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# Open Standards and Open Source in Swedish schools: on Promotion of Openness and Transparency

Björn Lundell and Jonas Gamalielsson

University of Skövde, Skövde, Sweden,  
{bjorn.lundell, jonas.gamalielsson}@his.se

**Abstract.** We draw from a study aimed to establish the state of practice concerning schools' expectations and provision of IT and software applications in Swedish schools. Analysis focuses on Open Standards and Open Source Software (OSS), and considers educational lock-in. Results consider schools' expectations and provision of software and standards for digital artefacts, and show that schools expect students to use a variety of different software systems including a number of well-known OSS. The study reveals significant misconceptions concerning standards and software applications, characterises problems, and presents some recommendations for action.

## 1 Introduction

The use of IT and pedagogical software in schools has received significant attention in many countries in a desire to gain positive pedagogical effects and prepare students for society and working life (e.g. Balanskat et al., 2006; IES, 2009; Livingstone, 2012). In acknowledging mixed experiences there is also some research addressing teaching and learning experiences from Open Source Software (OSS) usage at University (e.g. German, 2005; Kilamo, 2010; Lundell et al., 2007) and high school levels (e.g. Lin and Zini, 2008), but there is a lack of research on expectations and provision of open standards and OSS in schools for young students.

As part of a study aimed to establish the state of practice concerning IT usage in Swedish public sector schools with students in ages 7-19, this paper presents novel results from an analysis covering all Swedish schools for young students (ages 7-16). Specifically, results presented concern: provision of OSS applications for use by students; requirements for students related to use of different document formats (standards); requirements for students related to use of software applications for writing essays; and provision of software applications for writing essays. Our analysis provides a state of practice and addresses different implications of educational lock-in and its long-term implications.

A number of factors motivate consideration of Open Standards and OSS in an analysis of IT usage in public sector schools, and there are a number of initiatives and previous research efforts related to the study.

First, skills development in the ICT sector has been identified as important, not only for public sector procurement and standardisation, but also for a range of different stakeholder groups. We note that the European Commission reports, in its annual scoreboard, that “sufficient ICT skills” is an area of major concern as half of “European labour force does not have sufficient ICT skills to help them change or find a new job.” (EC, 2012)

Second, it is widely acknowledged that there are risks and different types of lock-in effects associated with use of closed file formats (Egyedi, 2007; Ghosh, 2005; Lundell, 2012). One such concern is educational lock-in which may occur in situations when a company sponsors provision of IT and training of teachers (Kirk, 2008), and with such practices there may be significant long-term effects on IT practices.

Third, previous research show that adoption of IT and software systems in the public sector sometimes, perhaps unintentionally, inhibit a fair and competitive market based on important principles of transparency, non-discrimination and equal treatment (e.g. Lundell, 2011). Such practices, with widespread adoption and use of closed standards in the IT area, may significantly reinforce competence development related to certain proprietary technology. Over time, this may contribute to a lack of competence in certain technology areas, with associated risks for lack of skills or an unbalanced pool of skills in the market.

Fourth, despite established principles in European and national law aimed to stimulate a fair and competitive market for public procurement (e.g. Directives 2004/17/EC and 2004/18/EC) it is clear that widespread misconceptions concerning Open Standards and OSS (e.g. FLOSS, 2002) reinforces bad procurement practices in the public sector (e.g. Lundell, 2011).

Fifth, despite a number of national policies and strategies (e.g. UK, 2012; Regeringen, 2009) aimed to achieve a number of desirable effects for the public sector by promotion and use of Open Standards, such as compatibility and interoperability issues (Ghosh, 2005), there are also other potential benefits, such as strengthening democracy, which can be achieved by promotion of Open Standards. For example, it has been claimed that standards “are also strongly relevant to democracy to the extent they affect the conditions under which citizens engage in the democratic process.” (DeNardis and Tam, 2007)

The rest of this paper is organised as follows. First, we provide a background on the situation in Sweden (2) followed by our research approach (3). Thereafter we make some observations concerning the responsiveness to the study (4), followed by a presentation of the results (5, 6 and 7) of the study. Finally, we discuss results and present conclusions (8).

## 2 Background

Openness and transparency have been recurring themes in public speeches from representatives for the Swedish government for a number of years. For example, in its 2004 IT bill (2004/05:175), the Swedish government declared that the use of Open Standards and OSS should be promoted (EU, 2005). More recently, in a public speech during the Swedish EU presidency, the responsible minister presented the Swedish position on the importance of openness in the public sector:

“It is my belief that we need a clear definition of openness in the European Interoperability Framework and that the definition of open standards and open source software as defined by the European Interoperability Framework version one has served us well so far. The use of open standards and open source solutions decreases the public sector’s reliance on specific vendors and platforms and it increases European competitiveness as well as the transparency” (Odell, 2009)

From a policy perspective, the concept of Open Standard has been clarified in the Swedish context through inclusion of a clear definition of openness, adopted from the EIF version one (EU, 2004), in the first report from the Swedish e-Governance initiative (SOU, 2009). With the clarification of this fundamental concept, important principles underlying the idea of an Open Standard have been established.

First, use of an Open Standard ensures that data can be interpreted independently of the tools used for its generation, something which is particularly important in an educational context as students cannot be expected to buy (or pay for renting) specific proprietary technology when studying in Swedish public schools. In fact, the The Swedish Schools Inspectorate examines an important principle for education in Sweden, namely that “education shall be free of charge” (Skolinspektionen, 2011), and clarifies that costs for calculators used in public schools and costs related to use and insurances of laptops provided to students for use at school and at home cannot be charged for. However, a minor fee (approx. €10) can be accepted on an occasional basis, such as for costs related to a day with outdoor activities.

Second, when a standard is published, its technical specification contains sufficiently detailed information, and it is provided under royalty free conditions (FRAND, 2012) it can be used as a basis for implementation in software systems under different proprietary licenses and different OSS licenses. Such a standard, which adheres to the definition of an Open Standard (SOU, 2009), fulfils fundamental prerequisites of non-discrimination and equal treatment promoted in national policies and directives for public procurement. With Open Standards as a basis for procurement of IT, software systems, and educational (digital) learning objects (i.e. educational material, documents, and data which are maintained in Open Standards) in an educational context, there will be reduced risks for discrimination against students. Such a policy and practice is well in line with a statement from Kroes, then European Commissioner for Competition Policy, in a public speech: “No citizen or company should be forced or encouraged to use a particular company’s technology to access government information.” (Kroes, 2008)

In the context of the Digital Agenda for Sweden, the Swedish minister responsible for IT has addressed the topic IT usage in schools and education (Näringsdepartementet, 2011). In a public speech, the same minister commented that many schools provide IT equipment to their students, but also stressed: “I would argue that for schools there is much room for improvement in terms of IT use.” (Hatt, 2012a) Further, in another public speech on the topic “Every single child has the right to modern IT in schools”, the same minister amplified the importance of openness for promotion of democracy in her conclusion: “With openness and transparency, we can strengthen democracy, promote innovation and new jobs.” (Hatt, 2012b) In light of this, we note that current practice is far from this vision as the Swedish National Agency for Education is acting just the opposite of these recommendations and the view of the European Commissioner for Competition Policy when they publish information in closed file formats on their website (Skolverket, 2011), and thereby promote use of proprietary licensed software and closed formats.

Recent statistics reported by the Swedish National Agency for Education show that computers are most commonly used when teaching the subject Swedish (as a native language) with students aged 13 to 15 years old (Skolverket, 2010). For this group of students, results for computer usage when teaching Swedish show that 17% of the students “never” and 32% “rarely” use computers, which imply that almost half (49%) of Swedish students rarely or never use computers. It should be noted that writing essays and reports are rather common activities in primary schools, and in light of these results, statements concerning room for improvements in terms of use of IT by the Swedish IT-minister may, perhaps, not be perceived as surprising. Further, according to the chair for the educational commission at Swedish Association of Local Authorities and Regions, most students learn IT at home with associated risks for a digital divide and that there is an urgent need for an IT-strategy for Swedish schools and IT competence in schools (SKL, 2011).

### **3 Research approach**

Our goal is to establish the state of practice concerning IT usage in Swedish public sector schools, and to address this a study was designed in order to collect responses from all public sector schools in Sweden through data collection via each municipality.

With a tradition of openness and transparency in its Swedish public sector, there are high expectations and a strict policy on governmental responses to questions and requests for public documents: it is expected that all questions are responded to, and requested public documents must be provided.

The study included 12 questions and 4 requests for public documents. The same questions and requests for public documents are used for all schools, and specifically address a number of aspects concerning students’ IT usage.

In this paper, we focus on public sector schools for young students (in ages 7-16) and present our analysis of responses related to the following questions:

- Which OSS and IT equipment (i.e. stationary computers, laptops, tablet computers, etc.) are provided to students in schools in your municipality for use in school work? (*see section 5*)
- Which document formats (and versions of these) are students in schools in your municipality expected to manage in order to be able to read, write and edit documents (as well as to be able to exchange these documents electronically with teachers and other students) to be able to engage in school work? (*see subsection 6.1*)
- Which software (and versions of these) are students in schools in your municipality expected to have access to and regularly use in order to be able to read, write and edit documents (i.e. essays, instructions and other texts that students should prepare and communicate with teachers and other students) to be able to engage in school work? (*see subsection 6.2*)
- Which software (and versions of these) are students in schools in your municipality provided access to on stationary computers and on portable computers (i.e. laptops or tablet computers etc.) for use in order to be able to read, write and edit documents (i.e. essays, instructions and other texts that students should prepare and communicate with teachers and other students) to be able to engage in school work? (*see section 7*)

At time for the design of the study, we had informal dialogues with practitioners in the domain, including potential respondents in the study, in order to scrutinise our design and planned actions for data collection. From this we obtained a number of useful insights about the domain which was accounted for in our detailed planning of the study, and in particular concerning detailed planning of the data collection process. As part of this process initial results have been presented and discussed with practitioners and policy makers in several national and EU contexts (e.g. Lundell, 2012b).

When the data collection was initiated (January 2012), Sweden had 9,5 million citizens (in its 290 municipalities) of which 889000 were students (in ages 7-16) in one of the 4616 public sector schools. For data collection, we sent an email containing the questions and requests for documents in plain text to each municipality (290 in all), with follow-up reminders sent over a twelve month period. The text in the email was supplemented with two attachments (one ODF and one PDF/A-1b file) comprising data collection for the study. The instructions clarify, for reasons of privacy, that respondents can reply via email or by sending a letter containing printed documents.

The study resulted in both quantitative and qualitative data. Quantitative data was analysed to gauge the overall position with respect to informed decision making about students' IT usage in public sector schools. The text of responses, together with that of supplied documents, was analysed qualitatively, to give some insight into the real state of practice.

#### 4 Responsiveness to the study

The request email was sent to the registered address of each municipality. A municipality is required to respond promptly at least with an acknowledgement (usually an acknowledgement is interpreted to mean within 24 hours). If no response was received within four working weeks, then a reminder was sent. This continued with, for each reminder, increased emphasis. After the fourth reminder the email also included a clear request for an acknowledgement of receipt of the email, and after more than twelve months of elapsed time since the initial request (and in one case after thirteen reminders) all municipalities had acknowledged receipt of the email. We note that the fourth reminder resulted in a significant effect and we received many acknowledgements of receipt of the email during a short time-window (slightly more than 4 months after the initial request).

Figure 1 presents an overview of the data collection process (for the 370 days following the initial request). The dashed line shows accumulated proportion of acknowledged receipt of the email over time and the solid line shows the proportion of respondents that have responded to questions in the data collection over time.

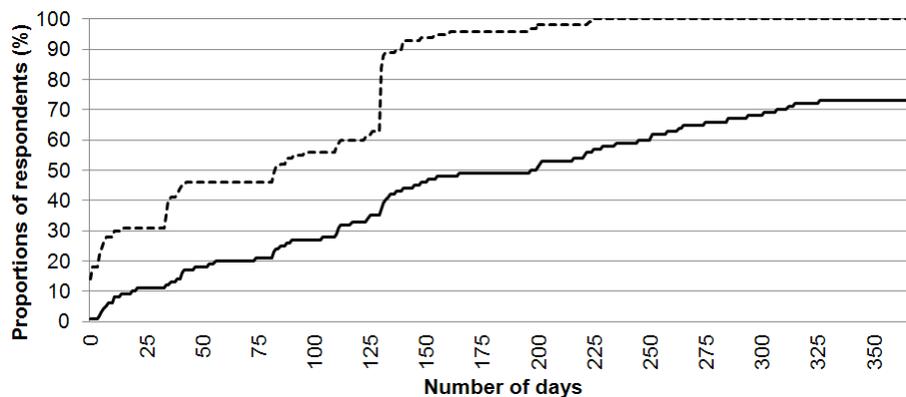


Fig. 1. Overview of the data collection process

Prior to initiating the data collection we anticipated a complex process when collecting data for schools in larger municipalities, but it came as somewhat of a positive surprise to us when we observed that it was not more difficult in comparison to data collection from schools in smaller municipalities.

It should be noted that the email sent for data collection included requests for public documents that they are required by law to respond to (at least with a notification of that requested documents do not exist, or that documents cannot be provided according to a decision in the organisation, e.g. for reasons of national security or privacy).

Initially, some municipalities seem to have ignored the email despite the fact that it contains a request for public documents, whereas yet others explicitly declined to respond. Several provided partial responses, which are probed further. On average, it

took 76 days and 2.7 reminders since the initial request before a municipality acknowledged receipt of the email, and even longer before receiving a survey response (at time of writing more than 1800 reminders have been sent concerning the questions in the survey). Many of these reminders contain clarifications and explanations, and a number of telephone conversations have also been used for clarifications.

Some municipalities explicitly declined to respond and others provided partial responses, which were probed further. Some delays were evidently caused by confusion over who should respond, no individual feeling able to respond to all requests. This meant that the email was circulated within and between organisations (as there are also different types of collaborations between schools and municipalities). In many cases this resulted in partial answers being given from different parts of an organisation and from the data collection process it is evident that several individuals were involved. Many respondents expressed reluctance to provide responses and all requested documents, and in some cases even some frustration. In a few cases, respondents (and some non-respondents) even explicitly stated that they have no interest in contributing to the study and no interest to provide requested documents. However, the vast majority of respondents have expressed significant interest in the study and amongst those that have responded several have expressed that they look forward to its results.

The initial request was responded to by 10% of the respondents. A reminder elicited further responses, resulting in a 19% response rate and after a second reminder, 27% had responded. At time of writing, the response rate for the study is 73%. In addition, some respondents provided requested documents, but did not respond to the questions (6% in total) which implies that we obtained valuable information from 79% of all respondents. On average, it took 138 days and 6.4 reminders since the initial request before receiving these responses.

## **5 Use of Open Source software in schools**

Results show that schools typically use several hundreds of software applications and many respondents provided detailed lists of precisely which software they use as requested. However, a number of respondents gave explicit reference to specific software packages (provided by specific suppliers), whereas others explicitly mentioned a handful of software applications with a note that they also use other pedagogical software. From the information provided in detailed lists of software applications used in schools, we find that many schools use a mix of proprietary and OSS licensed software.

From analysis of responses that explicitly mention the OSS used, we find that a number of different OSS applications are provided to students. Table 1 presents an overview of OSS solutions provided by schools which have been mentioned by more than a single respondent. As many respondents did not provide information

concerning specific version of the software provided, our overview presents the license used for each software at time of writing.

**Table 1.** Overview of OSS solutions provided in schools

Software type	Software	License	Link
Sound	Audacity	GPL v2 (or later)	<a href="http://audacity.sourceforge.net/">audacity.sourceforge.net/</a>
e-books	Amis	LGPL	<a href="http://www.daisy.org/projects/amis">www.daisy.org/projects/amis</a>
Graphics	Blender	GPL v2 (or later)	<a href="http://www.blender.org">www.blender.org</a>
Text editing	Bluefish	GPL v3	<a href="http://bluefish.openoffice.nl/">bluefish.openoffice.nl/</a>
Mind mapping	Freemind	GPL v2 (or later)	<a href="http://freemind.sourceforge.net/wiki/index.php/Main_Page">freemind.sourceforge.net/wiki/index.php/Main_Page</a>
Web browser	Firefox	MPL v2	<a href="http://www.mozilla.org/firefox">www.mozilla.org/firefox</a>
Graphics	Gimp	GPL v3	<a href="http://www.gimp.org/">www.gimp.org/</a>
Mathematics	Geogebra	GPL v3	<a href="http://www.geogebra.org/">www.geogebra.org/</a>
Graphics	Inkscape	GPL v2 (or later)	<a href="http://www.inkscape.org/">www.inkscape.org/</a>
Office suite	LibreOffice	LGPL v3	<a href="http://www.libreoffice.org/">www.libreoffice.org/</a>
Office suite	OpenOffice	LGPL v3 / Apache license 2.0	<a href="http://openoffice.org/">openoffice.org/</a>
Desktop publ.	Scribus	GPL v3	<a href="http://scribus.net/">scribus.net/</a>
Graphics	TuxPaint	GPL v3	<a href="http://www.tuxpaint.org/">www.tuxpaint.org/</a>
Media player	VLC	GPL v2 (or later) / LGPL v2	<a href="http://www.videolan.org/vlc/">www.videolan.org/vlc/</a>
Mind mapping	Xmind	LGPL v2 / EPL v1	<a href="http://www.xmind.net">www.xmind.net</a>
Archiving	7-zip	LGPL v2 (with unRAR restriction)	<a href="http://www.7-zip.org">www.7-zip.org</a>

Amongst other OSS mentioned, responses for use in schools include: CMS and blogging tools (e.g. Wordpress), development environments and platforms (e.g. Eclipse, Netbeans), calculator applications (e.g. KCalc), pedagogical software for astronomy teaching (e.g. KStars), text editors (e.g. NotepadPlusPlus), personal information management tools (e.g. Evolution), text-based web browsers (e.g. Lynx), remote desktop servers (e.g. ThinLinc), libraries and programs for handling multimedia data (e.g. FFmpeg), Linux distributions (e.g. Ubuntu), and e-mail server and web clients (e.g. Zimbra), and administrative software for administration and dialogue between students, their parents and the school (e.g. Unikum).

In acknowledging that not all respondents explicitly mentioned all software they use we note that three OSS projects are the most widely adopted: Audacity, Firefox, and OpenOffice. Further, five additional OSS projects also seem widely used as there are more than a dozen of respondents reporting use of one of these: Amis, Freemind, Gimp, LibreOffice, and VLC.

From our analysis of responses, we note that several respondents lack (or at least report to us in their response that they lack) documentation of which software they use. From a licensing perspective, such lack of documentation is obviously not an issue, whereas for proprietary licensed software it is important to keep track of precisely which software is being used. For this reason, one may conjecture that the

extent to which OSS is used in schools may be (somewhat) underestimated. However, the number of respondents that explicitly commented on their lack of control for which software they use came as something of a surprise to us.

## 6 Expectations on use of document formats and software applications for writing essays

As writing essays, reports and other texts is one of the most common activities in primary schools, this section presents results concerning what a school expects from its students concerning use of specific document formats and specific software for writing, editing, and exchanging documents with teachers and other students.

### 6.1 Expectations on use of document formats for writing essays

From analysis of responses related to what schools expect from their students concerning use of specific document formats six broad categories emerged that could be meaningfully interpreted. These six categories represented 93% of all responses concerning what a school expects from its students and below we comment on our analysis of these. For the remaining 7%, it was not possible to give a meaningful interpretation due to lack of information in each response. We make a number of observations from our analysis of responses in the identified six categories.

The first category (39%) includes responses for which it is evident that respondents understand what a document format actually is. For most of the responses in this category commonly used document formats are identified (see Table 2 for an overview of the most common formats). However, there were also some respondents which included file formats primarily aimed at other types of files (in addition to document formats) in their response. File formats primarily aimed at other types of files mentioned in responses include file formats for images (e.g. bmp, jpg, png and gif), video/multimedia (e.g. mpeg4, wmv, avi), and audio (e.g. wav). Several responses include expectations for use of several document formats.

**Table 2.** Expectations concerning document formats for respondents in the first category

Expected document formats	Percentage of respondents
doc	87
pdf	55
docx	51
odt	29
pages	5
rtf	4

From the second category of responses (29%), it is clear that many of those responding do not understand the concept of document format. Most respondents in this category mention software applications which schools expect students to use for writing documents. Responses include: “MS Office”, “Word”, “Office”, “Open Office”, “iWork”, “Software which is compatible with MS Office”, “Office Pro Plus 2003-2010”, “MS Office 2010”, “Microsoft Office 2007”, “Word 2003”, “Office 2003”. There are also some responses in this category which included other types of software, file formats (not primarily aimed at editing text), and platforms, such as: “Fronter”, “outlook.com”, “word and pdf”, and “Word for XP”. A few responses in this category were more elaborated. For example, one respondent seems to equate “Word” with a document format: “In general it is word and PDF that we expect students to be able to read” and another responded with a policy for its municipality concerning document formats as follows: “The recommended document format in our municipality is Office 2007”. As public schools are governed by municipalities, this policy (implicitly) also applies for all schools in this municipality. Others seem to be more aware of their unfamiliarity with the concept of document format. For example, one respondent commented on the lack of understanding and that “most schools use office software. I do not know what the student understands, nor how they have learnt the software. The educators in X-municipality may register for PIM but there is no explicit requirement for the level they are expected to achieve. Today this is up to each headmaster to decide.”

The third category (20%) contains responses which refer to specific software with an explicit account for associated format without being specific about which document format they expect students to use (i.e. selection of software implies format). Hence, for these respondents it is clear that consideration of which software the school should expect students to use precedes any decisions on document formats. Several responses in this category were vague and implicitly referred to formats provided by a specific vendor or product. For example, responses in this category include: “Microsoft’s”, “The formats in Office 2007”, “The document formats which are supported by Apple”, “The formats supported in Open Office”, and “All formats which can be generated by our software”.

The fourth category (5%) includes a number of responses which made explicit that the school does not expect students to be able to use specific document formats. Several responses clarified that it does not matter, as illustrated by these responses: “Nothing is expected”, “There are no documented guidelines or requirements”, and “We currently do not have any such requirements”. Some responses were more elaborated and the responses show some awareness of the challenges associated with different versions of document formats and different versions of software for those formats: “So far it has sometimes been difficult for primary school students and teachers because there are several versions of word processors and suppliers. The primary school currently strives for the iPad and we do not yet know what this will lead to”.

Some respondents did not explicitly respond to the specific question concerning document formats, but it was still possible to identify expectations concerning use of

document formats. This comprises the fifth category (5%) of responses. From analysis of responses to other questions in the data collection (most notably those related to expectations concerning use of software) we included into this category responses which were explicit about expectations concerning software use. Hence, responses in this category (implicitly) clarified expectations and the responses were similar to those responses that were categorised into the third category (which explicitly expressed expectation regarding document formats). The remaining responses were categorised into the sixth category (2%) and included a few responses in which respondents explicitly express uncertainty.

From these responses, it is apparent that there is confusion concerning what a document format actually is and how choice of such formats may affect users. This includes awareness of the potential impact on students when schools express, explicit or implicit, expectations concerning such formats. In particular, there is considerable confusion amongst respondents concerning the difference between a document format and software systems aimed for reading, writing, and editing of documents.

## 6.2 Expectations on use of software for writing essays

Related to the issue of document formats, the study also investigates what a school expects from its students concerning use of specific software applications (and software provided as a cloud service) for writing and managing documents.

From analysis of responses it is clear that a majority of schools expect their students to use (one or several) specific software applications (see Table 3). Some respondents included details concerning which specific version of the software they expect their students to use, whereas others provided no such information.

**Table 3.** Expectations concerning use of software applications for writing documents

Expected software applications	Percentage of respondents
Microsoft Office	77
OpenOffice	18
LibreOffice	9
iWork	6
Google docs	4
Others (responses include MS Live, Works etc).	2

Table 3 does not distinguish between responses that make a difference between “Microsoft Word” and “Microsoft Office” (with or without specific version number), and all such responses are summarised into one row. Similarly, we do not distinguish between “iWork”, “Pages”, and “Apple” (these responses are merged into one row, “iWork” in Table 3). Amongst respondents who included expectations concerning specific version, we note that Microsoft 2010, 2007, and 2003 dominate. However, responses that included version also mentioned 97, 2000, and 2002. For

“OpenOffice”, most respondents did not mention a specific version, but amongst those that did, versions mentioned ranged from “OpenOffice 2.0” to “OpenOffice 3.3”. For “LibreOffice”, only one response mentioned a specific version (3.4.4).

To gain some additional insights concerning the relationship between expectations for document formats and software we specifically analysed the second category in subsection 6.1 (i.e. the respondents that do not seem to understand the concept of document format) and investigated their expectations for software. From this, we find that 93% of those that do not seem to understand what a document format is expect students to use a proprietary licensed software (e.g. Microsoft Office and iWork), whereas the remaining 7% expect their students to use a software which is licensed under an OSS license (e.g. OpenOffice and LibreOffice) that can be obtained without a license fee.

To further analyse the relationship between expectations for document formats and software we also analysed the first category in subsection 6.1 (i.e. respondents that seem to understand the concept of document format) and investigated their expectation for software. From this, we find that only 3% of respondents expect their students to only use document formats for which there are software applications provided as OSS.

## 7 Provision of software applications for writing essays

From our analysis of responses we find that a clear majority of schools provide (one or several) specific proprietary software applications to their students (see Table 4). Some respondents included details concerning which specific version of the software they provide to their students, whereas others provided no such information. Some responses include several software applications (and software provided as a service) that they provide to their students.

**Table 4.** Provided software applications for writing essays and other documents

Provided software applications	Percentage of respondents
Microsoft Office	81
OpenOffice	20
LibreOffice	9
iWork	5
Google docs	3
Others (responses include MS Live, Works etc).	2

Table 4 does not distinguish between responses that make a difference between “Microsoft Word” and “Microsoft Office” (with or without specific version number), and all such responses are summarised into one row. Amongst respondents who included expectations concerning specific version, we note that Microsoft 2010,

2007, and 2003 dominate. However, responses that included version also mentioned 97, 2000, and 2002. For “OpenOffice”, most respondents did not mention a specific version, but amongst those that did, versions mentioned ranged from “OpenOffice 2.0” to “OpenOffice 3.3”. For “LibreOffice”, only one response mentioned a specific version (3.4.4).

We analysed the correspondence between responses concerning expectations of file formats and software (as reported in subsections 6.1 and 6.2) with responses concerning the provision (as reported in this section) of software to students for writing and managing documents, and make a number of observations. First, perhaps unsurprisingly, we find that in almost all cases when a school expects its students to use a specific software the school also provides that specific software to its students. However, responses show that some schools expect their students to use specific (proprietary) solutions which the school does not provide to its students. Secondly, there are also schools which expect their students to use specific OSS solutions that they do not provide to their students. It should be noted that in such cases, it is critical that students are allowed and able to adopt and install the specific OSS (that the school expects them to use), either on their own equipment or on stationary computers or laptops provided by the school.

## 8 Discussion and Conclusions

In a public speech in the Swedish context, the Swedish minister responsible for IT stated (Hatt, 2012a):

“The objective of the Digital Agenda for Sweden is that Sweden will be the best in the world at using digitization opportunities. It is a goal that not only means that we should follow the trend, but we really should be at the forefront of it.”

In light of this ambition, it seems clear from the results of the study that current practice is far from this ambition and that Swedish schools face significant challenges concerning IT education and usage.

Concerning use of document formats and software applications, our results show that many schools expect their students to use document formats that are based on a technical specification which “is not complete” and “include references to proprietary technology and brand names of specific products” (EU, 2012). This, in light of presented results, imply that many students are expected to use proprietary software provided from a single vendor. Such expectations from schools are certainly not in line with the regulations from Swedish authorities concerning the requirement that education shall be free of charge for students in Swedish public schools. Further, as such expectations contribute to educational lock-in and clearly are in conflict with national goals concerning use of Open Standards in the Swedish public sector, they also inhibit innovation in society as a whole.

Although our results show that OSS is used to some extent, it is evident that current practice, in the majority of schools, promotes use of software based on proprietary technologies, closed document formats, and a closed mindset for IT

usage amongst students. From an educational perspective, a more sustainable strategy would be to utilise solutions based on Open Standards for which there exist OSS implementations.

In the short term, it appears that an effective recommendation for schools based on the results would be to always undertake evaluations of document formats prior to decisions on software applications, and in so doing always consider interoperability and lock-in scenarios.

We acknowledge an inherent uncertainty in our results concerning IT usage in Swedish public sector schools for young students caused by lack of responses from 27% of respondents. Therefore, we undertook a further analysis of different data sources made available by those that did not respond to questions in order to reveal some insights concerning use of specific software in this group. Data sources for this analysis include information provided in response to the initial request for public documents by those that did not respond to questions (in total 6% of all respondents), other information provided via respondents' web sites, and via direct dialogue. This information provided insights into specific instructions for how to use specific software, which software has been adopted and deployed to students, and other statements indicating various decisions concerning use of specific software in the educational environment. From this we conclude that there are strong indications that the proportion of respondents providing proprietary software applications is somewhat underestimated. In addition, we found that this analysis only identified software already explicitly mentioned in responses (and explicitly mentioned in table 4). Further, this analysis also identified an acknowledgement of inherent problems related to use of different file formats, and we also observed explicitly stated expectations concerning use of specific file formats.

To conclude, results from the study suggest that there is significant scope for improvements in the Swedish formal education concerning IT usage. In particular, there are many misconceptions and significant unawareness amongst respondents. Many schools seem unaware of the potential with Open Standards and OSS as enablers for innovative use of IT that does not discriminate any student.

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