A Student Laptop Roll-out for International Information Technology Students

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ABSTRACT

Adequate computing resources are essential to the effective teaching of Information Technology. There are several complicating factors when these resources are provided in the context of computer laboratories. These include the reliability of machines, consistency of software environments, and adequacy of hardware and the cost in both financial and human resources. We addressed these problems by progressively phasing out desktop computers in laboratories in favour of issuing laptops to IT students. These laptops were of a consistent specification and had a standard software environment.

Practical problems encountered with this approach included procuring appropriate numbers of laptops in a timely manner, challenges with technical support and monitoring of students during practical tests and exams. Procedural problems included security of the laptops, handling returns and meeting student expectations. Each of these problems was solved and we succeeded in creating an efficient, cost-effective and flexible laptop-based environment. This created an improved teaching environment where student fees could be directed to other areas, where technical staff could focus on other issues, and students have greater flexibility in their work. We can therefore recommend a transition to laptop-based teaching for Information Technology students.

Keywords: international students, student computing, student laptops

1. INTRODUCTION

The context of the project reported here is the Information Technology Programme at Auckland Institute of Studies. This programme offers four qualifications: the one-year Diploma in Information Technology (DIT) level 5; The two-year DIT level 6; The three-year Bachelor of Information Technology (BIT, level 7); and the one-year, level 7, Graduate Diploma in Information Technology (GDIT). Three specialisations are currently taught: software development; computer networks; and information systems. There are three semesters per calendar year, and students may enter the programme at the start of any semester.

It is axiomatic that effective teaching of information technology requires extensive practical work. This has traditionally been done using student computer laboratories, where desktop computers are installed. At the start of the project the IT programme had six dedicated computer labs, including two network labs. The desktop computers in these labs were between two and four years old. This situation had several problems.

The most substantial problem faced by the IT Programme at AIS was that the size of the lab, with respect to the number of computers installed, had to be matched to the size of the class. If there are not enough computers in the lab, then staff must scramble to install more before classes can begin, or enrolments must be capped, causing students to miss out on courses they need to complete their qualifications. If there are too many computers then machines sit unused, which is a waste of resources and a cost via depreciation.

The breakdown of a single lab machine inconveniences everyone who uses that lab. Since students are not always reliable in reporting faults, a breakdown could go unrepaired for some time. This means that labs must be regularly inspected, which is a time-consuming but vital activity, especially before practical tests or examinations.

While a standard image can be easily installed on each lab machine, and software installed on user profiles fed from a central server, some courses have software that is particular to that course. Some of that software, for example the data mining package WEKA (Witten & Frank, 2005), cannot be installed on profiles and must be installed locally on each machine. This is time-consuming and inefficient. If the class needs to be shifted to another lab, then the local installation process must be repeated for every machine in that lab. If any machines in the lab need to be replaced, there is the potential for the special installation to be overlooked.

While larger institutions can bear the cost of having student labs open 24/7, this is too expensive for smaller institutions. The cost of security can be substantial and even with cameras in every lab, thefts of equipment can still occur.

Finally, running computer labs forces an institution onto a regular update treadmill. As computers get older they become

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less reliable and therefore require more cost of maintenance. They also become less capable of running the latest software. Lab machines must therefore be replaced regularly, but even disposing of the old computers has a cost.

Issuing laptops to students solves these problems. If every student is given a laptop, then there are always enough machines available to the class. If a laptop breaks down, it only inconveniences one person, and then only until a spare or new laptop can be given to that student. Being portable, they are available at all times to the students, and security for "their" machine becomes their responsibility. Finally, software can be installed on the machines on an as-needs basis, or students can install the software themselves. The self-installation approach is especially appropriate for IT students, as this can be useful training for their future employment: that is, IT students need to be able to install software, and therefore need practice in doing so.

Previous research with high school students has shown that laptops positively contribute to student academic engagement (Keengwe, Schnellert & Mills, 2011). Students in middle schools have also been shown to significantly improve their academic performance after being issued with individual laptops (Lowther, Ross & Morrison, 2003; Gulek and Demirtas, 2005), while students in higher education report that the usefulness of laptops outweigh the challenges associated with using them (Wurst, Smarkola & Gaffney, 2008; Kay & Lauricella, 2011). Officer candidates at the West Point military academy in the USA reported that laptops made note-taking and other learning activities more efficient (Efaw et al, 2003). Other research, however, warns of the potential for the increased distractions that laptops provide to negatively impact student learning (Fried, 2008).

Our goal was to replace the student IT labs with a one-laptop-per-student approach, where the cost of the laptop was recovered from the per-course resource fees. The laptops needed to be powerful enough to run the coursework software yet priced such that the full cost of the laptop could be recovered from a one-year, eight-course qualification, that being the shortest qualification we offer. At the end of the transition, every student was to have a laptop and all of the computer labs were to have been decommissioned.

2. WHAT WE DID

We designed and implemented a one-year, or three-semester, plan to transition our teaching from a lab-based to a laptop-based mode of instruction. It commenced in the third semester, or September intake, of 2014 and completed the end of Semester 2 (August) 2015.

The first step was to identify existing students who still had at least three semesters of full-time study remaining. These were the students who would be paying enough in resource fees that we could issue them laptops without sustaining a financial loss. Students who entered the IT programme in the September 2014 intake, and each subsequent intake, were also issued with laptops.

We supplied students with laptops, rather than implementing a Bring Your Own Device (BYOD) model. This was because we wanted to ensure that the laptops were capable of running the required course software, and that the software on the laptops was legal. If we had gone with a BYOD model, it was considered to be highly probable that at least some of the laptops students brought would have been incapable of running course software, which would have left the student unable to do their coursework. It was also considered likely that at least some of the software on the laptops would have been from "less than legal" sources, with all of the security risks that that would have entailed.

Laptops were acquired from local vendors. Due to the on-going and long-term nature of our acquisitions (we need to acquire a new batch of laptops three times per year, for each of the three student intakes) we were able to secure a highly competitive pricing. We also arranged insurance policies for each laptop, and students paid a small bond to cover the excess of the policy.

At the end of Semester 3 2014, the two IT labs with the oldest desktops were decommissioned, and the desktops removed. These were re-designated as common teaching rooms. Two additional labs were decommissioned at the end of each of the following two semesters, so that by the start of Semester 3 2015 there were no IT computer labs remaining. Careful tracking of students and allocation of teaching rooms to courses meant that there was only one case of a student without a laptop being placed in a teaching room with no computers. That was easily solved by placing a single desktop (taken from a decommissioned lab) in that room, solely for that student to use.

Several networked multi-function devices (MFD) were installed on-campus before the laptop roll-out commenced. Students were therefore already experienced with using these MFD to print material, as well as scan and photocopy.

When the students completed their programmes of study, ownership of the laptop was signed over to them. Thus, problems with aging hardware and disposal of obsolete equipment were eliminated. This also avoided the problems and costs of cleaning laptops and otherwise restoring them to an acceptable state for re-use. The insurance bond was also refunded if no insurance claim was made on the laptop.

3. WHAT WE FOUND

Overall, the transition went smoothly. There were no "show stopper" problems encountered and the goals of the transition plan were all met. We did, however, learn several valuable lessons. These lessons can be broadly divided into three groups: administrative; technical, and pedagogical.

3.1 Administrative Lessons

Firstly, it takes a year to transition. During the first semester of the transition, approximately one-third of the student body had laptops. A larger proportion would have been too difficult to manage, as numerous small problems arose. These problems were both technical and procedural. If we had gone for a "big bang" rollout, and given laptops to every student at once, these small problems would have been magnified into large problems and made the entire laptop initiative more likely to fail. There also would have been a financial cost, as we would not have been able to recoup the cost of the laptops from the students before they completed their studies and left.

Secondly, you cannot please all of the students all of the time. Some existing students were unhappy because they missed out on a laptop. This was expected, and by clearly communicating to those students that it was a financial matter, that they simply weren't going to be with us long enough for us to recover the costs of the hardware, this concern was dealt with. Conversely, some students were unhappy because they *did not* miss out on a laptop. This was also down to communication, as not all incoming students of the Semester 3 2014 intake realised that they would be issued with a laptop, and so bought their own before arrival. Other students thought that a coincidental change in the way fees were charged had been made to cover the costs of laptops, which also led to student complaints.

We have experienced a student laptop attrition rate of 2-3 % per annum. That is, on average one student laptop per semester will be lost. These losses have been caused by simple carelessness (the student forgot to take their laptop with them when exiting public transport) through theft (the student's car was stolen with the laptop inside, or the laptop was stolen from their car), breakage (the laptop was dropped, or sat on) and even fire (the student's room along with its contents was destroyed by a faulty gas heater). There have also been a small number of hardware failures, mostly fatal hard-drive crashes.

Attrition and hardware or software failures mean that we must keep a small number of spare laptops on hand at all times. These are about 2 % of the total number of student laptops, and are loaned to students who lose their laptops (for whatever reason) until a replacement can be procured. They are also used to cover any sudden failures during practical tests or exams. While these spares do represent a cost, the cost is much smaller than that of purchasing and maintaining lab machines. Spare laptops are usually laptops that have been returned by students who have had to withdraw from the IT Programme. As used hardware, returned laptops cannot be issued to incoming students. Using them as spare or backup machines makes good use of them.

Along with spare laptops, we also maintain a small supply of spare peripherals, especially laptop power supplies. We have found that students frequently leave their power supplies at home and try to do their classes with depleted laptop batteries. Having spares that we can loan to them allows them to do their class work, and is especially important for practical tests or exams.

Illegal software can be a problem under this model. While it is very useful for IT students to be able to install and configure software themselves, this is open to abuse. Students who disregard instructions and warnings, and install illegal software including downloaders and torrent clients, create legal issues for the institution and must be dealt with using student disciplinary procedures. Installing such software has also been found to cause laptop performance problems, which the students often blames on the institution, for supplying them with inadequate hardware.

Good warranty support for the hardware is vital. We experienced several hardware problems with the first batch of laptops issued to students, which took an inordinate amount of time for the vendor to resolve. Similar support is needed for the insurance policies on each laptop: we encountered problems with the insurer trying to shift responsibility for the loss onto students.

There must be good communication with students. They must be clearly informed of their responsibilities with respect to the ownership and maintenance of the laptops, and they must be clearly informed of how to do things. For example, how to claim on the insurance if the laptop is lost. This is particularly problematic for international students, as English is usually not their first language. Instructions must therefore be as unambiguous as possible. A further complicating issue is that students often set the language of the laptop to their native language instead of leaving it as the default English. This can cause problems with connecting to the Wi-Fi as well as causing problems for IT support – it is obviously difficult to solve technical problems on a computer, if you can't read the language it is using.

There must also be good communication between staff. Sharing of common problems, and the solutions to them, is essential to providing a good experience to the students. This is especially true for practical assessments. To facilitate this, we held staff debriefing sessions after every midterm test and final exam cycle during the roll-out, and for the first semester afterward. As time went on, we found that there were fewer and fewer issues being reported by staff after each midterm and exam cycle. By Semester 1 2015, no issues arose during midterms and a substantial body of knowledge existed to help avoid issues developing.

Administrators should be prepared for an accounting loss during the transition to laptops. This is because lab machines must still be available for those student who do not qualify for laptops, and those machines are still depreciating and must still be maintained. The loss from this is still much less than the loss that would have been brought about by giving all students laptops, however.

Finally, clear policies must be developed, disseminated and implemented. These policies must cover all of the situations that might occur: for example, a student changing programmes from IT, or a student withdrawing from their studies must both be covered. These changes in policies will require revisions to many of the standard forms and procedures and must be anticipated and completed before the roll-out is completed. For example, the graduation clearance form needed to be modified for IT students. Since some of the software is licensed, and cannot be taken away by the student, it must be removed before they leave AIS. A box was therefore added to the clearance form for the IT support staff to sign, indicating that the licensed software has been removed. A second box was added to indicate that ownership of the laptop had been transferred to the exiting student.

3.2 Technical Lessons

Good campus Wi-Fi is essential to the successful deployment of student laptops. At any one time, there might be up to one hundred students in various classes, who will all be using their laptops. This places a substantial load on the Wi-Fi, which must be able to handle it or risk frustrating students and staff. While the Ethernet network cabling was left intact in the ex-labs, student numbers in the IT programme have now grown to the point that some classes do not fit in those rooms and must now be placed in other larger rooms such as lecture theatres. These classes are completely reliant on Wi-Fi for networking services. We were only able to commence the laptop roll-out because a major upgrade of campus Wi-Fi had been carried out in the first half of 2014. This upgrade also determined the start date of the laptop roll-out.

Although the campus Wi-Fi is now of a high quality, unfortunately students still like to access entertainment sites while on campus. We have therefore had to institute blocks on the network, which disallows students from accessing sites that are not related to their studies.

Every IT professional will speak about the importance of backing up data. Backing up student data is just as important. We found that you can provide students with the facilities to back up their work, impress upon them the need to back up their work – and they still will not backup their work. Unfortunately it takes a few disasters for the message to get through to the students. Each student has one terabyte of cloud storage to use for backing-up their work. Recent experience has shown that the backup message has gotten through to the students, who are now avoiding disaster by backing-up their course work.

The laptops issued to students must have a good battery life and a short charging time. While every teaching room and almost every lecture theatre now has power points at every desk, students will still forget to bring the power supplies for their laptops. Given the proliferation of smart devices, it is also beneficial to students without laptops (that is, students outside of the IT Programme) to have power points available at every

desk. Students also like to work outside of the classroom, in common areas of the campus, where power points might not be available.

3.3 Pedagogical Lessons

We found that students were able to quickly adapt to using laptops in class and to using them in practical tests and final exams. We developed a consistent and rigorous set of instructions for students on what they are expected to do and how to do it. For example, how to connect to exam servers for assessments. This is for assessments in software development and database courses, where the student's work is saved onto exam servers at the end of the test or exam. We have found, however, that no matter how clear the instructions are, there will always be some students who do not follow them. This is essentially a training issue, and while it is plainly exacerbated by nerves during assessments, we have used several approaches to deal with this problem. Firstly, we run the students through the process in class, before the exam. Secondly, for the introductory courses, we make the conditions in the midterm test the same as the final exam: the students therefore gain hands-on experience in using a laptop for a practical assessment. By the time they attempt the final exam, they have already done the laptop setup several times before and no longer find it quite so daunting.

Monitoring software is essential to ensure the integrity of examinations and tests. We use LanSchool, which allows the course lecturer to view each student's screen. It also allows for the selective blocking of applications such as web browsers and document readers. In those rare instances in which a student tries to cheat, by accessing forbidden material during an exam, the software allows the lecturer to take screenshots of the student's activity. This is powerful evidence if disciplinary action is taken against the student. LanSchool software is also useful in regular classes, as its messaging facility allows the less-confident students to ask the lecturer questions quietly.

There was an institution-wide shift to e-books contemporaneous with the transition to laptops. This shift had less impact on IT students compared to students from other programmes, as e-books were much easier to roll out to laptops. Students in other programmes needed to use their own smart devices, which led to problems caused by different platforms and the appropriateness of the device.

We are able to teach computer networks using laptops, by making use of Virtual Machines (VM). However, the limitations of laptop hardware makes it difficult to run enough VM to give the students experience in networking more than a few computers. The VM files are also too large to submit to file servers over the local network. This makes it a time-consuming exercise to collect the files for practical tests as we must do so using portable drives. We have recently acquired some high-end servers, at least one of which will be used for teaching networking. The VM needed for networking will be run on the server in future, and students will access them using a remote desktop application. The laptops will thus be access devices and will not have to carry the burden of running the VM. This approach also obviates the problem of submitting large VM files over the network, as the VM files never leave the server.

Students in the IT programme are for many courses required to give oral presentations in class. This is especially so for the final group project course. Before the transition to laptops, we often had problems with student presentations. Students commonly had problems loading their presentation material onto the computer used for the presentation. This caused delays and disruptions to the presentation schedule, as well as increasing the anxiety of the students presenting. There were also problems with software compatibility. The switch to laptops has eliminated this situation: students present using their own laptops, with all of their presentation material available. When it is their turn to present, they simply plug their laptop into the room data projector and start presenting.

Laptops have proven to be valuable in software development courses. If a student has a problem that is likely to affect other students, or the student has created a particularly elegant solution, then the lecturer can simply plug the student's laptop into the data projector, and demonstrate the solution to the entire class. That is, rather than helping students individually, or helping one student and then describing the problem to the rest of the class, the lecturer shows the entire class as they are helping the first student. This saves time, and has been observed to help with building something of an *esprit de corps* among the students.

As AIS has a favourable licensing arrangement with software vendors, we are able to allow the students to install software on their laptops such as Microsoft SQL Server. For database students, having this server on their laptops gives them valuable experience in managing the server, creating databases, and attaching to and detaching from databases. These experiences would not be achievable if a central, institutional server was used, as the students would not have access to it.

4. STUDENT IMPRESSIONS

Although a rigorous survey of student satisfaction has not yet been carried out, comments from the students are favourable. There are several common themes in their comments.

Firstly, the portability of the laptops is seen as a major advantage. Students can work on their assignments from home, and therefore must only be on campus for their actual classes and final assessments. This saves the students' time, as they not only do not have to travel to the labs, but they also don't have to worry about finding a free lab computer.

Secondly, the standard hardware and software configuration of the laptops means that students are able to run all of their course software. This standardisation is also important in tests and exams, as the students are using a device and environment they are familiar with, which helps to reduce the stress and anxiety they might otherwise experience during assessments.

5. FUTURE AND CONCLUSIONS

There are still a few improvements to be made to the laptop-based teaching model. We plan to implement a secure method for accessing our servers from off-campus. This is especially important for our software development courses, as they require access to the database and web servers, so students can work on their assignments. This will allow students to pursue their course work 24/7 from anywhere in the world, although they will still need to attend classes for lectures.

Overall, the laptop roll-out has been a success. We now enjoy much greater flexibility in teaching, and in the allocation of teaching rooms. This flexibility in room allocation means that we have been able to abolish class size limits, which means that students do not miss out on the opportunity to sit the courses they need to complete their qualifications. Students also enjoy more flexibility in working on their assignments, as they are no longer constrained by the opening times of computer labs.

Our next step will be to perform a rigorous analysis of the effects of the laptop roll-out. We will do this by comparing course outcomes between cohorts of students from either side of the roll-out. We will also run a survey of existing students to quantitatively determine their satisfaction with the laptops and

identify outstanding issues. We are particularly interested in determining whether they have improved the efficiency of learning, as put forward by Wurst, Smarkola and Gaffney (2008) or have increased the levels of distraction in class, as was identified by Fried (2008).

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7. REFERENCES

Efaw, J., Hampton, S., Martinez, S., & Smith, S. (2004). Miracle or menace: Teaching and learning with laptop computers in the classroom. 2003 *Annual Proceedings-Anaheim*: Volume# 2, 150.

Fried, C. B. (2008). In-class laptop use and its effects on student learning. *Computers & Education*, 50(3), 906-914.

Gulek, J. C., & Demirtas, H. (2005). Learning with technology: The impact of laptop use on student achievement. *The journal of technology, learning and assessment*, 3(2).

Kay, R. H., & Lauricella, S. (2011). Exploring the benefits and challenges of using laptop computers in higher education classrooms: A formative analysis. *Canadian Journal of Learning and Technology*, 37(1).

Keengwe, J., Schnellert, G., & Mills, C. (2012). Laptop initiative: Impact on instructional technology integration and student learning. *Education and Information Technologies*, 17(2), 137-146.

Lowther, D. L., Ross, S. M., & Morrison, G. M. (2003). When each one has one: The influences on teaching strategies and student achievement of using laptops in the classroom. *Educational Technology Research and Development*, 51(3), 23-44.

Witten, I. H. & Frank, E. (2005) *Data Mining Practical Machine Learning Tools and Techniques*, Second Edition, Morgan Kaufmann Publisher, United States of America, 2005.

Wurst, C., Smarkola, C., & Gaffney, M. A. (2008). Ubiquitous laptop usage in higher education: Effects on student achievement, student satisfaction, and constructivist measures in honors and traditional classrooms. *Computers & Education*, 51(4), 1766-1783.