

Report 2003:24

Experiences from the Use of Skolelinux

Use of Open-Source Software at Four Norwegian Schools



Forward

This survey has gathered together accounts of experiences that schools have had in the implementation and use of Skolelinux.

The survey has been done on commission by NorOSInet which is an organization that promotes open standards.

The survey has conducted thorough studies of four schools that have used Skolelinux. The schools in the study were selected for their depth of knowledge and experience in the use of Skolelinux. The schools were not selected as being representative for the use of IT in Norwegian schools.

We would like to thank all of the teachers, pupils and ICT administrators at the schools who have contributed to this survey. Without their assistance this survey would not have been completed. We would also like to thank those who have provided us with feedback concerning the accounts of the various schools.

The survey was conducted during the period of June-September 2003. Guri Verne, from the Section for Information Technology, has been the Project Administrator. The Project Leader has been Senior Advisor Endre Grøtnes.

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1 Introduction

Since the introduction of the concept ‘Open-Source Software’¹ at the end of the 90’s, great attention has been focused around the use of Linux and other open-source software. The use of open-source software in the public sector has especially been under debate. The debate has had ideological undertones, and open-source software has often been portrayed as the underground’s battle against the Establishment. The question about the use of open-source software, especially in the public sector, is of course more complex than a simple yes or no answer. Open-source software denotes software where the source code is freely available, and the program can be used, adapted, improved, expanded and redistributed by anyone who wishes to do so.

In Europe, Latin America and Asia, many politicians have argued strongly for the replacement of existing software in the public sector by products based on open-source software. Several countries, including Norway, Sweden, Denmark and the EU have conducted investigations on the use of open-source software ([1], [2], [3] and [4]). These studies have primarily focused on explaining the concept and the financial aspects of implementing open-source software. There have also been books published in this field. The most well-known book is *The Cathedral and the Bazaar*² by Eric Raymond. This book was the first to focus on this area and described the environment and possibilities for this type of software. Studies have also been done that have focused on the licensing terms as well as special technical aspects of open-source software. There has been little done to gather concrete experiences in the use of Linux and other open-source software.

In Norway, there have been two projects, among others, that have had the goal of developing open-source software that can be used in the public sector. These two are the OpenOffice project³ which has translated the office package OpenOffice into standard Norwegian and New Norwegian (the two official written languages of Norway), and the Skolelinux project which is developing a distribution of Linux especially adapted for Norwegian schools, the product known as Skolelinux⁴.

The goal of this survey was to gather from schools their experiences in the implementation and use of Skolelinux. Interviews have been held at four schools. The interviews were structured, giving the respondents the opportunity for personal reflection, but with a focus on areas such as the school’s ICT situation, evaluation and experiences in the use of Skolelinux, compatibility with other ICT systems and reasons for choosing Skolelinux. The interviews were conducted at the various schools and included ICT-administrators and teachers at the schools. The schools surveyed were selected from schools that had provided feedback to the Skolelinux project that they used or wished to use Skolelinux at their school. Schools were chosen that could provide the most knowledge and experience in the use of Skolelinux. The schools were not selected because they were representative. Observations were made of the use of Skolelinux during teaching situations. There were also conversations conducted with representatives for the Skolelinux project.

Since in many connections it has been asserted that open-source software can replace other software, and that in other countries there have been politicians who have strongly argued for

1 See webpage <http://www.opensource.org/index.php> for more information.

2 *The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary/ Eric S. Raymond; with a foreword by Bob Young. - Rev. Ed, O'Reilly, 2001*

3 See webpage <http://www.openoffice.org> for more information.

4 See webpage <http://www.skolelinux.org> for more information.

demanding the implementation of open-source software in the public sector, we deemed it important to gather some concrete experiences of its use. The goal of the survey and interviews was not to set the different types of software up against each other, but to gather in experiences that others can use in their evaluation of Skolelinux and other open-source software. Hopefully, these experiences will provide a broader basis for the evaluation of which type of software that should be used in any concrete situation. We hope that the interviews can also provide indicators of the circumstances which are important in evaluating if a school should adopt Skolelinux. We have made our own evaluation of this based on the views that we received in the interviews.

In this report, no financial calculations have been done about how much one could save by implementing Skolelinux. For more about this, see the report “Open-Source Software in Norway” done by Teleplan on commission from the Ministry of Labour and Government Administration(AAD) and the Ministry of Trade and Industry (NHD)[8]. Neither have we conducted our own tests of interoperability. For more about this topic, refer to the report on interoperability by the Swedish Agency for Public Management (*Statskontoret*) [7].

The interviews and work on the report were done on commission from NorOSInet. In the beginning of the 90's, NorOSInet was an organization that worked to promote the use of OSI-protocols in Norway. The organization is no longer active and wanted to use its remaining funds on kindred projects. Statskonsult was one of the founders of NorOSInet.

2 Skolelinux and Open-Source Software

This chapter provides a quick introduction and definition of open-source software as well as a short description of the Skolelinux project.

2.1 Open-Source Software

The term "Open-Source Software" denotes software where the source code is freely available and the program can be used, adapted, improved, expanded and redistributed by anyone who wishes to do so.

There are clear definitions of both "Open-Source Software"⁵ and "Free Software"⁶. Open-source software denotes software where the program's source code is freely available, and the program can be freely used, adapted, improved, expanded and redistributed by anyone who wishes to do so. Our use of the term open-source software denotes software that fulfills the requirements specified below.

Open-source software can be distinguished by the freedom given to each user⁷ to

- use the software in the way he/she wishes, on as many machines and in any situation that is desired.
- have the possibility to adapt the software so that it satisfies his or her special needs. This includes making improvements in the software, debugging, expanding the software and the possibility of studying how the program works.
- redistribute the software to other users, who can further adapt the software according to their needs

The points listed above can only be possible if the following prerequisite is met:

- The user of a program must have access to the source code of the program.

The source code of a program, which is often written in a high level programming language such as Java, C or C++, is an absolute prerequisite for the user being able to understand how the program is built up and functions, so the program can be adapted, expanded or debugged.

2.2 Skolelinux

The goal of the Skolelinux project is to develop a Linux distribution for Norwegian schools. The Skolelinux distribution should be simple to install and maintain and it must be based on both standard Norwegian and New Norwegian (the two official written forms of the language) and, as much as possible, on the Sami language (the language of the Sami people, an indigenous people in Scandinavia).

5 The Open Source Initiative's definition of Open-Source Software is found at: <http://www.opensource.org/docs/definition.php>

6 The Free Software Foundation's definition of Free Software is found at: <http://www.fsf.org/philosophy/free-sw.html>

7 In open-source software environments, a user is thought of as a competent software developer and not an ordinary 'point and click' end user. The user perspective in the environment is very developer oriented.

From the start, the project had three primary objectives. One goal was to translate all programs included in a Linux distribution into both standard Norwegian and New Norwegian, and some of the more widely used programs into the Sami language. The second goal was to develop a concept for simple installation and maintenance of the software in the schools. The third was to achieve a realistic introduction and spread of the software in the schools.

One of the basic concerns for the project has been that ICT in the schools should be based on pedagogical principles and not be guided by whatever software is most widely used.

The project started in the summer of 2001 and has had contributions from several hundred volunteers. Several students have also done their theses in connection with the project. Today there are more than 20 schools that have implemented Skolelinux and more are considering doing so. For more information, go to: <http://www.skolelinux.org>.

3 ICT in Education

This chapter gives a short introduction to the primary challenges facing the Norwegian schools, concerning the acquisition of ICT infrastructure. It refers to some of the conditions that are peculiar to the schools in this regard.

The following is taken from the action plan *ICT in Norwegian Education- Plan for 2000-2003*. [6]:

The goals specified for ICT in education can only be achieved through access to modern equipment and good technological infrastructure. While the equipment situation is improving rapidly, even in the primary and lower secondary schools, there is still a need for good, cost-effective solutions and for the acquisition of equipment and software. There is also a need for appropriate solutions relating to costs and the use of the Internet. The establishment of a satisfactory technological infrastructure will also increase demands on service and support. Equipment and service will continue to be the main responsibility of the owners of schools and institution.

The above quotation gives a good indication of some of the central conditions surrounding the use of ICT in the schools. There are not enough PCs in the schools. There is a need for good arrangements for the acquisition of ICT equipment and software. There is a need for greater Internet capacity. Operation and maintenance is a challenge. The acquisition of ICT equipment is the responsibility of the individual school/municipality.

In the action plan *ICT in Norwegian Education- Plan for 2000-2003*, the following items are seen as national challenges concerning infrastructure and cooperation:

- Satisfactory availability of equipment for both students and teachers and fulfillment of the requirements of users with special needs
- Good access to the Internet
- Good arrangements for operation, maintenance and technical support in educational institutions
- Better reciprocal utilization of competence and resources between business and education sectors

In addition, there are a number of conditions tied the working environment such as the generation of heat and noise by PCs. The noise and heat generated by the use of PCs in the school can have a negative effect on the working environment. Because of this, solutions that are used in the schools should generate as little heat and noise as possible. Students and teachers do not have their own work places. In urban areas there are many students in each class. Students and teachers move from classroom to classroom. The teachers and students do not have their own offices. ICT equipment is primarily placed in common rooms such as the library or computer room where many PCs are placed in the same room.

The report by SITES [5] also shows that ICT administrators in Norwegian primary and lower secondary schools consider themselves to be "less competent" than their colleagues in other countries, regarding their ability to give support to users in the school. Most of the ICT administrators have teaching of pupils as part of their job description at the school. Less than 20% of the ICT administrators said that their job included network administration.

In short, we can say that increasing the number of computers in the schools is a goal in Norway. Few of the schools' resources are focused on operation and administration of ICT systems. The ICT administrators focus on helping others in the school with the use of software. Consideration must be taken to the special working environment in the school when acquiring ICT equipment.

4 Experiences from Other Reports

There were two other parallel surveys completed, that focused on Linux and other open-source software. A study under the direction of the Ministry of Labour and Government Administration (AAD) and the Ministry of Trade and Industry (NHD) attempts to give a current description of the status of the field and makes some financial calculations surrounding the use of different types of software in the school [8]. Another report from the Swedish Agency for Public Management (*Statskontoret*) has tested the interoperability of Microsoft Office and StarOffice [7]. StarOffice can be viewed as a commercial version of OpenOffice.

4.1 *The AAD/NHD Study*

Parallel to this survey, a study has been conducted on Linux and other open-source software under the direction of AAD and NHD. We have assisted in the development and gathering of information for the AAD/NHD survey. This survey looks at Linux from a broader perspective, but has made some financial calculations concerning the use of Skolelinux. Instead of doing the same job twice, we have used the financial analyses from the parallel investigations.

The survey shows that it is financially advantageous to use Skolelinux with thin clients instead of using thick or thin Windows clients. The following is taken from the AAD/NHD survey:

4.2 *Scenarios for Use in School*

As a basis for this scenario, we have used a primary or lower secondary school that wants to have 60 student and teacher computers with operating systems and office suites. It is assumed that the current machine park is out of date and must be replaced in all of the scenarios, but that the school already has broadband access and a local network. No consideration has been taken to any remaining value after the estimated lifetime of 6 years, and we have used a discount interest of 6%. Based on this, three scenarios have been developed:

- A. Windows thick: One buys 60 new PCs that are powerful enough to use WindowsXP.
- B. Windows thin: Instead of using PCs, one buys inexpensive thin client machines where the storage and processing of data takes place on the school's servers. One uses Windows as the operating system for both the server and client machines.
- C. Skolelinux. One sets up an environment with thin clients and uses the Skolelinux variant of Linux.

Table 6 shows the results of the analysis. The most expensive scenario is Scenario A (Windows thick client) which is over 2.5 times as expensive as Scenario C (Skolelinux). Scenario B (Windows thin client) is estimated to cost 63% of Scenario A, and Scenario C is calculated to cost 40% of Scenario A. Based on this, the following conclusions can be made:

- Switching over to thin clients, either Windows or Linux, is financially advantageous, which means in our example a savings of about 1.1 million NOK over 6 years.
- The use of Skolelinux is the most advantageous solution, which means a savings of about 0.6 million NOK in addition to the savings of 1.1 million NOK made by switching over to thin clients.

The reduction in the calculated costs comes, to some degree, from the reduced costs for hardware and licenses. But the especially steep decrease in operating costs makes the thin-client network, and especially those based on Skolelinux, to be the most economical

alternative. Over 70% of the difference between Scenario C and Scenario A is due to reduced operating costs.

Table 6: Example Lifetime Costs – School

<i>Scenario</i>	<i>Windows Thick (A)</i>	<i>Windows Thin (B)</i>	<i>Skolelinux (C)</i>
Hardware	470	340	290
Installation	50	30	10
Training	10	20	50
Total Implementation	530	390	350
Licensing (annual)	26	23	1
Hardware (annual)	40	0	0
Operating costs (annual)	400	240	160
Total Annual Costs	466	263	161
Current Value Over 6 Years	2830	1640	1140
Percent of Windows thick	100%	58%	40%

Source: Teleplan analyses, expert interviews, suppliers. All figures in Norwegian Kroner, not including VAT. 60 machines.

As the excerpts from the AAD/NHD report show, Skolelinux is the most economical alternative for a school if they want to upgrade their existing machine park, or increase the number of machines in the school. As mentioned earlier, the schools in Norway do not have 1 PC per student, and the lack of enough computer equipment is the greatest challenge facing the schools.

4.3 The Swedish Agency for Public Management Survey

The Swedish Agency for Public Management has completed an investigation of interoperability between Microsoft Office Word and StarOffice Writer. StarOffice and OpenOffice is built on the same code, while StarOffice is today a commercial product.

The goal of the survey was to see how simple it was to convert various formats between the word processing programs StarOffice Writer and Microsoft Word. Some of the conclusions from the investigation were:

- The first impression of the two programs show that StarOffice Writer resembles to a great degree Microsoft Word. The symbols and icons are in the most cases similar and the functionality the same.
- The functionality of StarOffice is adequate, but not completely compatible with Microsoft's doc-format.
- The test found some areas where conversion from doc-format to StarOffice was not entirely stable/correct. This concerned structural information, particularly for numbered and unnumbered lists.
- StarOffice Writer also had problems with correctly showing templates which were developed in Microsoft Word.
- Some documents change layout when they are saved, if the users use the "save as doc" function in StarOffice Writer. A warning about this appears when documents are saved, and users should take this warning seriously.

5 Experiences from the Schools

The following are summaries of the interviews that were conducted. There were interviews with ICT administrators and teachers from the 4 schools. The statements and evaluations are the interview subjects' own and have not been evaluated. The interviews took place at the schools. For the most part, there were several present at the interviews such that they could supplement each other. This could have had a restrictive influence on some of the opinions that were expressed.

The schools in the survey were chosen from schools that had provided feedback to the Skolelinux project that they used or wanted to use Skolelinux at their school. The schools were chosen so they could provide as much knowledge and experience as possible in the use of Skolelinux. The schools were not chosen for being representative. For more information about the schools, contact the Project Leader Endre Grøtnes by e-mail (endre.grotnes@statskonsult.dep.no).

The experiences from the schools will be first individually presented before we try to compare possible similarities in the different cases.

5.1 School A

5.1.1 About the School

The school has about 500 students in grades 8-10. The school has 50 teacher positions. There are 3 administrative employees. The average age of the teachers is over 45 years. There is no one who is employed solely as ICT administrator. There are 2 who share the responsibility as ICT administrator, one mainly responsible for operation and the other for training. They also teach at the school. The ICT administrators have good general knowledge of ICT and also good knowledge of Linux. The school has used Skolelinux since Spring 2002.

5.1.2 ICT at the School

Prior to the installation of Skolelinux, the school had a few old PCs which were a mix of Windows 95 and Windows 98. They were experienced as being very unstable and crashed very often. The students often downloaded new software and changed the setup of the PCs. The school had little money to buy new machines and software for the machines. The number of PCs per student/teacher was low. In total there were no more than 10 PCs in the whole school.

At the start, Skolelinux was installed on 6 of the teacher machines. Today there are about 25 teacher machines and 50 student machines that have Skolelinux installed. The Skolelinux machines are set up as thin clients.

Students and teachers use Skolelinux. The administration uses Windows and is connected to its own network. The students and teachers are each connected to their own servers with the two networks separated by two firewalls. It is clearly evident which network one is coupled to when one logs on. The set up of Skolelinux as thin clients makes the machines simple to administer, having a common setup. This also means that the students have access to their own home directory no matter which student machine he or she uses to log on. The teachers

also have user accounts on the student net, but then they do not have access to their documents on the teacher network.

The school has a 2 Mb line out to the Internet. Some of the teaching is based on the use of the Internet. The teachers use educational portals (learning platforms) such as the School Network from The Learning Center (Læringsenteret), "Classfronter" and "It's Learning". These are places where the teachers can place information for entire groups/classes. Some of these websites also hold educational software. Some of these require a lot of bandwidth so there cannot be many who use these external programs at the same time.

The school uses the following software: OpenOffice for word processing, Gimp for graphics, Opera as an Internet browser, K-mail as e-mail program and various educational software for mathematics, chemistry and astronomy. All of the teachers use e-mail.

5.1.3 Experiences Using Skolelinux

Prior to the implementation of Skolelinux, the school expected a stable system that was simple to operate and did not cost much money. All of the expectations were realised. The school has received the advantages they hoped to get: the stability, use of old equipment, economic gains. The number of machines has increased greatly.

The school expected some resistance to the choice of solution from individual teacher. There has been some resistance and some negative comments, but these have died down as the number of PCs available has increased and they have learned how to use the system.

The ICT administrators experience a stable system that demands little daily supervision. How much of this is due to Linux and how much is due to the transition to thin clients is uncertain.

Students and teachers are primarily satisfied with Skolelinux. Those who are most satisfied are those who have not had much prior experience. The teachers have had training in the use of Windows. They felt they lacked better training in the use of Skolelinux. The school has not accepted the offer of training from the Skolelinux Project.

The transition from the Windows to Linux has led to there being more machines available for both students and teachers. They view this as positive.

There has not been an especially advanced use at the school. Mostly there is word processing, gathering of information on the Internet and use of software for graphics. The users focus on what they have available and not on what they do not have.

One problem is retraining of those with prior skills so that they can become familiar with the new platform.

5.1.4 Evaluations about Choosing Skolelinux

There are many reasons for the school's choice of Skolelinux. The school had earlier experienced great instability and machines that did not work. They had little control over the students' use of the PCs. The school also had few resources to use on new IT equipment. Parts of the operating environment at the school also had competence in Linux/Unix. It was a mix of economic, competence and technical grounds that lay behind the decision to use Skolelinux. Some of the operating personnel were also involved and were familiar with Skolelinux. They have since become active in the environment.

The school chose Skolelinux so they could use old machines. They also consider that it is easier to operate a Linux network than a Windows network. With Skolelinux, it is no longer necessary to have a Unix/Linux background. The school chose Skolelinux as a Linux distribution because it was designed to work right out of the box. Other distributions have to be adapted to the school's everyday routine. Skolelinux is built upon Debian which is considered to be the one distribution that is simplest to administer and gives the best control.

In Spring 2002, the operating personnel were granted a sum of money for the acquisition of new IT equipment. During a holiday period the systems administrators got the go ahead to install Linux. After Easter holiday 2002, there were 6 machines with Skolelinux installed. There was no official decision at the school that Linux should be used. It was purely a financial/administrative choice.

5.1.5 Interoperability with Other Systems

Conversion between simple text documents and spreadsheet is not problematic. The teachers can exchange documents with their home machines. At home they use Word and/or OpenOffice while at school they use OpenOffice. All documents in OpenOffice are saved as Word documents at school.

Some documents exhibit changes in layout when they are converted to HTML and are published to the net. WYSIWYG functionality in Linux is not always entirely correct.

5.1.6 Other

In the future, a lot will be based on the use of centrally located educational portals or learning portals. Some examples of this are utdanning.no and skolenett.no. Recently the school has gone over to using only Classfronter. This learning platform functions better with Skolelinux and OpenOffice. The decision to use Classfronter was taken centrally by the School District.

The school has stopped using Opera as its standard Internet browser, and now uses Mozilla instead, because it is based on open and free software (in contrast to Opera). Besides it functions better on the most important educational websites (Classfronter, www.viten.no etc.).

The training of teachers is based on Windows. LærerIKT is a centrally-offered training program that is based on distance learning via Internet, drilling teachers in the use of Windows. This is wasted on a school that uses Linux. This makes it more difficult to use Linux-based PCs in the schools.

5.2 School B

5.2.1 About the School

The school has 270 students in grades 1 – 7. There are a little more than 20 teachers. In addition there are a number of assistants. The school was built in 1995 and the last part was finished in 1997. There was no computer cables installed when the school was built. The school is one of Education Minister Clement's bonus schools. The ICT administrator has 2 teaching hours a week available for use as ICT administrator.

5.2.2 ICT at the School

PCs are located in every classroom. These machines use Windows. In addition there are PCs located in the media centers in the school. The teachers also have PCs in their work room. There is a mix of Windows versions and Linux in the school. In total, there are about 30 Linux PCs which are connected in a network to a server. The Linux machines are set up as thin clients. The machines in the classrooms use Windows and are not connected to the network today. There are also a number of Windows machines in the media centers. These are also not connected to the network but some of them are connected to the Internet. There is a network printer in each of the media centers which only does printouts from the Linux machines.

The teachers and the students have separate networks. The teacher machines use Windows. There is 1 PC in each teacher office. Each office is shared by 2-5 teachers. The teachers use the PCs to make annual plans, schedules, lesson plans, etc. The students use the PCs for project work. Primarily, they use word processing, spreadsheet and Internet browser to surf on the Internet. There are some educational software placed on the PCs in the classrooms.

After the acquisition of so many new PCs the school needed broadband. They arranged it themselves. They advertised for EEA bids and a local supplier won.

The school has developed its own training plan with accompanying exercise booklets for the students' use of ICT. They refer to this training as their own version of the Computer Driving License. This training plan was developed based on the use of Windows, and has been revised to include both systems. The school must now change the exercise booklets so that they also show the use of Linux programs. This means that at the moment, the school lacks totally updated training materials for ICT instruction for the students.

5.2.3 Background for Choosing Skolelinux

In spring 2002, the Skolelinux Project contacted the school to hear if they could install Skolelinux at the school. The school was promised PCs almost free of cost and the help to install the equipment at the school. The Skolelinux Project contacted the headmaster who, in turn, contacted the ICT administrator. Together, they discussed the proposal with the ICT administrator for the municipality. The proposal was also put before the employees at the school. The school had only a short time to evaluate the proposal. The school chose to accept the proposal from the Skolelinux Project. This was the first school that got Skolelinux installed by people from the Skolelinux Project. (This information came from the Skolelinux Project). A course was held after the end of the school year for ICT administrators in the municipality. There were 3 administrators from the school who participated. In the course of July-November 2002, a network was set up and PCs were installed in the school. This was done by volunteers from the Skolelinux Project and some of the parents.

5.2.4 Installation of Skolelinux

It was more difficult than expected by the Skolelinux Project to get the PCs for the school. It took a lot of work and the school accepted all of the machines that were offered to them. Many of them later proved to be too bad to be used for Linux installation. Afterwards they realised that they should have made more clear demands regarding the machines and been more clever at choosing which machines to accept.

Parents and enthusiasts from the Skolelinux Project did the cabling for part of the school. Many of them had to be trained to do so. (From the project's side, this was seen as a learning process where the installation routines were developed and various schemes were tested. This information comes from the Skolelinux Project.)

During the summer of 2003 the 5th-7th grade classrooms were cabled by a professional firm. It became apparent that the markings on the cables were not done according to specifications. Now there are network plugs in all classrooms, grouprooms and in the student kitchens for the 5th-7th grades. There are network jacks in the media centers and in the teachers' workroom. The installation was done by the municipality.

The school's decision to use Skolelinux was supported by the municipality. Without such support, the school would not have chosen to accept the offer from the Skolelinux Project. Two other schools in the municipality have chosen Linux and several will follow.

5.2.5 Evaluation and Experiences in the Use of Skolelinux (and ICT)

There is not enough Norwegian educational software for Linux. The schools have some software that the municipality has bought so that everyone can use it. This software only works with Windows.

The students primarily use word processor and Internet browser in their work. These work excellently well with Linux. It is impossible to save on diskettes on a Linux network. The students cannot switch documents between Windows and Linux. The respondents realised that there was a need for the students to be able to save onto diskettes. Skolelinux has told them that there is no need for this; they can save on the network and send documents to each other by e-mail. It is difficult to switch (exchange documents) between different versions of Windows. Earlier, the ICT administrator has learned that they must save in RTF and not in MS format in order to be able to switch between different versions of Windows (this is especially true between W95 and W98).

Today, the students do not have their own user accounts on the student network. There are 6 user names/passwords that are used to log on to the network. The respondents thought that the students were not ready to have their own user name/password. The students would forget them and the ICT administrator or other teachers would have to spend a lot of time helping the students log on. Many students also forget to log off so the next user would get access to that user's area and not their own. The respondents were not certain how they wanted, in the future, to organize storage, user accounts, and if the students should have their own user name and password or if each grade would have a common user account. (N.B. The Skolelinux scheme works best when all of the students have their own user names/user accounts on the network.)

Printouts are a problem for the school. The printers have too little memory so they take a long time to print out. When the printouts do not appear, the students think that they have done something wrong and click several times. So, even more printouts are queued up. It can take

many hours before one printout comes out. This is not a Linux problem, but a general one. The school has no limit on how many each individual student can print out.

The respondents have not used Skolelinux's e-mail list to get help. Previously, the ICT administrator has written e-mails directly to some of the enthusiasts she knows to get help. One of the contacts in the Skolelinux Project has come to the school many times and helped with problems and upgraded to new versions. The people in Skolelinux and the teachers do not use the same technical jargon. They have too high expectations concerning the teachers' knowledge. The municipality has now got a contract with a firm for service for the Linux machines (Linux Labs). The firm has managed to arrange several things when they were visiting the school to get to know them.

The students must use both Windows and Linux. The school uses Word and not OpenOffice on the Windows PCs. The students do not complain about Linux. They use word processing and the Internet. The students work by trial and error and think that everything is OK. The obstacle for Linux is that it lacks educational software. There are some purchased educational software for Windows. There is none for Linux.

The implementation of Skolelinux happened quickly. There was not much time to make preparations. A lot was promised but not everything was delivered. Not all of the machines worked. It took a lot longer time to get Linux installed on the machines and do the cabling for the network. There are now less problems with the machines than previously. The school has got a more stable operating environment.

5.2.6 Other

The school has got more PCs by using Linux. The school could have afforded 1-2 new PCs per year without Skolelinux. The school has not been influenced by the municipality in its choice. The solution was not forced upon them. The school would not have chosen Skolelinux if they had not got support from the municipality. The municipality has paid for the necessary hardware for the server and cabling.

The respondents would probably make the same choice again if they got to choose again.

Some of the students get PCs from the Regional Center for Technical Aids. These are installed with Windows. The school or the ICT administrator cannot change these. The PCs are the student's property, not the school's.

5.3 School C

5.3.1 About the School

The school has a little more than 200 students in grades 8-10. The ICT administrator shares the position with another. Together they use 5.6 hours per week on this. Normal working time for a teacher is 24 hours per week, so there is a 25% position devoted to ICT in the school.

5.3.2 ICT in the School

Today the school has a student network consisting of 25 PCs in a network and 6 free-standing PCs. The PCs in the network are set up with Skolelinux, as thin clients. These PCs were set up in spring 2003. The teacher have not got their own network. The administration has their own PCs which are connected to the municipality's systems. Today the PCs are mostly placed in common areas such as the school library. The software that is used is primarily ordinary

standard software and not specially developed educational software. The PCs are set up with a central server with the other PCs connected as thin clients. This is the standard set up for Skolelinux. The clients do not have diskette stations and the students have no possibility to install their own software.

When the ICT administrator came to the school there were only 6 machines at the school. These had different operating systems, connected to the outside world by modem. They were not connected to any local network. Some of the cabling in the building had been done incorrectly, so that had to be fixed. The work continued from summer 2002 – spring 2003. Now all the rooms in the school are cabled. The cabling of the school was done by a professional installation firm. The ICT administrator also ordered the broadband connection from Bluecom.

5.3.3 Background for Choosing Skolelinux

When the ICT administrator came to the school, there were few PCs present. The school could not afford to acquire more PCs or software. The school received an extra grant from the municipality that made it possible to invest in more equipment. The municipality has passed a resolution that Linux would be used in the schools on a trial basis. When new PCs and software were to be acquired, Linux became the choice. The ICT administrator took the initiative in considering Linux. The ICT administrator put forward a suggestion about this to the headmaster and the other employees. They accepted the suggestion when they saw that the investment made it possible to buy up to 30 new ICT working stations for the students.

5.3.4 Evaluation Concerning the Use of Skolelinux

The ICT administrator does not regret choosing Skolelinux. He recognises that he has got more PCs in the school than with the choice of other solutions. He considered it relatively simple to install Skolelinux in the school. In this work, he has had the help of external suppliers, people from other schools and from Skolelinux's e-mail lists. The best and most concrete help has come from the other schools and from Skolelinux's e-mail lists.

Installation of the broadband connection to the Skolelinux network was not a problem. The ICT administrator and the firm that installed the connection did not experience any difficulties.

Some of the students have reacted to the fact that they cannot install any software they want and that they cannot use programs such as Chat, etc. There have been no comments that the available software is difficult to use. As of today, the students at the school do not share documents with others. If they need to save a document on a diskette, they must go to the ICT administrator to get it done.

The ICT administrator has uncovered some errors in Skolelinux. He has got help from the project to correct or work around the errors. He has also experienced that Skolelinux has got better over time. He recognises that today's version is better than six months ago. Skolelinux still has some errors that have not been corrected.

It is easy for the ICT administrator to install new programs in Skolelinux. He has done this, among other things, with the Internet browser Mozilla. This was done by using a few commands.

For the most part, the ICT administrator is satisfied with Skolelinux. He misses a few things such as printout management (i.e. being able to set a limit on the number of pages an individual student can print out), integration with Windows (i.e. support for Samba and other

software that makes it possible for Windows files to be accessible on a Linux network) and a better backup system. Most of this is under development in Skolelinux.

5.3.5 Other

The municipality has made a contract with a commercial party for remote operation and support for the schools that use Skolelinux. This has freed up resources for the ICT administrator. He recognises this as a great advantage and security.

The school has a budget of between 1000-2000 NOK for ICT operation. This is supposed to cover damaged equipment, toner for the printers, etc.

The ICT administrator has a good dialogue with the person in the municipality who is responsible for ICT in the schools. He has got support from central municipal authorities for choosing Skolelinux.

The ICT administrator would still choose Skolelinux if he got the possibility to make that choice again.

5.4 School D

5.4.1 About the School

The school is an upper secondary school with over 600 students. There are about 60 teachers at the school. There are 2 students per PC at the school, while each teacher has their own PC. The school offers the following foundation courses: General Studies, Health and Social Care, and Sport and Physical Education. The school was named Bonus School in 2002 for its results in the use of ICT in education and for development of a good school environment. The school has pilot classes with laptops for all students. The school has ICT as one of its areas of concentration.

5.4.2 ICT in the School

This school year, the school has begun using two new ICT systems. One is Skolelinux and the other is the learning platform Classfrontier. The systems are new for both students and teachers. The school has previously used another learning platform and Windows as its sole operating system.

The school has also set up a new, large ICT room that they call 'IKTeket' (ICT Center). This is a room with 90 thin clients that use Skolelinux as an operating system. The machines that are used are PCs that the school has received or acquired cheaply. They are heterogeneous and have various processor and memory capacity. The ICT Center is made up of three previous classrooms that have been turned into one large computer room.

The school has several computer rooms and a mix of PCs that use Windows 98, Windows 2000 or Linux. The school also has one class for each grade level that is equipped with laptops. These classes are called 'laptop classes'. Two of the classes have laptops with Windows 98, while the class that started in Autumn 2003 has laptops equipped with Linux. The school has a wireless network so that those who have laptops can always be connected to the Internet. The school has also many servers. Most of these use Linux as an operating system, but there are also servers that use Windows. All of teachers have laptops. These machines have Windows operating systems.

The instruction at the school has also been changed. For the foundation course, the school has gone over to referring to 'groups' instead of 'classes'. The foundation level is divided into two groups with their own team of teachers (6 teachers). Each of the teachers on the team has responsibility for some of the students in the group/level. They have responsibility for giving marks to these students. Teaching has been reorganized so that the students have subject days, that is, days when they work on the same subject the entire day. Part of the day they spend in a "pencil room" and have traditional instruction. The instruction takes place in a room large enough for everyone in the group to be together. The room can also be divided into smaller units with partitions. There are also smaller rooms available for separate teaching. In the other part of the day, the instruction takes place in the ICT Center. The two groups trade places in the pencil room and the ICT Center during the course of the day. The students have subject days for English, Norwegian, mathematics and Science. Not all of the subjects use the entire day for instruction. In Second Foreign Language teaching, they have traditional double class hours. They use ICT in almost every subject. Even those taking the foundation course in Sport and Physical Education use ICT in sport subjects.

The use of ICT and learning platforms (Classfronter) has become a part of the daily routine at the school. The exercises are published on Classfronter where the students can download them. Classfronter is also used as a communication channel between teacher and student. Information about homework, schedules, messages, etc. can be found by the student on Classfronter. Classfronter is an Internet-based tool so the students also have access to it when they are not at the school.

All of the students have their own user name and password for Skolelinux. In addition, they have their own password to get into Classfronter. For the most part, the students remember their passwords for Skolelinux (the system at the school), but they have so far often forgotten their password for Classfronter. The office and the teachers are responsible for Classfronter, while ICT operation is responsible for Skolelinux.

The administration has its own network that is separate from the educational network. The machines on this network use Windows. The administrative software runs on Windows. Much of the software is run centrally in the municipality.

5.4.3 Experiences from the Use of Skolelinux and Classfronter

The school has had startup problems with the implementation of Skolelinux. At the beginning, the machines often froze and they were slow. The teachers felt that they had got too little training in the use of the system. This also applies to the students. It was a great transition to make because the school got two new systems to learn about at the same time. Today, it functions pretty well. There are many factors outside of the school that have created problems.

The students said that the system was slow to respond and had previously froze a good deal. They had no problems using the software. This was true even for those who had never used Linux before, only Windows. The programs are different from what they were used to, but there was no problem using, for example, OpenOffice in the school.

OpenOffice version 1.1 is better than previous versions and makes it possible to get more from Word into OpenOffice Writer. Today, the teachers use Windows and Word. There has been a suggestion that the teachers use OpenOffice with Windows. There has also been a suggestion that all of the students should get a copy of OpenOffice to install at home so that documents can be used both at school and on their home machines. Some of the economy textbooks have exercises in Excel and these cannot be opened in OpenOffice Calc, (the OpenOffice spreadsheet). It is also difficult for the students to make the transition from

using Microsoft PowerPoint to OpenOffice Impress. It was an evaluation that OpenOffice Writer is greatly similar to Microsoft Word, but that there were greater discrepancies between the two presentation programs Impress and PowerPoint. This resulted in some individuals having a difficult transition to this program.

The teachers were just as much occupied with the implementation of Classfronter as they were with Skolelinux. The teachers used Windows so they primarily had to orient themselves to Classfronter. Classfronter is the school's learning platform on the Internet. In addition, the use of ICT in teaching is based on the use of word processing, spreadsheet and Internet browser. The students get their tasks on Classfronter. They have an overview of schedules and activities on Classfronter. The students have access to Classfronter both at school and at home. One of the teachers, together with office personnel, have responsibility for administration of Classfronter. One of the teachers is also resource person for Classfronter.

We tested one of the machines during a teaching hour. In relation to what we are used to, it seemed as if it was slow. One of the ICT apprentices that was present said that the machines could be slow at times. They said that the machines had different amounts of memory, everything from 32 MB to 128 MB. The machine we tested had only 32 MB. The students were lumped together and not spread out around the ICT center. Probably they try to use the machines with the fastest CPU and most memory.

The greatest challenge the school faced in implementation of Skolelinux has been getting Skolelinux and the Internet browsers that are used there to satisfactorily work together with the learning platform Classfronter. In addition there have been problems with the sharing of resources on the network, and that the upper limit for the number of concurrent processes on the system was too low at the start of school year. Much of this has been fixed.

To get Skolelinux to work with Classfronter, the school has used various Internet browsers. This has created some frustration, since the students and teachers had to learn to use several programs. Now the school has chosen Mozilla as its Internet browser. As of today, this works fine with Classfronter.

5.4.4 Evaluations on the Choice of Skolelinux

The school's main reason for choosing Skolelinux was economical, plus the fact that the ICT administrator promoted the solution. In order to run thin clients with Windows, the school would have needed several new servers. By using Skolelinux, they only needed one new server. The school expects to save money on licensing and they can use the existing equipment longer.

The ICT administrator has promoted Skolelinux for a long time. Without his initiative and knowledge of the system, it would probably not have been considered as an alternative. The headmaster made the formal decision that Skolelinux should be used on some of the PCs.

The teachers were informed that Skolelinux would be used at the school. They did not actively participate in the decision-making process. The teachers still use Windows. For them, the migration to a new learning platform is more important than the migration to Skolelinux. The teachers complained that they had not got to participate in the choice of the learning platform, but that the decision was made by municipal authorities.

5.4.5 Interoperability with Other Systems

The school has had some problems with getting Skolelinux to work together with the chosen learning platform. After discussions with the supplier of the learning platform, conditions have got better. The school has also tried several different Internet browsers to find one that

would function best with the learning platform. The school has chosen Mozilla. This Internet browser also works with Windows. The school considers this to be the best Internet browser for Skolelinux that is available today.

There have also been troubles with switching documents between school and the student's home machines. The students do not have OpenOffice at home, so when they save documents on Classfronter in OpenOffice format, they cannot open them at home. This can be avoided by giving all students OpenOffice to install at home, or by having the students save OpenOffice documents in "RTF" or "doc" format.

5.5 Why the Schools Implemented Skolelinux

The schools' primary reason for implementing Skolelinux was financial. There were less expenditures in licensing and there were possibilities to use older and cheaper PCs to raise the number of PCs in the school.

The schools also wanted a more stable system and a system that could give them better control over the students' use.

The survey shows that several ICT administrators had knowledge of Linux before the choice of Skolelinux was made, and their acquaintanceship with Skolelinux helped influence the choice. These ICT administrators are also part of the Skolelinux Project and, as such, have the possibility of influencing the further development of Skolelinux. This has also been an argument for implementing Skolelinux. At one of the schools, Skolelinux took the initiative to get the school to implement Skolelinux. This was so that they could get a reference installation. At all of the schools there were active and clever ICT administrators who were positive to the implementation of Skolelinux and who actively contributed to the process.

There were few or no pedagogic reasons to indicate that the school should not choose Skolelinux. Some of the educational software that they have for Windows is not useable, but there is a lot available for Linux, too. As time goes by, a lot of the ICT training/teaching will be based on centrally available Internet services. This reduces the need for a specific operating system at the school. The primary and lower secondary schools' use of ICT today is not so advanced that it cannot be taken care of by Linux software.

It varies whether the school has got support from the municipality in its choice. The schools that did not get support from their own municipality have had ICT administrators with very good competence in Linux. These have made the choice despite the municipality's objections. None of the schools have been asked by their municipality to implement Skolelinux.

The goal of the schools was to get more machines within the limits of their budget. By choosing Skolelinux and the thin client solution, they got more and cheaper machines and were spared having to devote more resources to operating the system. Simpler system operation was also an argument for choosing Skolelinux. Just getting a system that the school could administer by itself was an argument for Skolelinux.

5.6 Experiences in Using Skolelinux

The evaluations from the schools tell that they are satisfied with Skolelinux. They have got access to more machines, something that according to the SITES report, was the most important thing for the schools, and they have got a more stable operating environment. It is unclear if this is due to the transition to Skolelinux, to thin clients or to a combination of the two things.

Skolelinux and the accompanying software are simple to use. All that is needed is a little time to get used to it. Those that are most satisfied are those who have not had a lot of previous experience. One small problem is retraining those who knew a lot from before, so they get used to Skolelinux. This also tallies well with a report about the user friendliness of Linux by Relavantine AG in Germany [9] which concludes that Linux as a desktop system is about as user friendly as Windows XP.

Word processing, spreadsheet and Internet browser are the programs that are used most often in the school. There are few problems using these programs both for the teachers who use Linux and for the students. It varied from school to school whether they had pure Linux environments or whether they had a heterogenous environment. Some of the teachers viewed it as an advantage, for the teachers and students to have the same system, while it did not make any difference for others. Student complaints about the system primarily concerned the fact that they were not allowed to install their own programs or change the system themselves. There was also some dissatisfaction among some students about limitations on which programs were available and that some of the machines did not have loud speakers, CD-ROM or diskette stations. There were few or no complaints that there were no educational programs available. In some cases there were also complaints that the system was slow and that Skolelinux could not be integrated with existing external software and learning platforms.

Those students we spoke with said that they thought Skolelinux was OK. They missed some programs, but they thought it was simple to relate to both the OpenOffice suite and the Internet browser Mozilla. The younger the students were, the easier it was for them to adapt to Linux. The youngest students did not need any retraining.

Several of the schools used many different systems. This meant that the teachers used one platform while the students used another one. So, the teachers did not get as well acquainted with the systems. Several said that it would be expedient for the teachers and students to have the same programs. OpenOffice and Mozilla are available both for Windows and Linux. The schools with a heterogenous environment considered using OpenOffice and Mozilla on both platforms to make the transision between the two systems easier.

There is a lack of some educational software in Skolelinux. This is especially true in mathematics and economics where exercises have been developed based on Microsoft's Excel. These exercises are not available for Linux.

There are different experiences concerning compatability of Skolelinux and the learning platform Classfronter. Those who have used the combination the longest time are satisfied, while those who have just started have experienced difficulties. The learning platform Classfronter works best with the Internet browser Mozilla.

The Skolelinux scheme works best when all of the students have their own user name and password on the network and when student work is saved on the network or on a learning platform.

The school's administrative systems are physically separate from the teaching part of the schools' network. This means that there is no existing administrative system to be integrated with Skolelinux. This has made the implementation of Skolelinux easier. According to the survey from AAD/NHD, the lack of availability of administrative software for Skolelinux is one of the obstacles to the use of Linux in Norwegian municipalities.

All of the ICT administrators in the schools that were surveyed are resource persons who have contributed a lot to make Skolelinux work well in the schools. It is much to their credit that the school has implemented Skolelinux and that the operation of the machines is so stable as it is. Even if Skolelinux is made to be so simple to install and operate that nearly anyone can do it, it is still necessary to have the will and the knowledge of ICT to understand Linux. The

systems for administering users, permissions, etc. was especially developed for Skolelinux and adapted to the needs of the schools. This helps simplify the operation of Skolelinux.

Skolelinux is focused on creating a total environment for the schools. They have adapted a general system to a specific environment. They are the only ones who make a total environment for the schools. There is no "SchoolWindows". The version of Windows that is used by the schools is the same one used by everyone else with all of its strengths and weaknesses.

The transition to thin clients has made system administration simpler, while the control of the use of programs and resources has got better. The systems at the schools have become more stable after the transition to Skolelinux and the problem with viruses has been significantly reduced. All in all, the transition to Skolelinux has led to a more stable operating environment where the ICT administrator can focus more on user support than on troubleshooting acute problems. The transition to thin clients has also meant that the users get their own set up no matter which machine they log onto. This is important in schools where the students do not have access to their own machine. As one of the ICT administrators said, "The advantage of Skolelinux is that it works right out of the box."

All of the ICT administrators would have made the same choice again if they had the same opportunity.

5.7 Interoperability with Other IT Systems

The schools reported minor problems concerning the conversion of documents written in Linux programs to other systems. It was necessary to save documents written in OpenOffice Writer or other programs as RTF files.

The schools had some problems importing documents written in Word. This was especially true when lists and bullets were used. Some macros and templates in Word were not interpreted correctly by OpenOffice Writer. This is supported by a report developed by Statskonsult about the interoperability of "StarOffice"⁸ and Word. Documents written in OpenOffice can be saved in Word format. This makes it simple to retrieve a document using Word later. Some of the formatting may change when documents written in OpenOffice Writer are saved in doc format.

OpenOffice had also got some limitations concerning the choice of fonts and styles. Converting documents from OpenOffice Writer to Word works fine, but some changes can take place when documents are converted from Word to OpenOffice Writer. The text does not disappear when converted between the two systems, but the layout may be changed.

Concerning the use of the Internet browser, Mozilla worked well together with most of the web-based services. As of today, Mozilla is the best choice for an Internet browser for Skolelinux.

Both OpenOffice and Mozilla are available in versions for both Linux and Windows. This makes it possible to transfer documents between the two operating systems in a simple and problem-free manner. The introduction of OpenOffice on a Windows platform can also make the transition to a Linux platform easier because the user is familiar with parts of the system.

⁸ StarOffice is the commercial version of OpenOffice, but the two products are built primarily on the same source code.

6 Evaluations and Conclusions

Skolelinux is a good product for the schools, satisfying all of the main needs of the schools. It is inexpensive, stable and can be used together with various learning platforms and learning portals. Using thin clients, Skolelinux in a school environment is less expensive to acquire and operate than different Windows versions.

The schools who have picked Skolelinux are satisfied with the choice that they have made, and would do the same again if they got to choose once more. A survey also showed that it is financially advantageous to choose Skolelinux with thin clients over choosing a Windows environment with new machines that must be acquired or upgraded.

The concept that Skolelinux is built on, with thin clients and central administration of a server in the school, simplifies the operation and should be implemented to a greater degree in the schools. Schools with few PCs per student have the most to win by implementing Skolelinux since they will not have as great transitional costs. Skolelinux has taken the action plan "ICT in Education" seriously and made a product that is adapted to the school's situation and resources.

The Skolelinux scheme works best when all of the students have their own user name/user account on the network. As of today, Mozilla is the Internet browser and OpenOffice is the office suite that should be used together with Skolelinux. Both programs are available for Linux and Windows, making the transition easier between the two systems.

Conversion of text from Microsoft Word to OpenOffice Writer works well, for the most part. Some of the layout elements get changed when converted. This is especially true with numbered and unnumbered lists.

Skolelinux lacks some educational software. Some learning platforms work poorly together with other Internet browsers than Internet Explorer. This is a problem that Skolelinux and the schools should address.

The centrally organised training of teachers is based on Windows. This makes it difficult for the schools to choose anything other than Windows-based solutions. The training of teachers should be more flexible and not based solely on the use of products from one single supplier. After conversations with the team responsible for the training program for the teachers, the team maintain that the training for the school year 2003/2004 will not be so based on Windows as previously.

According to our evaluation, Skolelinux is well suited for use in the school.

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