELA scheme are 'to develop teacher confidence and competence in the use of ICT for professional development, for teaching and learning, and for administration' (page 4). Schools gain access to laptops for their teachers on the condition they manage the integration of the laptops into the school environment where this includes providing and meeting the costs of additional ICT infrastructure, professional development and technical support. The Ministry information package for the scheme states that school commitment to these requirements is 'essential for an application to succeed' (Ministry of Education, 2003, p. 4). This paper reports on the first two years of findings from the *Digital Horizons: Laptops for teachers evaluation (Years 9-13)* which was set up to evaluate the impact of the laptops on teachers' work, specifically teacher professional growth and development, lesson planning, assessment and administration, and classroom practice.

The research design

The research design was to use a mixed-methods approach incorporating three cycles of annual nationwide surveys; regional focus groups, and school-based longitudinal case studies. The questionnaires provide prevalence data on teacher use of the laptops and the kinds of support they have experienced for these uses. The focus group component allows for in-depth exploration of the issues associated with teacher use of laptops in a manner that allows participants to build on each other's ideas and introduce topics of interest to them (Morgan & Krueger, 1993). The case studies provide for a rich description and analysis of what is happening in a bounded system (Bassey, 1999), in this case the schools and classrooms in which the teachers were utilising their laptops. An initial focus group discussion contributed to design of the questionnaire. Subsequent focus group discussions illuminated the questionnaire data. Building on this, the case studies provided insights into how particular school contexts interact with teacher personal factors to shape teacher use of laptops.

There was a similar sample of questionnaire respondents in each of the three years. Forty-nine secondary schools returned completed questionnaires in 2003, 48 in 2004, and 50 in 2005. The number of respondents was 688 in 2003, 744 in 2004 and 690 in 2005. Across the three years the respondents were generally experienced teachers: half had been teaching at a secondary school for more than 15 years. There were roughly equal numbers of male and female teachers. Almost two thirds of teachers came from main urban centre secondary schools. Nearly all teachers had a teaching role in their school. Over a third were heads of department or faculty. Around 15% of teachers had responsibility for ICT in their schools. Each year around a fifth (2003-21%: 2004-21%: 2005-26%) of questionnaire respondents

rated themselves as expert users of the laptop, two thirds as intermediate users (2003-65%: 2004-67%: 2005-65%) and around 10% as beginner users (beginners) of the laptops (2003-14%: 2004-12%: 2005-9%). Nearly eighty percent had a computer at home and around forty percent had had a computer at home for at least 6 years.

Each year six focus groups were conducted to ensure reasonable coverage of issues (Vaughan, Schumm and Siaguh, 1996). Focus group schools were selected based on their geographical location and reasonable proximity to a main centre with due regard given to school socio-economic status, gender, and the school roll. Between 6-10 teachers from 3 or 4 schools attended each group, a total of around 48 teachers from 20 schools. Focus group discussions were held in non-school venues and lasted for up to three hours. The focus group participants held positions in their schools ranging from that of principal to first-year teacher. Some described themselves as 'computer freaks' and others said the laptop was the first computer they had used. While it was not always easy to recruit teachers, due mainly to time factors, those attending commented on the positive experience of attending a focus group and on the professional development that it had given. Discussion was lively and positive.

Eight case studies were undertaken in a range of schools each year. Between eight and 14 teachers were interviewed at each school, some individually and some in departmental groups.

Teacher use of the laptops and factors that support and constrain these uses
The findings of the first two years of the TELA evaluation are presented here in terms of teacher use of their laptops for the purposes associated with the TELA goals: collaboration and communication; administration and management, lesson planning and preparation, and classroom use. Several factors emerged as supports and constraints to these teacher uses of the laptops. These factors were: leadership and school organizational support, professional development and school ICT infrastructure. Each factor appeared as salient for each of the uses, although it manifested in different ways for different uses and for different teachers, depending on their knowledge and expertise. These aspects are explored/described under the different uses that teachers made of their laptops for – administration, communication, lesson planning and preparation, collaboration and instruction/classroom use.

Consistent with international research (Bebell, Russell & O'Dwyer, 2004; Dale, Roberston & Shortis, 2004) non-instructional/administrative uses predominated in the 2003 and 2004 questionnaire respondent reports of the ways teachers used their laptop with over half of the respondents overall indicating they used their laptop for administrative tasks such as writing reports for parents, recording and checking student data. A higher proportion of beginners used the laptop for writing reports for parents than any other task. In 2004, 60% of all beginners used the laptop for this purpose, 20% more than used the laptop for any other listed task. The higher involvement by beginners in just this one task suggests they were driven by more than their own goals and indeed the focus group and case study teachers indicated that computer-based reporting was a school requirement in all but one of their schools. Recording and checking student grades were tasks performed by just over two fifths of those who rated themselves as beginners, two thirds of those who rated themselves as intermediate users, and nearly all (86% in 2004 up from 73% in 2003) of those who rated themselves as expert users. These too are administrative tasks associated with teachers' obligations to monitor and report on student progress, which perhaps explains their prevalence. The use of the laptop for student data entry was most likely driven by the external demand for electronic NCEA results. The prevalence of these uses may also be a consequence of teacher experience of school-provided professional development: teachers

reported they had had professional development in the use of school network (49%) and administration programs (41%). A well-set-up school infrastructure is crucial for teacher use of the laptop for administrative and management functions including reporting, student data entry and internal communication.

Over half of the intermediate users and expert users in the 2004 questionnaire reported they used the laptops for 'routine communication with the school'. As might be expected, the use of email as a means for whole school communication, both formal and informal, was not seen as viable unless all staff had an laptop/computer, easy access to the school network *and* could be relied on to use this facility on a regular basis. The suggestion was that whole-school communication via email needed to driven by the school leadership. However, some principals preferred face-to-face communication, as did some teachers. Email played a role in communicating with colleagues in other schools and with teacher organizations for just over two fifths of the questionnaire respondents overall (predominately those who rated themselves as expert users). Many focus group and case study teachers recommended email for this purpose, claiming it allowed for greater flexibility of communication with those outside school than did the telephone or fax. Teachers were now in more regular contact with a wider range of colleagues around the country to plan joint activities, including extra-curricula activities for students and meetings and conferences for teachers. Email was used as a tool for sharing and collaboratively preparing lesson materials. In one case study school the science department was collaboratively planning a new course with colleagues in a school around 100km away. Where teachers lacked home access to the school network, teachers emailed work to and from home and school. Other studies have reported extensive teacher use of email for professional and personal communication suggesting that it provides an engaging entry point for teacher use of ICT, one that includes obvious and immediate feedback and efficiencies.

Tasks associated with lesson planning and preparation include the preparation of student handouts, and accessing the Internet and Te Kete Ipurangi (TKI) for curriculum or assessment-related documents. Nearly three quarters of teachers overall (71%) had used their laptops to prepare student handouts or worksheets (83% of expert users and 74% of intermediate users). A third of teachers overall (31%) had accessed online resources for their lesson preparation (53% of expert users and 28% of intermediate users).

Teachers in the focus group and case study interviews were positive about the benefits of greater access to a range of multimedia resources, including those on educational and other websites, CD ROMs and copies of electronic materials given to them by colleagues. They also appreciated the functionality of the laptops for undertaking research related to units they were teaching. A majority of these teachers used the laptop as their main/only repository for the materials, including lesson and assessment resources that they used and produced. For these teachers the laptop had become a portable office that could be transported easily between school and home. Teachers appreciated the flexibility of the laptop in allowing them to design lesson materials at school in collaboration with colleagues, and at home within a family setting. Some reported they now spent more time at home on schoolwork but this was acceptable to them because they were not 'shut away' from their family. For example, three technology teachers from one case study school described the laptops as 'socially beneficial' in the way they brought people together, both at home and school. On the other hand, three focus groups expressed concerns about 'work creep', and were apprehensive that working at home would become an expectation, rather than a choice. Departmental mentoring and leadership, either from a head of department and or ICT expert within a department, was said

to be vital to encourage the development and sharing of electronic lesson materials, and the setting up of a well-organized central repository for lesson materials. For example:

Rather than standing in the middle of the room and looking around everybody and saying, "Who has got something for this text or novel?" The first thing you actually do is ask for help. The system we have at our school is that of going to the Q-drive and looking in the English folder and then by year group and the topic and see what somebody else has already put there. And our HOD is trying to remind us constantly that every time you develop a new resource, put it there so others can access it and change it for their class needs.

Laptops provide the flexibility of easily-modifiable resources that can easily be shared and as such were said to fit well with the collaborative culture of many departments. Teachers considered that access to a laptop had led to increased sharing of resources. Teacher commentary suggested that the more teachers within a department with laptops the more likely departmental colleagues were to collaborate using a laptop. That is, there needed to be a critical mass of teachers with laptops and those who used their laptops to establish and maximize the benefits of collaborative development and sharing of electronic resources. Teachers from three case study schools commented that the TELA restriction on part-time teachers accessing laptops restricted the use of the laptops for communication and collaboration within a department. For example, in one department there were 12 full-time and 10 part-time teachers, and only the full-time teachers had a TELA laptop. This reduced the possibilities for collaboration and the sharing of resources. In contrast, all the teachers in the art department in one case study school had laptops. These teachers reported that the synergy between them contributed to the development of ICT use. A department workspace that was set up with space for collaboration and easy access to the Internet and school server was an important catalyst for departmental sharing. Three teachers from one technology department outlined the benefits they had accrued since the beginning of 2005 when their workroom had been cabled. Now, they could work together more efficiently, sharing and developing lesson materials. One of the teachers had accessed a laptop through the scheme so that he would not miss out on the gains being made. There was some indication that department exclusive use of this space could lead to isolation from other teachers although one school at least supported the deliberate diffusion of ideas, as a focus group teacher explained:

There is a hierarchy here that classroom teachers share ideas with each other within the departments. They learn a skill and then they share it with another department and it is leaked out through the school to the person who is a full time techie kind of Digital Horizons consultation facilitator.

The questionnaire results indicated teacher use of the laptops in the secondary school classroom, even the use of *PowerPoint* was not widespread. Just over a tenth (13%) of respondents, overall in 2004, reported they routinely used *PowerPoint* presentations in class. This proportion rose to a third (34%) for those who classified themselves as expert users even though just over three quarters of expert users (76 %) reported easy access to a data projector. Of those who classified themselves as intermediate users only 8% were making routine use; 48% reported easy access to a data projector. Only one percent of those who rated themselves as beginners said they used the laptop for *PowerPoint* presentations, although 22% reported easy access to a data projector. In terms of occasional use, 44% expert users reported use of *PowerPoint* compared with 37% of intermediate, and 14% of beginners.

A majority of focus group and case study teachers, and some questionnaire respondents, reported a significant impact on their teaching, as the following comment indicates:

The laptop has made the most significant change to my teaching practice. It is of immense value to me. Thanks. (Questionnaire respondent)

The case study interviews indicated that teachers from different subjects might use their laptops in qualitatively different ways in the classroom for instructional purposes in a manner consistent with research by Hennessey, Ruthven and Brindley (2004) in the UK and Bebell, Russell and O'Dwyer (2004) in the USA. An analysis of teacher commentary suggested these differences might be grounded in different subject subcultures and associated pedagogy and practices rather than different levels of classroom access to the Internet/data projector and or differences in personal knowledge and expertise. For example, in 2005 the 14 science teachers from seven case study schools were enthusiastic about the use of the laptop-plus-data projector/Internet for teaching science. They reported extensive use of lesson materials that integrated text, simulations, interactives and real-world data (images and video clips) to stimulate student interest and engagement. Similarly, technology teachers were enthusiastic about the laptops as a teaching tool to access search the Internet for information and for *PowerPoint* presentations, these often incorporating digital photographs of student work and *Computer Aided Design (CAD)* demonstrations. Digital photographs were useful as a record and a tool for assessment. Physical education teachers used the video capabilities of the laptops for analysis, teaching and assessment of student performance, both individual and team, curricular and extra-curricular (tennis, golf, netball). Social science teachers in one school considered their area of expertise 'lends itself nicely' to the use of *PowerPoint,* virtual field trips and websites such *Google Earth* and *Geographic Information Systems (GIS).* The mathematics and English teachers were divided as to the value of ICT/the laptops with some asserting that ICT did not fit their philosophy of effective English teaching and learning. They emphasized the importance of discussion and debate and argued that ICT was not a viable alternative to paper-based texts for reading or writing although they used the laptops for personal research.

Consistent with the suggestion that innovation takes time, focus group participants in 2004 considered they were just beginning to realise the full range of potential benefits.

The provision of a laptop has been GREAT - appreciated and used (not to its full potential yet) but I am working on it slowly. Being able to do student reports at home will relieve pressure put on us at school. The laptop is a valuable and necessary teacher tool!

Consistent with this, learning more about how to use the laptop for teaching and learning was the main goal for nearly half (45%) of the 2004 questionnaire respondents and most focus group and case study teachers. In conjunction with professional development, continuity of access to a data projector and/or the Internet was considered a major influence on how the laptops were used in the classroom for teaching and learning. Fifty-one percent of questionnaire respondents reported that they had easy access to a data projector, and 51% had easy access as a goal.

Conceptualising the second level of improvement infrastructure

Engelbart (1992) defines the second level of an improvement infrastructure as providing for improvement, in this case the improvement of teacher use of the laptops. Teacher commentary in the study indicated that professional development, school technological infrastructure, and school organisation and leadership shaped and constrained the opportunities and incentives teachers had to use their laptops. These factors influenced, in varying ways, all teacher uses of the laptops albeit they manifested in different ways for different teachers and for different uses of the laptop.

Policy makers routinely use professional development as a tool to leverage change and in the TELA scheme, schools and teachers were obliged to undertake 40 hours of professional development over the three years of the laptop lease. Despite this, the 2003 teachers were largely unaware of this requirement. There was uncertainty as to what could count towards the 40 hours, this persisting into 2005. This said, the 2004 questionnaire respondents reported they had had professional development on learning about the school network (49%), using the administration programs (41%) learning about specific software (32%), and beginner computer skills (29%). Only 24% had undertaken professional development in the use of the laptop with curriculum applications, and just 20% had received assistance with development of resources. Focus group and case study teachers recalled introductory sessions with the technician when they collected their laptop, slots in staff meetings in which colleagues presented ideas, and in-house workshops run before or after school or during the lunch hour. Some focus group teachers noted, and the questionnaire responses indicate, that much of the available professional development was targeted to needs of beginning users. They argued that they too needed opportunities to extend their knowledge and expertise. Whole-staff professional development was recommended for institutionalised activities such as reporting, absences and data entry as a means of ensuring that consistency was maintained. It was also seen as having some value for skill development. Otherwise, generic professional development was said to lack immediacy and personal relevance.

As teachers sought to integrate the laptops into their work supported by limited formal and funded professional development, they were turning to colleagues for help and support. Teachers in each component of the study identified peer mentoring and collegial support as the main mechanism for enhancing their use of the laptops for teaching and learning: nearly three quarters (70%) of questionnaire respondents had been helped by school ICT staff and a half by other teachers. Collegial help was described by those interviewed as the preferred and most prevalent form of professional development. Teachers acknowledged that certain individuals had particular expertise in ICT and emphasized the importance of opportunities to work in a sustained way with these colleagues as mentors. The professional development provided by same subject colleagues for ICT use in teaching and learning was seen to be especially valuable because it was 'immediate' and 'in context'. Colleagues as mentors provided access to models of how a laptop could be used for teaching within setting teachers found themselves. Some departmental leaders orchestrated the development and sharing of collective expertise by sending interested staff to external courses and providing opportunities for them to share what they had learned. In one case study school the ICT personnel targeted expert individuals within a department for training and then encouraged these individuals to share what they had learned within their department. Departmental cultures of sharing and learning had emerged, catalyzed by, and revolving around, exploring the possibilities available through the laptops/ICT.

You can see learning happening [in the workroom]. People ask questions. They ask for help and others listen in. There is a learning environment happening.

In this way, it appears that informal peer mentoring has the potential to enhance teachers' sense of belonging to a professional learning community (Senge, 1994). The general consensus was that without the collaborative culture that exists amongst New Zealand teachers very little progress would have been made in the use of the laptops/ICT. One caution about informal collegial professional development was that it was dependent on teacher access to local expertise and thus could be haphazard.

The provision of infrastructure, particularly computers has tended to be the focus of ICT policy initiatives with an associated focus on student-computer ratios as an indicator of the success of these policies (Dale, Robertson & Shortis, 2004). Under the TELA scheme schools are required to manage the integration of the laptops into the school environment, including the provision of additional ICT infrastructure and technical support (Ministry of Education, 2003). In the 2003 focus groups and case studies, school technological infrastructure including hardware, software and technical support was described as a key constraint on teacher use of the laptops. Consequently, ICT infrastructure was an explicit focus in the 2004 research round. The extent of the variation in infrastructure provision and access amongst teachers within the same department and the same school, and between teachers in different schools is the key finding to date in relation to this aspect.

Over a half (51%) of the 2004 questionnaire respondents reported they had easy access to on. This said, access to the school network was identified as an important form of support needed by 26% of teachers. There was some evidence of different histories and levels of initial familiarity with ICT in schools on entry to TELA scheme, along with indication that this had consequences for the integration of the laptops into school and teacher practices. Teacher comments intimated that the nature of a school technological infrastructure was the culmination of various antecedent decisions by school leadership under the Tomorrows' Schools (Ministry of Education, 1989) school self-management regime. Schools where ICT had long been a strategic focus tended to have well-developed ICT systems and resources including hardware, software and personnel with the expertise required to provide advice and guidance in the development of school ICT policy and facilities. Staff from these schools indicated that in-school personnel had been able to anticipate some of the demands of the laptops and had planned to address these. For example:

We made the decision, "Were we going to avail ourselves of this opportunity like getting laptops for teachers?" We started out by costing the whole thing out. What was the cost of leasing the laptops to school? And we were going to follow that approach rather than asking the staff to pay [the lease costs] themselves. What additional infrastructure was required in the school? So we costed that. What technical support was going to be required? Because teachers can't do this on their own. What is the additional software that was going to be required? What PD was required? So we took that overview to it and costed in all those factors.

At the other end of the continuum, schools that had joined the laptops scheme to 'kick start' ICT developments in the school were working to connect all classrooms and to up skill teachers. Focus group participants indicated that these schools were sharply aware of the variations in ICT development among schools and saw the TELA scheme as an opportunity to develop ICT within their school.

The introduction of laptops had prompted further investment in ICT infrastructure in all focus group schools, and all but one case study school. The focus of this investment was qualitatively different in different schools, consequent on the existing technological infrastructure (hardware, software, and personnel with technical knowledge and expertise). It would seem that school technological infrastructure plays a crucial but different role at different times in teacher and school ICT development. Generally, professional development needs were seen as less pressing in schools with a poorly-developed infrastructure. In these schools the teacher focus was on the need for schoolwide networking. In schools with a more established infrastructure the laptops had prompted the purchase of additional ICT resources and, in some cases, ICT professional development. Increased teacher access to ICT/laptops and professional development led to increased demand for suites of computers for curriculum teaching and in-class data projectors.

Teachers in interviews made a distinction between easy and ongoing access to a data projector. Teachers were not prepared to make a commitment to the use electronic resources unless they had reliable, and preferably ongoing, access to a data projector. The time and effort required to access and set up a data projector often exceeded any benefits that teachers anticipated, particularly since they envisaged as ideal the flexible use of the laptop as a tool to respond to student ideas and questions. They recounted how colleagues with reliable access used the laptop-plus-data projector as a 'natural thing'. Schools were slowly acquiring data projectors, albeit not at a rate teachers would have preferred.

At this time a theme is emerging that senior management leadership is crucial irrespective of its form. In the initial stages, a leadership decision was required for a school to take part in the TELA scheme. Just over two fifths (42%) of the 2003 questionnaire respondents reported they had joined the scheme on the encouragement of the Principal. Under the TELA scheme, teachers or their schools pay a portion of the lease for the laptops, the decision about who paid being one that was made by the Board of Trustees with the principal. Some teachers reported their Board of Trustees saw the laptop as a personal item and were not prepared to fund the lease. Others explained that their Board and principal were actively pursuing a vision for ICT integration and were fully behind the scheme, to the extent of paying the lease costs. Teachers reported that the need to pay the lease cost had impacted on teacher participation in the scheme. Teachers were aware of the financial implications of a Board paying for teacher laptops and appreciated the Board paying some, or all, of the lease. They saw the need to pay as an equity issue for teachers and students. Where teachers within a school or department did not have a laptop, or a computer, this limited their involvement in some administrative and management tasks and the development and sharing of electronic lesson materials. Teachers considered they should not have to pay for a tool that was increasingly being positioned as central to their work.

Subsequent to a school entering the scheme, school policies and practices determined the incentives and opportunities teachers had to use the laptops. School polices about acceptable use reflect a meld of the TELA scheme requirements and the benefits and opportunities the school envisions for teacher access to a laptop for their exclusive use. Some schools restricted teacher acceptable use of the laptops to school-related tasks; others allowed laptop use for all but inappropriate and objectionable tasks. Schools with a more flexible approach considered all teacher use could contribute to teacher use for professional purposes. In these schools the leadership focus was on reducing any barriers, as a school leader explained:

You know there are enough barriers to ICT as it is and especially for people who aren't very competent and so we just didn't want any barriers.

School leadership to develop policy and practice was exercised by different individuals in different schools. These individuals included the principal and or member of the senior management (deputy principal); a small group whose membership consisted of senior management and teachers with expertise in ICT, and/or enthusiastic individuals.

Focus group and case study teachers noted where the integration of ICT was part of the school strategic plan and supported by senior management and/or the Board of Trustees the introduction of the laptops had been accompanied by careful planning for the integration of the laptops into school systems. Teachers were very appreciative of this and the implicit valuing and support for their efforts in using the laptops. In some schools a lack of ongoing leadership to bring about successful ongoing support for laptop use had led to integration problems. For instance, in one case study school the consequence of low-level initial Board of Trustees and principal leadership support for ICT/laptops, had contributed to a very small teacher uptake of laptops. Continuing low-level support for actual use was considered by those interviewed to have contributed to a subsequent decline in the number of teachers with laptops. Where schools did not have active senior level leadership for ICT the resulting vacuum was filled, or not, at the departmental level by the head of department and/or teachers with enthusiasm for and expertise in ICT. In these schools, ICT/laptop use was inconsistent and support for use was generally thought to be poor/inadequate by those interviewed. In sum, it would seem that leadership is important for initiating and sustaining the conditions that support teacher utilization of laptops and for helping teachers extend their use of the laptops. Without a clear vision and senior management level leadership, school-wide development may be haphazard and ad hoc, dependent upon individual capability and interest.

Towards the third level of improvement infrastructure for laptop use

Engelbart's (1992) third level of improvement infrastructure enables the on-going improvement of improvement processes. That is, it is what accelerates teachers' ability to enhance their use the laptop. A synthesis of the data across the two years (2003 and 2004) indicates that it is not sufficient to consider professional development, available ICT infrastructure, resources and support, and teacher confidence and expertise in isolation. It is the convergence of teacher confidence and expertise, the professional development they receive, as well as access to reliable ICT resources that supports the integration of the laptops into teachers' professional lives. It is these factors in combination that support and sustain, and or inhibit teacher use of ICT/laptops. Individually and in combination they are manifest as enablers and constraints in different ways in different school and department settings and in different forms at different stages in teacher, department and school integration of the use of ICT/laptops.

For beginners, help to use the laptop, including prompt technical support, is important when they are 'stuck'. With more experienced and knowledgeable users, attention may turn to the development of lesson materials, the knowledge of resources to support this and the skills to make use of these resources. Once teachers are able to prepare multi-sensory materials, it seems that the focus shifts to the need for ongoing access to a data projector and models of how to use ICT for teaching and learning. Competent teachers who have classroom access to a data projector and the Internet were eager for professional development to extend their knowledge and skills. They were interested in opportunities (and training on how to) to share their enthusiasm and expertise with colleagues. As Salomon (1993) points out, the effectiveness of a tool, in this case the laptop, 'results from and contributes to the whole

configuration of events, activities, contents, and interpersonal processes taking place in the context of which it is being used' (p189). While clauses in the TELA scheme specifying that schools provide for school-based integration of the laptops with regard to professional development, technical support and technical infrastructure suggest that policy makers were aware of these dimensions, it seems probable that neither they, nor the schools, appreciated the full import of this requirement, or the way it was entangled with school interpretation and enactment of previous policy, which had provided very little direction and support for ICT use. The findings highlight that school and teacher response to a particular policy does not take place in a vacuum. Responses are shaped by previous policies as they have become embedded in local organizational policies and practices and supporting material resources and technological infrastructure.

The findings to date indicate that school leadership is crucial in providing the impetus, encouragement, and conditions for enhanced teacher professional use of the laptops. It is a key component of the third level of a school improvement infrastructure. Like others (Anderson and Dexter, 2000; Hayes, 2003) we found that school leadership, vision and support for teacher use of ICT/laptops, including the provision of ICT infrastructure and technical support, in interaction with the school and departmental culture for collaboration and in conjunction with a teacher's own knowledge, expertise and vision for the impacts of ICT/laptops, influenced the practical uses teachers made of a laptop. The purposes and possibilities envisioned by school leaders within the national policy framework and their own vision of ICT use by teachers and students in their school, shaped and subsequently framed teacher access and actions with ICT. School leaders for ICT, dominated by the nature of principal support, which guided the transformation/ translation of the TELA policy into school-based policies and practices. However, Haynes (2003) notes, principals need a vision for how technology might fit with and support student learning, they need to appreciate that the task of integrating ICT into schools is complex and risky. Principals need to manage the development of a stable and reliable technological infrastructure that has financial, knowledge and management risks to their own and the school's reputations that might arise from trying unproven methods. The challenge for school leaders is to establish and maintain a stable and accessible technological infrastructure and at the same time build teacher capability to use technology and integrate it into meaningful and well-designed learning programmes. A critical mass of expertise and active laptop users is crucial to support and then extend individual teacher, department and whole-school laptop use.

In terms of the third level of improvement infrastructure, the findings of this study attest to the importance of professional development: change would, in the teacher's opinion, have been greater with more professional support. Our findings resemble those of other researchers in New Zealand in according maximal value to peer mentoring and collegial help as a source of professional development (McGee et al., 2002). This said, if teachers and schools rely solely on collegial help and local good practice opportunities to learn are necessarily distributed in random and ad hoc ways. Teacher access to someone with the pertinent expertise and a willingness and ability to share determines opportunities to learn. That all teachers will have this access cannot be assured without some form of intervention. Added to this, teacher learning may be confined to what is available locally rather than what might be needed. What is needed is a balance between opportunities to share and to grow local knowledge and expertise. School-wide and departmental leaders in ICT, particularly those from smaller schools need opportunities to meet with peers and experts from outside their own school to share problems and solutions. Once back at school, there needs to be a mechanism for these teachers to share what they learned with colleagues and for their

colleagues to have time to experiment with and explore what has been learned. Principals, Boards of Trustees and school senior management need opportunities to extend their understanding of the potential and possibilities for ICT in their particular school. As Dale et al. (2004) point out, school-based policy and subsequent practices are often shaped by the principals'/senior management's knowledge and expertise and the advice available to them. In the absence of sufficient experience and understanding of the issues to formulate questions, the tendency is to demand answers to locally shaped problems, and questions about possibilities are shaped by the available answers. The benefit of opportunities to share problems and solutions was amply demonstrated within the focus groups. When teachers sought advice on how to solve a particular problem, they were often surprised to find other schools managed the task in completely different ways. Given the evolutionary nature of ICT and its possible uses it seems likely that opportunities to share will continue to be important.

Discussion

All institutions face challenges with the integration of ICT. For schools these challenges have been exacerbated by the tendency for policy initiatives to be hardware-driven without a complementary investment in time and resources to develop teaching and learning. Computers have been provided to schools with very little consideration of teacher perspectives and the realities of classrooms (Selwyn, 1999). The findings of this study lend support to the contention that any analysis of the impact of ICT cannot afford to decontextualise it from the wider social and political variables that shape the larger context of schools (Selwyn, 2000); a systems analysis is required (Selwyn, 1999). As Olson (2000) suggests, policy makers need to 'engage in conversations with teachers about their work culture, the technologies that sustain it and the implications of new approaches for those technologies' (p. 6).

Differences in school technological infrastructure highlight that government policies are not self-sufficient entities. The cultural, material and knowledge/expertise setting for school/teacher response to a particular policy is shaped in part by antecedent policies and the ways in which these have played out in the local context. School ICT infrastructures reflect the intersection over time of national and local school-based policies. The flow on from the differential value placed on ICT by different schools, in part explains current differences in school organizational, technological and personnel/expertise infrastructure. Schools with better-established ICT policies and practices not only had better-developed technological infrastructures, but also greater access to on-site expertise, and thus were better able to anticipate and provide for teacher needs arising from access to personal access to a laptop where these need encompassed access to facilities, professional development, technical support and organizational and administrative systems that allowed teachers to utilize the affordances of teacher exclusive use of a laptop.

Teacher commentary in this study attests to the efficacy of professional development as a policy tool, albeit not formal professional development provided by external experts. Indeed, data from this study suggests the provision of externally developed and delivered courses needs careful consideration. Professional development deployed as policy tool to build teacher capacity and inclination to use ICT/the laptops may be better focused on support for peer mentoring. Easy access to models for teaching students using ICT would seem to be essential. This situation has the additional benefit of supporting the development of schools as learning communities (Senge, 1994). Leadership support for 'consequential uses' (Becker, 1994) that take advantage of the affordances of the laptop would seem to be essential.

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