

British school switches students' computers to Linux, reducing costs and improving computing knowledge

Background

The British education sector has been dominated by Windows and other Microsoft products and a few large vendors of software and hardware. Formerly, purchasing rules for schools were criticised by members of the UK parliament [1] for “denying schools the option of benefiting from both free and open source software and the value and experience small and medium ICT companies could bring to the schools market”. The organisation previously overseeing these rules, BECTA, was disbanded in 2011 giving schools greater freedom in their choice of software and hardware.

The teaching of Information Communication Technology (ICT) to 11-16 year old students has focussed primarily on the use of standard desktop applications such as word processor and spreadsheet programs. In January 2012, British Education minister, Michael Gove, set out a plan [2] to overhaul the teaching of ICT, with a vision that “instead of children bored out of their minds being taught how to use Word and Excel by bored teachers, we could have 11-year-olds able to write simple 2D computer animations using an MIT tool called Scratch” and that “by 16, they could have an understanding of formal logic previously covered only in University courses and be writing their own Apps for smartphones”.

In 2012, Westcliff High School for Girls Academy (WHSG) in the southeast of England was faced with the need to update its IT infrastructure for students from Windows XP machines. Instead of updating hardware and software to accommodate the latest Microsoft offerings, they – due to budget constraints and a desire to teach more rigorous ICT – chose to switch the students' desktop machines to Linux. There have been similar efforts in the past and, in this case study, the experiences of WHSG are contrasted with those of Hassenbrook Technology College, also in the southeast of England. There, in the late 2000s, Jason Bassett led a team that implemented Linux thin-client systems on obsolete machines, giving them a temporary new lease of life.

Westcliff High School for Girls Academy

The School

WHSG [3] is a single-sex selective state school. Under the UK secondary education system for 11-16 year olds, there are state schools (funded by the state and free to attend) and so called 'public' schools which are, in fact, in private ownership (often operated by charitable organisations) most of which charge fees to the majority of their students. Within the state school system there are comprehensive schools, which accept students of all academic abilities and – in some parts of the UK – selective or 'grammar' schools which accept students based on satisfactory performance in an entrance examination.

WHSG has around one thousand students aged 11-16 and a further education college for 16-18 year olds with around 340 students. It was founded in 1920.

Motivation for change

The migration was led by the school's Network Manager, Malcolm Moore. In part due to budget constraints, but also due to belief in their own abilities and experience, the team decided to manage the transition from Windows to Linux in-house without the services of an external company. The IT Support team consists of three staff and is responsible for support and provisioning of all IT-related equipment within the school. This includes 200 teacher machines, around 400 student machines, 33 iMacs, over 100 laptops and a few Android tablets. They also support all the multimedia devices such as projectors, interactive whiteboards and TVs.

The WHSG team already had experience with Linux, having used it as the operating system for their email server, Virtual Learning Environment and web site. Malcolm also had Linux experience from a former position in the financial industry.

The motivation for switching from Windows to Linux was “initially both cost and philosophical”. School funds are always limited. Moore notes that “the cost of using Windows is high but not always obvious, Windows carries a lot of baggage that bumps the cost up considerably over a Linux environment”. The philosophical angle was mainly down to the “philosophy of pragmatism”. The team wanted to offer “the best IT systems and education possible with the funds available”. Money spent on software could “be better spent on old-fashioned things like teachers”. The timing was also good in relation to changes in UK government policy on IT teaching in which they “threw out the old ICT syllabus, which was based largely on teaching students how to use Microsoft Office, and told schools to go for a more computer studies-based syllabus”. Introducing Linux to the students' machines provided a perfect opportunity to put this into practice.

Trials and winning approval

The WHSG team began testing Linux as a desktop operating system with a small trial set-up of sixty machines. They gathered feedback from the students, made adjustments to the system and gained further feedback. After several iterations with Red Hat/Fedora and SUSE/openSUSE set-ups the IT team was satisfied that Linux could take the place of Windows on the students' computers.

The next step was to persuade the Senior Leadership Team of the school. After two long meetings discussing the IT team's proposals in detail, the plans were approved. As Moore notes, the school “specialises in science and engineering” and if their students are to “go on to do great things like start the next Google or collapse the universe at CERN... they will certainly need to know Linux”.

Choosing the main software

The IT team recognised that, for desktop users, “pretty is a feature”. The students had to like the new software to accept it. From their use of Linux as a server operating system, the team was familiar with RPM based distributions (Red Hat, SUSE and their derived distributions). Given limited resources – which ruled out a supported, subscription base Linux – and limited time to plan and execute the transition to Linux, the team decided to concentrate on Fedora and openSUSE. In the trials, openSUSE [4] won due to its good support for KDE software. The team “did not want the change to be too much for students to handle and KDE's Plasma can be made to look very familiar [to Windows users]”. During the testing phase, students were encouraged to try both KDE's Plasma Desktop and GNOME 3. Plasma “was by far the winner in terms of user acceptance”. The final software choice was openSUSE 12.2 and KDE's Plasma Desktop 4.10 [5].

No new hardware was required in terms of desktop workstations for students. According to Moore “one of our main reasons to go to Linux was that it runs well on older hardware”. As a result, the school was able to avoid “replacing 400 student machines every 3 or 4 years”, which Moore describes as “a horrendous cost” that “many schools just simply can't afford”. The current performance of the machines is such that Moore envisages continuing to use them until the hardware fails.

Making the switch

The main switch over took place during the summer holiday of 2012 (a six week vacation when the students – and most teachers – are not present at school and so an ideal time to make major changes). In the initial switch, no significant technical issues had to be overcome. All computers were switched and ready for the new term.

The first half term with the new system did however uncover technical limitations. The “primary problem was system speed and particularly logging into KDE Plasma”. The tests had used only around sixty machines as it was difficult to find enough students willing to help test the systems during their free time. There was also a necessity during the testing phase to maintain at least 400 Windows machines for day to day use.

The problem was that, although Linux ran well on old hardware, the existing capacity of network infrastructure in the school was insufficient. LDAP authentication and NFS home directories, common in a school or business environment, require gigabit capacity networking. It was possible to run the systems with a 100Mbit network (that the school already had in place) but it was “an unpleasant experience”. The school had to replace a number of network switches to boost capacity to 1Gbit throughout. There were also some glitches with KDE software and NFS home directories, but these issues were resolved over time. By using custom scripts to enforce certain options in KDE software and upgrading the network, the problems were resolved within the first few weeks of the roll out.

Getting support

The WHSG team used online documentation, user forums and their own experience to enable them to make the switch to Linux.

Where problems were encountered, Moore and the team turned primarily to the community support infrastructure of the upstream software suppliers, asking questions at the KDE Forum and the openSUSE forum and reading online documentation.

Moore and the team found the documentation lacking in some areas. As Moore notes, “you can configure KDE software in every way imaginable using the GUI, but admins need to set up defaults for all users” and it was difficult to determine which settings needed to be set in which configuration files to automate the process. Moore blames incomplete documentation on the fast moving nature of the technology and thinks the problem is not limited only to Linux but also to Windows as releases of proprietary platforms also begin to happen more frequently.

Where documentation was lacking, Moore turned to the KDE and openSUSE forum for advice. The responses proved very helpful, but Moore notes that – for the openSUSE forum in particular – it was necessary to ask questions intelligently and to be thick skinned against a minority of unhelpful responses. Moore admits that in the early stages some of his questions “were not done well”. However, with limited manpower and time, reading manuals for all the software components was not an option. Moore notes that “despite being called an idiot occasionally, we got good working answers to all our questions” and he was impressed by the extensive support he received from a few key individuals, particularly on the KDE forum where “everyone has been very polite and helpful”.

Software applications

A wide range of software (often several applications for each task) are provided by Linux distributions such as openSUSE. The WHSG team chose some key applications to install, support and recommend for students' use.

For office and productivity tasks such as word processing and making spreadsheets, LibreOffice [6] was selected. LibreOffice is a fork of the popular OpenOffice.org office suite formerly developed by Sun Microsystems and Oracle. It enjoys the support and contributions of a number of Linux distributors and is the default office suite in many distributions. The WHSG team describe it as providing “six feature-rich applications for all your document production and data processing needs”. The LibreOffice suite provides compatibility with Microsoft formats enabling students to continue to work with their legacy files. It has proved to be a drop-in replacement for Microsoft Office.

The school also has a number of more specialised software needs in the areas of graphic design, animation, desktop publishing and musical production. Here again, free software alternatives to proprietary applications have proved satisfactory and, due to the lack of licensing costs, can be provided unrestricted to all students.

For graphical projects, Inkscape [7], the GNU Image Manipulation Program (GIMP) [8], Blender [9] and Wings 3D [10] have filled the school's needs. Inkscape is a vector graphics application, ideal for creating diagrams and line drawings. The GIMP is a specialised application designed for manipulation of bitmap graphics such as photographs. It enables students to do photo

editing as well as preparing original artwork. Blender is an advanced graphics package for producing photo-realistic 3D rendered scenes and animations. It has been used in the production of a number of short animated films [11]. Wings 3D enables production of realistic 3D models from wire-frame structures.

Musical recording and post-production needs are met by Audacity [12], a popular open source application. Desktop publishing, for production of newsletters and similar projects, can be done in Scribus [13], a frame-based publishing application with professional quality output.

The school provides two options for viewing videos, Umlayer and VLC. Both are well established media players and include codecs to play all popular types of video and audio file.

Functional comparison of old and new systems

For the most part, Linux has met all users needs. Staff are still on Windows, due to the lack of a Schools Information Management System client for Linux. Moore judges that “nothing is missing as far as educational software for Linux, but we have retained a couple of Windows applications which we run under WINE so that students with work in progress can move slowly to alternative applications”.

Moore highlights a particular benefit of using Linux on the students' main PCs: “one thing that is interesting is the use of the Raspberry Pi [14] and suchlike in schools - one advantage of using the Pi is that students can experiment without destroying the school or family PCs. With Linux, students can experiment now”. The WHSG ICT department is already teaching programming to students from age 11 and Moore notes that “in our environment, the worst thing they can do is crash their own account - even if they completely destroy their area, it can be restored in minutes and will not affect the next person using the machine”.

The robustness of Linux in this respect has enabled the staff to give students greater freedom over their own computing experience. Moore notes that “most admins lock down Windows as it is fairly easy for people, particularly students, to butcher Windows”. With Linux, they have “taken the view that we want to get back to a PC being a personal computer, so students can configure it any way they like as it gives a sense of ownership of their desktop”. There are restrictions, of course, but students can configure their desktop experience to best suit their way of working.

This experiment has worked well. In the beginning, some of the desktops were configured to extremes and required the IT team to get them back into a usable state, but “now that the novelty has worn off the desktops are more sane, and we haven't had to reset an account back to a more tasteful blue in months”. Moore hails this as “a great success - students are now taking responsibility for their work environment and how they achieve tasks rather than be told, 'Here is a generic Windows and Office - use that'.”

Student reactions

There has been surprisingly little opposition to the switch to Linux. As Moore notes, “younger students accept it as normal”. Older students can be a little less flexible as they have grown more accustomed to working with the Microsoft tools. Among staff, there is also a mix of views, although this also applies to Windows 7 and the Linux systems have been better received than Windows 8 (which, like Linux, also looks quite different to Windows 7)

Parents were notified of the change in advance via a school newsletter and Moore estimates that fewer than 1% of parents expressed concerns, most of them “maintaining that learning Office was a more useful skill”. Moore, however, argues that “an 11 year old student starting with us in September 2014 will probably not reach the job market until 2024 - what will Office 2024 look like? Good basic skills and a logical and analytical way of dealing with computers will be good for a lifetime”.

By teaching their students generic computing skills, rather than skills using a single provider's software, the school aims to make its students more adaptable and employable in the years

ahead.

Lessons and recommendations

The move to Linux has been a positive experience for WHSG. The only major technical difficulty was the need to upgrade the network infrastructure to cope with higher demands from network storage of home directories.

Excellent support was obtained from the community resources of the distribution (openSUSE) and desktop provider (KDE), but it can be important to phrase questions carefully to get the best response.

Hassenbrook Technology College

The School

Hassenbrook Technology College (now Hassenbrook Academy [15]) was one of many schools in England given a special designation for its specialism in technology teaching. It had around 700 pupils of both sexes and non-selective entry criteria, taking students of all abilities. It was state funded and charged no fees.

Motivation for change

The school's 700 pupils were served by around 200 dedicated workstations running Windows XP. Around fifty of the workstations (three dedicated computing rooms) were mostly unused as they were slow to boot and operate due to old hardware. The school's servers were running Microsoft Windows Server 2008 except for a Research Machines internet filtering server which was running Linux.

Jason Bassett, the school's Network Administrator, had previously encountered problems with the school's firewall software. It had proved unreliable and needed restarting several times each day, with all computers in the school losing connectivity while the firewall was restarted. Replacing the proprietary firewall with a fully licensed version would have cost a few thousand pounds, a cost that Bassett felt could better be invested elsewhere. On the advice of a Linux-using friend, he implemented a Linux firewall and was astonished at "what could be achieved for so little cost, legally".

Having experienced a successful and money-saving switch to Linux for the firewall, Bassett began to consider whether savings could also be made by using Linux on the obsolete desktop computers.

As part of other funding opportunities, Bassett requested a new server to support the school's IT infrastructure. The funding was received, opening the way for the use of thin clients with the new server. A key attraction was ease of maintenance: "upgrading one machine would upgrade the software network wide". Of course, such a system also introduces a single point of failure, the server. However, Bassett planned to use savings on new hardware from the scheme to set up a backup server for the thin clients.

Trials and seeking approval

After the successful use of Linux in the school's firewall, Bassett "had been trying out the various distributions of Linux on standalone desktops". However, with the new server available, Bassett decided "the best use of this would be to set it up as a Linux thin client server". As there were three rooms of PCs effectively unused, it was easy to connect them up to the new server to trial the system and "reopen the rooms of 'obsolete' desktop computers which now booted into a working desktop environment faster than any of the brand new machines".

Three rooms of obsolete computers were now operational. As Bassett recalls, "one particular room in the science department was used intensively, effectively giving the science department their own computer suite, rather than having to juggle the use of open access

rooms with other lessons”.

There was some support for the switch to Linux. As Bassett recalls, “our line manager was astonished at the speed the machines were operating”. However, “other senior management staff were more concerned about the software being 'Open Source' - they felt that this reduced the security of the software, despite our efforts to describe scenarios that make the opposite true”. Senior managers remained unconvinced, despite being presented with reports and news features released by another English secondary school, Orwell High School, which “had successfully implemented the Linux terminal server system with massive cost savings”. They eventually decided to discontinue work on the project

Choosing the software

In common with WHSG, KDE software was chosen to provide the desktop, due to its visual similarity to Windows (single task bar, menu to lower left). For particular tasks, OpenOffice.org [16] was chosen for its compatibility with Microsoft Office. For graphics, the GNU Image Manipulation Program and KDE's KolourPaint [17] were used.

Bassett recalls a key benefit of the software's free licences: “we were able to make the software available on the school website and even gave out CD's of Linux distributions to those pupils who showed an interest in finding out more”.

Getting support

Bassett made “extensive use of forums, IRC channels, websites and books to quickly learn the intricacies of the software used”. He also made contact with Orwell High School who had already implemented a thin client Linux system.

Using these resources and their existing knowledge, the team was able to set the computers up without major problems.

Student reactions

Students were “very receptive to the 'new' system”. Bassett recalls that “some even sat with us at lunchtimes as we demonstrated installing a Linux distribution on an old computer - some asked for copies of the software to take home”. The team demonstrated live CD and live USB versions of the software so that students could play with it at home “without fear of wiping the family computer”.

Lessons and recommendations

Bassett feels that, technically, the trial of Linux at Hassenbrook Technology College was a success. The problem was one of perception, even though the school was already using Linux in its firewall and on the Research Machines internet filter. Bassett believes some of the perception may be down to cost. Now running an IT consultancy he says he has noted a difference between the perception people have of software depending on whether they pay for it:

“We have experimented with selling GPL software OpenOffice.org (and reinvesting the money back into the Open Source community), we have found that those people we sell the software to are still using it months later when we enquire with them, often they praise the software for providing what they need at a reduced cost to Microsoft Office. Those people we gave the software to for free have often given up using it and instead purchase Microsoft Office, saying that it did not do what they needed (in most cases, producing a basic letter).”

Many companies using Linux or other open source software in their products do not advertise the fact. From wireless routers to personal video recorders, open source software is often hidden behind another brand and bundled with hardware. Bassett notes that “Research Machines did not push the fact that their RM SmartCache/Internet filtering unit was running Linux and other freely available packages. The school did not think twice about purchasing

such a unit.”

Conclusions

The move of 400 student desktops to Linux has proved relatively painless for WHSG. The new systems are accepted by students and have opened up new opportunities for student-ownership of their computing experience through customisation and the ability to explore the system more thoroughly. The migration supports greater depth in computing studies (as targeted by the British government's reforms to computer studies in the 11-16 year old age range) as each student has ready access to a system they can explore and experiment with.

Costs have also been minimised due to extending the life of existing hardware and avoiding the need to pay for new software licenses. Linux and its associated desktop software has proved a suitable replacement for Windows, reducing costs, making each student's computing experience more personal and supporting improvements to the computer education of students.

At Hassenbrook Technology College, Linux was rejected. This was not because it did not work well – it enabled the continued use of otherwise obsolete hardware – but because of perceptions that the software, being free and open source might not be good enough or might be insecure. Crucially, while there was local support among students and some staff, senior management were never convinced of the need for or usefulness of Linux on the school computers. Linux was seen as suitable for old computers unable to run Windows satisfactorily. It was not pushed as a better, more customisable form of computing that could aid development of student IT skills and be rolled out to all student computers.

For a school Linux deployment to be a success, the support of senior staff is essential. Also, an argument must be made for Linux providing a better solution, not merely a cheaper one. Linux and open source software has, for some years, been technically ready for use in schools. Now, with users and managers becoming more used to varied software on their computing devices and with the UK government targeting technical understanding rather than just use of proprietary office applications in the ICT curriculum, the time is right for more schools to make the switch to Linux and open source and share in WHSG's success.

[1] <http://www.parliament.uk/edm/2006-07/179>

[2]

<https://www.gov.uk/government/news/harmful-ict-curriculum-set-to-be-dropped-to-make-way-for-rigorous-computer-science>

[3] <http://www.whsg.info/>

[4] <http://opensuse.org/>

[5] <http://www.kde.org/workspaces/plasmadesktop/>

[6] <http://www.libreoffice.org/>

[7] <http://www.inkscape.org/>

[8] <http://www.gimp.org/>

[9] <http://www.blender.org/>

[10] <http://www.wings3d.com/>

[11] <http://www.blender.org/features-gallery/blender-open-projects/>

[12] <http://audacity.sourceforge.net/>

[13] <http://www.scribus.net/>

[14] <http://www.raspberrypi.org/>

[15] <http://www.hassenbrook.org.uk/>

[16] <http://www.openoffice.org/>

[17] <http://www.kde.org/applications/graphics/kolourpaint/>

<https://joinup.ec.europa.eu/page/legal-notice>