



E-learning Nordic 2006---

*Impact of ICT on education*



E-learning Nordic 2006

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## Preface

The Nordic countries are known as world leaders in the area of ICT in education. Ever since the early nineties, the Nordic countries have invested in ICT in the educational sector, based on the strong belief that the realm of ICT goes far beyond the immediate business and industry applications, and ICT is seen as an essential cultural technique which can significantly improve the quality of education. At the same time, however, there is a lack of measurable evidence showing the overall *impact of ICT on education*:

- Do pupils learn more and better with ICT?
- Have any new teaching methods emerged?
- Has home-school co-operation improved thanks to ICT?

These are just some of the many questions which must be asked when assessing ICT, but until now no Nordic studies have been undertaken on a more general level to demonstrate the impact of ICT. Most studies have concentrated on quantitative stocktaking of the ICT infrastructures in our schools and the number of teachers trained in the use of ICT. In addition, assessments of the educational impact of ICT have primarily been conducted with a national scope, thereby limiting the benefits and synergies that can be achieved by applying a broader, regional comparative scope.

*E-learning Nordic 2006* is the first inter-Nordic study specifically concentrating on the impact of ICT on education: What has been the return on investment from the investment in ICT in the Nordic countries?

It has been a great challenge to develop a methodology that could show the impact of ICT on a subject as complex as learning. In *E-learning Nordic 2006*, the method selected involved asking key participants about the impact of ICT, based on what they have experienced. Thus, the results from *E-learning Nordic 2006* show the *perceived* impact of ICT.

*E-learning Nordic 2006* was carried out in Finland, Sweden, Norway and Denmark. More than 8000 persons (pupils, teachers, headmasters and parents in primary and secondary schools) have participated.

*E-learning Nordic 2006* establishes a common Nordic framework for assessing the position of the four participating countries, in relation to one another, in the area of ICT in education. The Nordic countries in many respects share the same basic educational philosophy and the same framework in the educational systems. However, there are naturally also important differences among the

countries. These similarities and differences offer a unique potential for mutual learning and adaptation of new ideas and approaches.

This study has revealed results that will be valuable input to strategies and action plans for the years to come. The results of the study will also be brought into a wider European dialogue on how schools, teachers, and learners can benefit from the use of ICT in education.

The *E-learning Nordic 2006* study has been designed and launched as a partnership between the Finnish National Board of Education, the Swedish National Agency for School Improvement, the Norwegian Ministry of Education and Research, the Danish Ministry of Education, and Ramboll Management.

Ramboll Management is responsible for the operational implementation of the study and Ramboll Management is solely responsible for the analysis of the results and all conclusions presented in this report.

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## 1. Executive summary

In a partnership between the Finnish National Board of Education, the Swedish National Agency for School Improvement, the Norwegian Ministry of Education and Research, the Danish Ministry of Education, and Ramboll Management, the study *E-learning Nordic 2006* has been designed and launched. Ramboll Management is responsible for the operational implementation of the study and Ramboll Management is solely responsible for the analysis of the results and all conclusions presented in this report.

ICT has been introduced into schools during the last 10-20 years, and while many studies have analysed how ICT is used in schools and how often, hardly any studies have taken this analysis to the next level: *What is the impact of ICT?* By this, an important distinction is made between 'output' and 'impact'. Output refers to the direct product of the activities that are carried out, such as number of new computers purchased, number of lessons using ICT, etc. Impact refers to the changes brought about by these activities, in terms of for example improved learning.

The aim of *E-learning Nordic 2006* is to discover and document the impact of ICT on education within three key areas:

- Pupil performance
- Teaching and learning processes
- Knowledge-sharing, communication and home-school co-operation.

Ramboll Management is aware that defining and analysing impact is no simple matter. There are many interrelated factors that can have an impact on pupils' learning, isolating the impact of just one factor, such as ICT, therefore requires a well-considered approach. Various methods can be used to measure impact; however they all have their advantages and disadvantages. Ramboll Management has chosen a method where different key participants in schools are asked about their personal experiences using ICT and their perception of the impact of ICT on the pupils' learning. This is a method that makes room for assessing the impact of ICT against the background of the complex daily situations in school. With this methodology we do not claim to prove a direct link between the use of ICT and learning impact. *However, by asking those who experience the impact of ICT, we show how they assess it. This is the perceived impact of the headmasters, teachers, pupils and the pupils' parents.* It may not be the actual impact, but it is the view they themselves hold and express about the consequences of using ICT in schools.

Data collection in the study was based on an internet-based survey conducted among 224 Nordic schools. More than 8000 persons participated in the survey. Respondents were teachers in the 5<sup>th</sup> and 8<sup>th</sup> grades in primary school and the 11<sup>th</sup> grade in secondary school, pupils in all these grades, their parents, as well as the headmasters at the participating schools. Furthermore, 12 follow-up visits to schools in all four Nordic countries were carried out. The data collection took place primarily in 2005.

Results of the *E-learning Nordic 2006* show that ICT has a positive impact on the schools' overall target – improving the pupils' learning. But the study also indicates that the potential of ICT is not being fully realised at all schools. The use of ICT as a tool for pedagogical development is not in focus and the impact of ICT on knowledge-sharing, communication and home-school co-operation is only moderate. Below are presented the main results from *E-learning Nordic 2006* within the three key areas.

In the following chapter, we provide Ramboll Management's assessment of the strategic challenges facing the Nordic school systems in the years to come, if the full impact of ICT is indeed to be realised.

### **The impact of ICT on pupil performance**

The results of this study show that pupils, teachers as well as parents assess that ICT has a positive impact on improving the pupils' learning. What then are the areas in which the use of ICT has a significant impact and where does it have no impact?

- ICT impact is assessed by teachers to be strongest on subject-related performance.
- Learning basic skills such as reading and writing is another area where a positive impact of ICT is experienced
- ICT is seen by teachers to be a valuable tool to support differentiation. The use of ICT to support differentiation also has a positive impact; this study shows that the majority of teachers have experienced that ICT has a positive impact on both academically strong and academically weak pupils.
- Avoiding exclusion is still an issue with the use of ICT in schools. The study indicates that girls, as well as pupils with other native languages, are more dependent on learning ICT at school.
- According to pupils they generally use the computer more outside school than in school, but there are differences in what types of ICT competences they learn each place. Standard office programmes are learned in school, the rest outside school.

These key results are presented in depth in Chapter 4 'Impact of ICT on pupil performance'.

### **Impact of ICT on teaching and learning processes**

Results from *E-learning Nordic 2006* show that ICT generally has a positive impact on the teaching and learning situation. However, some people expected that ICT could in some ways revolutionise the teaching and learning processes at school, and compared with this view, the impact must be seen as more limited.

- On the average, half of the teachers had used ICT between 1 and 5 hours the week before they answered the questionnaire
- Generally, the pupils would like to use computers more in school than they do now.
- The results indicate that the pupils and teachers who use ICT the most are also the ones who experience the greatest impact.
- Use of stationary computers and internet is firmly rooted in the school, but new technologies are also getting a foothold. Digital cameras, mobile phones and chat have entered the schools. The results indicate that the use of these new technologies support teachers in differentiating their teaching.
- ICT does not revolutionise teaching methods. The teachers are mostly focused on using ICT to support the subject content.
- Pupils are far more often consumers than producers when using ICT, and they work more often individually than together.
- Still, the impact of integrating ICT in teaching can be measured in pupil engagement, differentiation, creativity and a less waste of time.
- The impact of ICT is very dependent on how it is used.
- Many headmasters view ICT as a valuable tool for pedagogical development but fewer actually experience this impact.

In Chapter 5 'Impact of ICT on the teaching and learning processes', these results are presented more thoroughly.

## **What characterises teachers who experience the greatest or the least impact of ICT on pupil performance and the teaching and learning processes?**

What characterises teachers who experience the greatest or the least impact of ICT on pupil performance and the teaching and learning processes? To answer that question, Ramboll Management carried out a cluster analysis grouping the teachers into three different clusters, each representing a level of impact from ICT:

- Teachers, who experience no impact of ICT
- Teachers, who experience a moderate impact of ICT
- Teachers, who experience a great positive impact of ICT.

The results of the cluster analysis show that the teachers who experience a *moderate impact of ICT*, are the largest group, representing almost half the teacher population. 30% of the teachers, experience a *great positive impact of ICT* and the teachers, who experience *no impact of ICT*, constitute the smallest group (23%). Hence, the great majority of teachers experience a positive impact of ICT on their pupils' performances and on the teaching situation.

See Chapter 6 for a presentation of the characteristics of the teachers in the different clusters.

## **The impact of ICT on knowledge-sharing, communication and home-school co-operation**

ICT is a very powerful tool, however the use of the tool organisationally has not yet fully matured. The preconditions for using ICT for knowledge-sharing, communication and home-school co-operation are at hand, and ICT is indeed being used for this in many schools, however the positive *impact* is as yet only moderate.

- The preconditions for using ICT for knowledge-sharing, communication and home-school co-operation are in place. The technical ICT infrastructure (such as computers and internet) and the organisational ICT tools (such as home pages and intranets) are available in schools and among teachers, pupils and parents.
- Many schools, teachers, pupils and parents use the ICT infrastructure for informational and collaborative purposes. But the results show that the tools are mostly used for communication among teachers, while the use of ICT to support dialogue between teachers and pupils, and to improve home-school co-operation is more limited.

- In spite of high volume of ICT-based communication within the teaching staff, the positive impact on co-operation and knowledge-sharing is assessed only to be moderate.
- About 50% of the parents use ICT in their communication with their children's school. Generally these parents assess that the communication with the teachers/school to a large degree has become easier. However, the parents report that they only to a moderate degree feel better informed or find that this dialogue has improved.
- At home, the pupils use ICT as a collaborative tool; they use e-mail, chat and mobile phones to communicate with classmates, giving and receiving help when doing their homework.
- Finally it must be noted as positive that despite the wide use of ICT to support home-school collaboration, the majority of teachers and headmasters do not at all or only to lesser degree perceive that the home-school collaboration has become more time-consuming.

A more in-depth presentation of the results of the impact of ICT on knowledge-sharing, communication and home-school co-operation can be found in Chapter 7.

### **Conditions for the use of ICT in schools**

Conditions at the individual schools are an important factor that influences the actual use and impact of ICT. However, many of the results about what makes an impact are based on old data. The *E-learning Nordic 2006* study shows a very interesting development in terms of the kinds of conditions that have an impact on the use of ICT.

- *Does the ICT infrastructure have an impact on the use of ICT?* Yes it does, according to *E-learning Nordic 2006*.
- *Do written objectives for ICT ensure the integration of ICT?* For many years, much work has been put into the development of ICT strategies and the majority of schools also have written ICT strategies. However, this study shows that no special impact can be seen in schools with written objectives for ICT compared to the ones without.
- *What impact does teachers' participation in competence development have?* Many resources has been put into developing the teachers' ICT competences, however, the study show that even though two out of three teachers have participated in competence development regarding ICT within the last three years, only one in three of these teachers feel ICT-confident, and no special impact on the use of ICT can be registered.

- *Is ICT used more in schools that have participated in an ICT project?* In many countries, ICT projects have been initiated to give teachers some hands-on experience with the use of ICT and inspire others to use it. However, comparing schools that have participated in ICT projects with those that have not, there is no difference between how the teachers and pupils use or experience the impact of ICT.
- *What are drivers and barriers for achieving a greater impact of ICT?* This study shows that there is still a great focus on access to the technology and competence development as both the drivers and barriers for the integration of ICT.

In Chapter 8, the conditions for effective ICT use in schools are presented.

## 2. Strategic challenges

*E-learning Nordic 2006* is the first inter-Nordic study specifically focusing on the impact of ICT on key areas in schools in the Nordic region – and the results are positive. Results from *E-learning Nordic 2006* show that ICT is a strong tool to support pupil performance, learning and the communication between pupils, teachers, headmasters and parents.

However, the results from the study also indicate that the use and impact of ICT is often still random, and that the full potential of ICT as a tool to support better schools has not yet been realised. This could be easily understood if ICT were a new phenomenon in Nordic schools, and that we just had to wait for the impact to show. But this is not the case. The use of ICT in education has been a major focus in the last 10-20 years – both at political and school levels.

According to Ramboll Management, *E-learning Nordic 2006* reveals that the Nordic school system faces some very crucial and strategic challenges if the full impact of ICT is to be achieved. In this section Ramboll Management will present the five most important strategic challenges that we envision for the Nordic school system in the coming years. The analysis behind these strategic challenges and the recommendations presented are solely the opinion of Ramboll Management.

### **Optimal use of ICT requires organisational implementation**

*If the potential impact of ICT in Nordic schools is to be further realised, school owners and management need to be more professional in their organisational implementation of ICT. Substantial investments in ICT have been made at both regional and local level, but often with no clear criteria for success and no structured monitoring of the benefits. At many schools, the situation can be compared to buying 10 new laptops and not un-wrapping them.*

For example, during the last few years a number of schools have invested in Learning Management Systems (LMS) with the ambition of improving education and knowledge-sharing. However, often the investments have not been accompanied by use of the new systems. Though benefits from the implementation of, for example, an LMS cannot be expected from day-one – implementation may take several years – there should still be a clear and continu-

ous focus on harvesting the benefits. It is Ramboll Management's assessment that such a focus is often lacking.

The same goes for the ability of many schools to benefit from the ICT projects in which teachers and pupils participate. The study shows that even though many schools have participated in ICT projects, these projects have not had an impact on the general use of ICT at the schools (see Chapter 8). Disseminating and anchoring the best experiences from the projects into daily routines is not ensured.

Return on investment from ICT investments and ICT projects require a commitment to organisational implementation on the part of the school management. They must be visionary enough to initiate and continuously support the use of ICT as a strategic tool for developing the general ambitions of the school.

This is so obvious, but still so hard to do in real life: Successful organisational implementation of ICT is the most important prerequisite for maximum impact of ICT in schools. Most headmasters know this, but they do not have the competences for doing so<sup>1</sup>.

For many years the ICT implementation at school level has been driven by a few committed enthusiasts among teachers, and many Nordic schools can be stated to be on a low maturity level, where ICT is not strategic but something that enthusiasts and the ICT department takes care of. This often results in arbitrary use of ICT at school where ICT is not seen as a part of the general strategy at school level. The study shows that many schools have indeed developed an ICT strategy (see Chapter 8), but Ramboll Management assesses that in many cases the strategies were developed years ago, they are not linked with other strategies at school and are not widely known among teachers or pupils. Instead ICT needs to be integrated into the schools' overall strategies and used to support school goals. In this way ICT has the greatest potential to act as a catalyst for change.

Ramboll Management believes that the responsibility of successful organisational implementation of ICT is in the hands of school management. The management cannot outsource the strategic goals of ICT to a deputy director or some committed enthusiasts among teachers. The successful school managers have understood that ICT implementation needs to be embedded in the core strategic development of the school and that it often contains a great deal of change management, because the school has to adapt pro-

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<sup>1</sup> Here it must be noted that schools are not the only ones facing this challenge. Many public and private organisations also have the same problems when implementing new technology, and many of them are just as poor at implementing ICT.



cedures in organisation and administration, co-operation and teaching principles, if the school is to benefit fully from ICT investments. Furthermore the consequences of unsuccessful ICT implementation can be very costly and time consuming. Therefore active leadership regarding ICT must be a core competence in school management.

The average school manager in the Nordic countries is not sufficiently competent when it comes to leadership of ICT. There is a need for competence development, ranging from understanding ICT per se, to understanding the pedagogical possibilities in ICT, to understanding how to link ICT implementation to change management. Ramboll Management believes that national initiatives on leadership within this field will create substantial return on investment.

### **Competence development must be followed up by clear objectives and activity plans**

*The Nordic countries have in general had a strong focus on competence development for teachers regarding the use of ICT for teaching and learning purposes. However, the results from the study show that the impact of these investments is random.*

*Results from this and other studies show that the poor results can be improved by a more strategic and systematic approach to ICT at more levels; Mandatory inclusion of ICT in all subjects, follow-up on the use of ICT at school level and more focus upon the integration of ICT for teaching and learning purposes in initial teacher training.*

The results from this study show that the respondents assess that ICT has a positive impact on pupil performance and the study indicate that the more ICT is used, the greater the impact (see Chapter 4). The study also indicates that schools where management systematically follows up on the use of ICT are the schools where the greatest impact is experienced (see Chapter 5).

The study shows that even though two out of three teachers have participated in competence development regarding ICT within the last three years, only about one in three teachers in this study assess that they have the necessary competence to integrate ICT in their teaching (see Chapter 8). Not only does their lack of competence influence their ability and willingness to use ICT for teaching and learning purposes, also teachers' ability to see the relevance of doing so influences their use (see Chapter 5). Only about 40% of teachers find it highly relevant to use ICT to support the academic content in their teaching. And even fewer to support their

pedagogical and didactical methods. Why is this so, if so many have participated in training aimed at integrating ICT?

As most teachers have computers and internet access in their homes (see Chapter 7) and have participated in some forms of competence development, one should believe that they have developed basic skills for integrating ICT. Maybe the competence development has not provided teachers with more than basic skills; maybe the connection between teachers' basic ICT competences and pedagogical methods and advantages is still a missing link.

Ramboll Management believes that the time has come where focus should be put on how ICT can best support the pedagogical and content-related objectives set out at national, regional and school level. Ramboll Management recommends that policy makers and school managers focus on:

- Formulating clear objectives for the use of ICT for teaching and learning purposes in all subjects
- Formulating specific plans for follow-up on the objectives
- Provision of examples that enhance pupil performance for all subjects and well-documented results of specific pedagogical methods, specifically related to curriculum
- Mandatory integration of ICT in all subjects in initial teacher training with the same clear objectives and plans for follow-up.

### **ICT has positive impact on basic reading and writing skills, but potential is not fully exploited**

*The study shows that ICT is a valuable tool for improving basic skills such as reading, writing and calculation. Furthermore ICT provides teachers with the possibility of differentiating their teaching because pupils can work at their own pace, in accordance with their preferred learning styles and with different subjects when at the same time teachers can provide each of them with personal support and feedback. However, this potential could be used better.*

*The impact of using ICT on the individual pupil's performance could be enhanced but a prerequisite for doing so is thorough documentation on which methods work the best.*

It is important to all Nordic countries that pupils in primary as well as secondary schools perform better, that they are educated beyond primary education and that the drop-out rate from secondary education is reduced. ICT is a strong tool when it comes to moti-

vating pupils to learn, to giving them confidence in their own capabilities and to enhancing their learning.

This study shows that ICT is assessed to have a positive impact on pupil performance in basic skills such as writing, reading and calculation skills, especially in the 5th and 8th grades (see Chapter 4). The impact can be seen among both the academically weak and the academically strong pupils while at the same time teachers assess that the use of ICT does not increase the differences between these groups. Furthermore the study indicate that ICT improves pupils' skills the more ICT is used, the more different types of ICT that are used and the more varied pedagogical methods that are used (see Chapter 5).

This study underlines the importance of making the use of ICT more widespread and making more teachers aware of the benefits for the individual pupil. Ramboll Management recommends that policy makers and school managers focus on:

- Documenting the types of ICT use that enhance pupils' learning
- Providing good examples of ICT use that are related to objectives in curricula
- Supporting the development of good digital learning resources, to make it possible to differentiate and organise collaborative work.

### **Schools and teachers do not respond clearly enough to pupils' and parents' wishes for stronger integration of ICT in teaching and learning**

*The vast majority of parents and pupils respond very clearly: It is important that the schools and the teachers actively integrate ICT in teaching and learning practices and in general in the daily life of the school, including the school's co-operation with the pupils' homes. School management and teachers, however, demonstrate a more hesitant and less focused approach to the use of ICT.*

The study shows that 96% of the parents participating in *E-learning Nordic 2006* have made it clear that they find the use of ICT in the schools' teaching very important (see Chapter 4). The pupils too make no secret of the fact that they would like to use ICT more in their learning activities. Still – and in spite of large and ambitious competence development initiatives – as many as one in three teachers feel restrained by their own perceived lack of competences from using ICT more in their teaching and in their pedagogical design of school work and learning activities (see Chapter 8).

Home-school co-operation is one area where ICT can deliver immediate and tangible benefits to all stakeholders: parents, pupils, teachers, school management and municipal school administrations. However, Ramboll Management experiences that many schools and municipalities seem to be unaware of the potentials, and except for a few outstanding best practice examples, the impact of ICT on home-school co-operation is limited in the four Nordic countries. *E-learning Nordic 2006* shows that both parents and school managers feel that ICT still not has delivered on its potential (see Chapter 7). There is only limited impact on areas such as:

- Parents' information level about school activities
- Parents' involvement in their children's schoolwork
- Parents' ongoing dialogue with the school and their children's teachers.

Ramboll Management assesses that school managers and municipal school authorities need operational guidelines on how to use ICT to strengthen home-school dialogue. Such a dialogue will also help schools to be able to respond more actively to the parents' wishes for a more integrated, pedagogical approach to ICT.

Ramboll Management recommends that to address these challenges, the following measures should be considered:

- Promote the use of ICT for home-school co-operation to school managers and municipal school authorities through best-practice examples
- Identify users' needs for co-operation tools: What do parents need, what do pupils need, what does school management need?
- Set up operational (editorial and functional) guidelines for the school's use of ICT vis-à-vis the parents
- Identify factors which must be addressed in order to ensure that ICT will not marginalise socially and/or educationally disadvantaged groups of parents
- Teachers and school managers urgently need to develop a more pedagogically open and pro-active attitude to the use of ICT and to enter into a dialogue with the parents and the pupils about their expectations and their ideas.

## Gap between generations on “digital competences” – Need for shared understanding

*At many schools, while the pupils think they have great ICT skills, the teachers hold an opposite point of view. Hence, there are different opinions of what constitutes ICT competences, or “digital competence”. The different opinions can be considered as a gap between generations. This highlights the importance of a common concept of digital competence. If no common understanding of digital competence is developed among management, teachers and pupils, there is both a risk for diminishing the use of ICT at school level and an increased social divide. In order for both teachers and pupils to know what to aim for in terms of optimal use of ICT in education, a shared definition and measurement framework needs to be developed.*

If you ask pupils and teachers what it means to be able to read and write, you will probably get quite uniform answers – formulated however with different words. But if you ask them what it means to be digitally competent, you will get totally different answers from teachers on the one hand and pupils on the other.

The study shows that there is a great gap between how ICT is used in schools and outside school, where pupils experience that they learn the most about ICT outside school (see Chapter 4). This gap can also be seen as a gap between generations. The pupils have competences learned outside school that are not acknowledged and not qualified in school. This can be illustrated by a Norwegian 13-year old pupil who submitted an assignment on e-mail. The assignment was in perfect Norwegian, but the short message in the e-mail to the teacher was in “SMS-language” with a lot of abbreviations. The pupils are becoming bilingual, but their digital language is not acknowledged inside the school.

The digital worlds of teachers and pupils are two separate worlds. Very few teachers know what is going on in the digital world of a 13-year-old pupil: chatrooms, participating in game clans on the internet buying virtual swords with real money, blogging and constant use of the mobile phone. On the other hand, the teachers are frustrated by the lack of source criticism among the pupils when it comes to the use of for instance the internet in the schools. The teachers believe that the pupils are the “copy-paste-generation”, who copy information on the internet and turn it in their teachers, as if it was their own work without any critical editing.

This constitutes a severe challenge, because digital competence in Nordic countries is viewed as a basic cultural competence on the same level as reading and writing. There are many different ICT competences, where some are relevant in school, while others are

not. Downloading illegal music from the internet is a competence that should not be learned in school, while an understanding of blogging as a genre probably should.

Digital competences are much more than just using the technology, but to really understand what it means, there is a need for a dialogue between teachers and pupils. Ramboll Management recommends a 'Digital-Competence-Dialogue-Day' in all schools and a focus on integrating the pupils' digital world into the ongoing ministerial work on defining digital competences. There is also a need for clear indicators for measuring digital competence in order to get an accurate picture of the actual digital competences among pupils. Ramboll Management assess that this is a great challenge that has to be met, if ICT is to have further impact in the Nordic schools.

Otherwise the gap between generations in the digital area will lead to that the potential positive impact of ICT will not be exploited. Furthermore there is a risk that this will lead to an accelerated social divide, where some pupils become digitally bilingual and use ICT in many different ways at school and at home – while others cannot. The results indicate that different groups of pupils – girls and pupils with other native languages – are more dependent on learning to use ICT in school and this need is not being met satisfactorily (see Chapter 4).

As inspiration, some of this is already under way in Norway. The Norwegian National Curriculum is under revision and in the new curriculum that takes effect from the school year 2006-2007, ICT is one of five basic skills that are to be embedded in all subject matters at all levels.

### 3. What do we mean by 'impact'?

With the focus on the impact of ICT in the Nordic countries, *E-learning Nordic 2006* is a unique study. However, defining and analysing impact is no simple matter. In this chapter we present Ramboll Management's considerations about 'impact' and the methods we have used to measure it.

#### What do we mean by 'impact'?

The main focus of *E-learning Nordic 2006* is to measure the impact of ICT on pupils' learning. To understand the complexity involved in measuring this impact, it is necessary to briefly address the concepts used by Ramboll Management<sup>2</sup>.

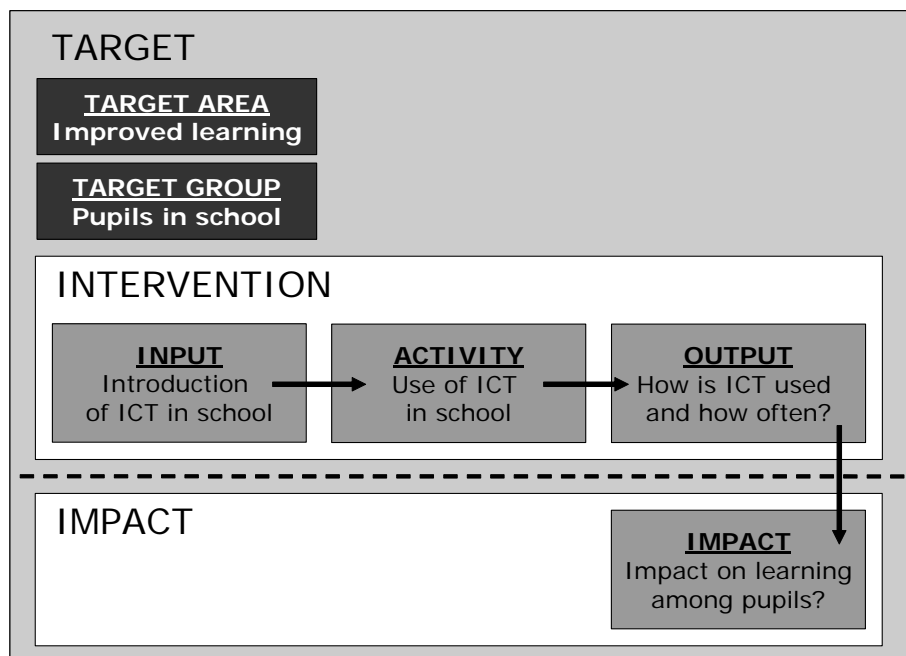


Figure 1: Model of the relationship between target, intervention and impact

The use of ICT in schools can be understood as a deliberate intervention, or intended change, in the way in which teaching and learning take place. When measuring the impact of this intervention on pupils' learning, we thus assume that there is a causal relationship between the use of ICT in schools and pupils' learning. However, it is not our hypothesis that ICT only has a positive impact on learning among pupils. In the study focus has been on

Causal relationship between the use of ICT and pupils' learning

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<sup>2</sup> It must be noted that the terminology used for impact analysis varies. With this Ramboll Management defines the terms used in this study.

showing *to what degree an impact is experienced* (does ICT have a negative, a positive or no impact on the pupils learning?)

By this we do not see a mechanistic relationship between the use of ICT and the impact on pupils' learning. It is not inevitable that the use of ICT will lead to the shown results under all circumstances; however it is our hypothesis that the use of ICT in schools under certain circumstances has an impact on learning among pupils. Therefore we have in the study placed special focus on analysing *what kind of activity and output* leads to the experienced impact.

Target for the use of ICT      When analysing and assessing impact of an intervention, it is necessary to relate this to the overall objective of the intervention. In the Nordic countries, the objective for using ICT in schools is to improve learning among pupils – for example, to ensure deeper learning or better differentiation of the teaching supporting the needs of the individual pupils.

The objective for the use of ICT in school is *not* to replace other media such as textbooks with ICT. This being the point of departure for *E-learning Nordic 2006*, the analysis will not compare the impact of ICT with the impact of other types of media, but instead focus directly on whether ICT has an impact on improving pupils' learning.

ICT has been introduced into schools during the last 10-20 years and it has now become compulsory in many countries to use ICT in teaching. Many studies have subsequently analysed how and how often ICT is used in schools, concentrating on mapping the extent of activities and output regarding the use of ICT. However, hardly anyone has taken the analysis to the next level: *what is the impact of ICT?*

Difference between output and impact      An important element in an analysis of impact is to distinguish between '*output*' and '*impact*'. *Output* refers to the direct product of the activities carried out, such as number of computers purchased, number of lessons using ICT, etc. *Impact* refers to the changes which the activities bring about, e.g. in terms of learning results. We present this definition to emphasise that the study does not focus on the number of hours in which ICT is used in schools (output). Instead the study reveals what that use of ICT leads to in terms of improved learning (impact).

The study does however not merely focus on positive impacts. It also examines any negative impacts that the use of ICT might cause, such as the point highlighted by public debate in for example Denmark that home-school collaboration is becoming more time-consuming due to the use of ICT.



## Challenges in measuring impact

Measuring the impact of ICT in schools is a challenge. As there are many interrelated factors that can affect pupils' learning, isolating the impact of just one factor, such as ICT, therefore requires a well-analysed method.

Different methods can be used to measure impact; however they all have their advantages and disadvantages. One method is to conduct randomised tests where one group of pupils uses ICT while another does not (a control group), and then subsequently measure the impact on learning of these groups. This method is rarely used in the educational sector due to ethical reasons. It can for example be noted that it would not be legal in many countries, as the use of ICT is a compulsory part of the curriculum.

Randomised tests with control groups

Another method focuses on measuring the impact directly, e.g. on the grades. Here the grade scores are compared with how much ICT is used, and how ICT is used in teaching. This has for example been accomplished as part of the large British research project *ImpaCT2*. However, this method does not in itself solve the problem of isolating ICT from other factors which might influence grades.

Measuring impact on grades

Finally, a third method is based on asking relevant respondent groups to assess the impact of ICT themselves. In this way, involved participants are asked about how they themselves experience the impact of ICT. This is a method that offers room for assessing the impact of ICT on a background of the complex daily situations in school. The disadvantage with this method is that the respondents may not have considered the impact of ICT, even though they have used it.

Assessment of impact

Ramboll Management used the third model in *E-learning Nordic 2006*.

### How is impact measured in *E-learning Nordic 2006*?

The methodology chosen by Ramboll Management is to ask various key participants in schools about their own experience using ICT, and how they perceive the impact of ICT on pupils' learning.

By asking different response groups, our intention has been to get diversified views and perspectives on the impact, thereby ensuring that conclusions are based on a valid background. The groups are:

- **PUPILS IN THE 5<sup>TH</sup>, 8<sup>TH</sup> AND 11<sup>TH</sup> GRADES:** Pupils are the target group for the intervention and therefore a key response group. Do the pupils themselves think that ICT has made an impact on their learning and their behaviour in the teaching and learning situation? Pupils, however, are a response group that is rarely asked directly, as their level of reflection on didactic issues may be limited. Furthermore it is very difficult to make self-assessments. These limitations must of course be taken into consideration when analysing and reading the results. However their answers still provide interesting information about the impact of ICT from the pupils' points of view. In the study, pupils in the 5<sup>th</sup>, 8<sup>th</sup> and 11<sup>th</sup> grades participated.
- **TEACHERS:** Teachers are, together with the pupils, a key respondent group. They are the ones who are actually together with the pupils in the classroom, who know how ICT is used and who thereby directly experience the impact of ICT. Teachers are thus at the front line, with their daily experiences from the teaching situation. Based on the national curriculum, teachers set the learning targets to be achieved by the different learning activities, carry them out and can evaluate whether the targets were achieved and whether the means applied were appropriate. We have questioned the teachers to the pupils who participated in the study.
- **HEADMASTERS:** Headmasters are another response group in the study. It was important to involve headmasters as they are responsible for setting the strategies for their individual schools and for determining the means to be used for meeting these goals. The headmasters also know to what degree they see ICT as a tool to achieve school objectives and – if they do – to what degree they have experienced any such impact. The headmasters are also in charge of deciding the conditions for ICT use (such as type and amount of equipment, competence development and support).
- **PARENTS:** Parents can be seen as an interest group. They 'lobby' for the best school for their children and, depending on their experiences with their child's learning and ICT use at school, they can put pressure on the school management and on the municipality at election time. As respondents they must however be handled with special care. Parents are seldom present in the classroom, and thus they do not have firsthand knowledge about what goes on at school. Their experiences are based on their dialogue with their children and their engagement with the school.

With this methodology, we do not claim to prove a direct link between the use of ICT and learning results. However, by asking those who experience the impact of ICT, we actually show how they *assess it*. This is the *perceived impact* of the headmasters, teachers, pupils and the pupils' parents. It may not be actual impact, but rather their own views about the consequences of using ICT in schools.

Perceived impact of ICT

In this report, we state in general statements at various places that '*an impact can be seen on [for example] the teaching and learning situation according to the teachers*' or '*no impact can be seen*'. Such statements will be based on an analysis of several questions regarding the impact of ICT on pupil performance or the multiple questions regarding the impact on the teaching and learning situation. Examining the responses we state whether a general impact can be observed. In the same way we have included specific analysis' of questions regarding the actual use of ICT among teachers and pupils, looking at whether certain responses characterise respondents with a greater or lesser use of ICT.

Statements such as '...an impact can be seen' based on a special analyses

Finally it must be noted that this report presents a status of the situation in autumn 2005. The situation changes continually in accordance with the use of ICT in schools as well as through the public discourse regarding ICT.

Status 2005

At the time of writing, Ramboll Management does not have data to show how the impact of ICT on pupils' learning has developed. No baseline exists which can be used to compare the results of this study in order to track such a development. However, *E-learning Nordic 2006* may provide a baseline for further studies, making interesting future comparisons possible.

## 4. Impact of ICT on pupil performance



Great potential to differentiate learning and thereby enhance learning

Many Nordic schools work with differentiation in general, for example using Dunn's different learning styles or Howard Gardner's many intelligences as a point of departure. Some children learn better by listening, other by viewing pictures and processes or by reading. These theories acknowledge that pupils learn in different ways and recommend that different learning styles be supported.

ICT has the potential to reinforce these theories in practice as ICT in itself offers the possibility to communicate content in many different ways and to challenge pupils at different levels. By planning and carrying out teaching where pupils work individually or together using ICT, the teacher is given a great tool to differentiate the learning processes for all pupils in ways that meet their special learning styles and needs.

ICT has impact on pupil performance

The results of this study show that pupils, teachers and parents assess that the use of ICT has a positive impact on the school's overall target – improving the pupil's learning. For instance, the results show that ICT has a positive impact on basic skills such as reading and writing as well as basic calculation skills. The study furthermore indicate that the assessed impact is slightly higher for boys than for girls.

Focus has often been primarily in relation to enhancing and supporting the academically weak pupils' learning processes, but ICT can also be used as a valuable tool to challenge stronger pupils as well. This study shows that ICT is an important tool for differenti-

ating pupils' learning processes, both for academically strong and weak pupils and thereby improving their individual learning.

In the *E-learning Nordic 2006* study, no comparison has been made between the level of ICT integration and pupils' grades or the schools' average grades. The results build solely upon the experienced impact seen from the points of view of pupils, parents, teachers. However other studies that have made such comparisons show the same results<sup>3</sup>. The UK study *ImpaCT2* (2002) shows that there were a statistically significant positive relationship between relative gain scores and level of ICT use. And the more recent OECD study *Are pupils ready for a technology-rich world? (2006)* shows that the longer pupils have used computers the better they perform (up to a certain point). For instance pupils who have used computers for less than one year score well below the OECD average while pupils who have used computers for more than five years score well above the OECD average.

### **Positive impact of ICT on pupil performance, according to teachers, pupils and parents**

Does ICT improve pupil performances or do pupils perform more poorly when ICT is used because – for instance – too much time is wasted by teachers on practical matters concerning the use of ICT or because pupils surf the internet or chat too much?

This is one of the central questions in this study. The answer is that ICT in general supports learning; teachers, pupils and parents all report that they experience that ICT has a positive impact on pupil performance.

When teachers are asked to assess to what extent the use of ICT in their own teaching has influenced their pupils' performances, the tendency is positive. Approximately two out of three teachers in Sweden, Norway and Denmark report that their pupils in general perform better, and only a very few (1-3%) report that ICT has worsened pupil performance.

Two in three teachers have experienced positive impact of ICT

Only the Finnish teachers' experiences are less positive. In Finland, only one in three teachers find that the use of ICT has had a positive impact on the performance of the pupils in general, and many more than in the other three countries think that ICT does not have an impact.

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<sup>3</sup> It must be noted that there are also studies that show that ICT has no impact or a negative impact.

Parents and pupils assess that pupils learn more with ICT

Also parents and pupils in general experience a positive impact of ICT on learning. Almost all parents (96%) agree that it is important that ICT be used for teaching purposes and approximately two out of three report that their child learns more when ICT is used.

The pupils themselves are a bit more critical than the adults. In Finland, Sweden and Denmark, there are two large and equal-sized groups of which one assesses that they learn more when they use ICT, while the other assesses that ICT has no impact on their learning (i.e. they assess that they learn neither more nor less with ICT). However, in Norway, the pupils experience a more positive impact on their learning. In Norway, the majority experience that they learn more when using ICT.

**How do teachers, parents and pupils assess the impact of ICT on pupil performance?**

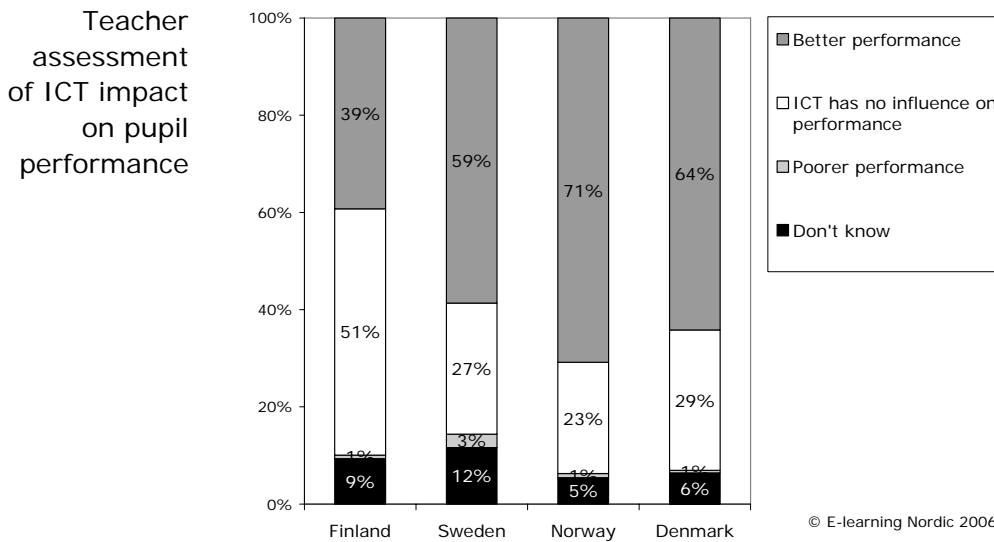
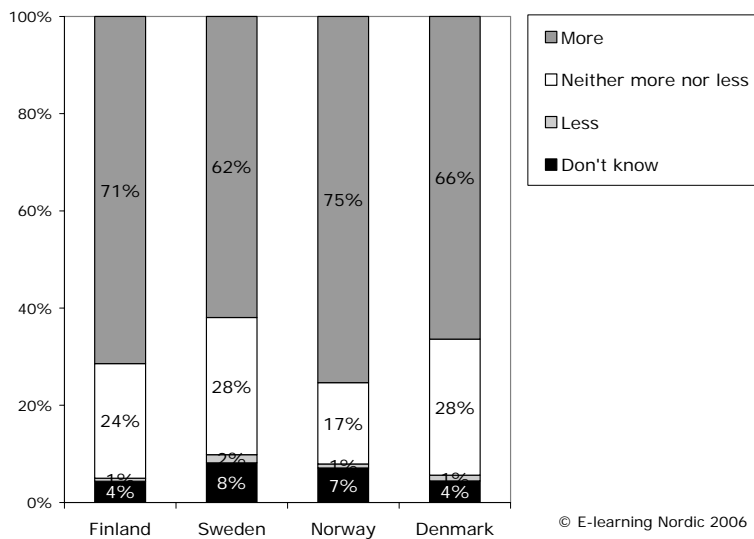
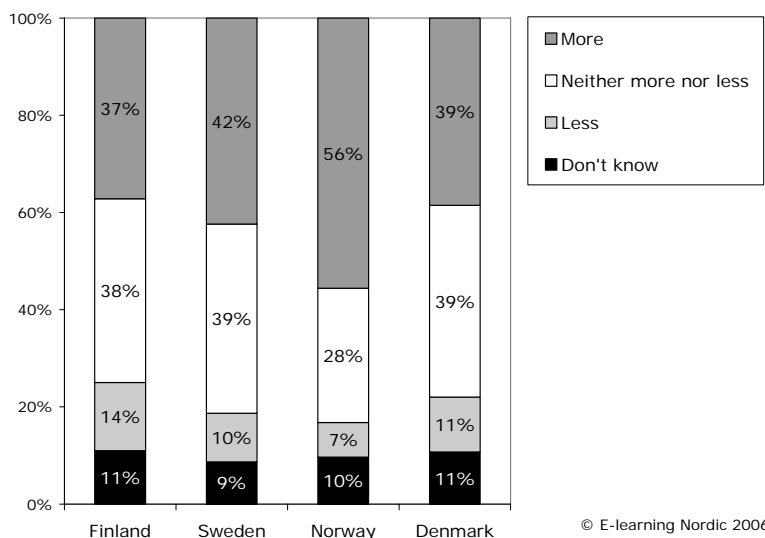


Figure 2: Question 11.1 to teachers: 'To what extent would you estimate that the use of ICT in your own teaching actually has influenced pupil performance?' Pupils in general (N=1165)



Parent assessment of ICT impact on their own child's learning

Figure 3: Question 3.1 to parents: 'How much do you think that your child is influenced by the use of ICT in the school? My child is learning less or more in school' (N=1777)



Pupil assessment of ICT impact on their own learning

Figure 4: Question 5.1 to pupils: 'How do you assess the use of computers in school? Do you think you learn more or less when you use computers in school?' (N=4999)

## Reading and writing skills improve with the use of ICT

Are there any special areas in which the use of ICT specifically has a positive impact? To find out, we asked the teachers in the survey to imagine a teaching situation where ICT was used and another equivalent teaching situation without ICT. They were then asked to compare the two situations and to assess to what extent ICT use had an impact. The answers show that there are two areas in

which teachers feel that ICT has a positive impact: Pupils' subject-related performance and their basic skills<sup>4</sup>.

Strongest impact on the subject-related performance

A positive impact is strongest on the pupils' subject-related performance where three in four teachers experience a positive impact from a moderate to a high extent. The results also show that the majority of teachers find it most relevant to use ICT to support the subject-related content of their teaching.

Also positive impact on basic reading and writing skills

The learning of basic skills such as reading and writing is another area where a positive impact can be observed. The study shows that teachers assess that there is a positive impact on basic reading and writing skills. Writing skills display the most significant results as 60% of the teachers reported that they experience a moderate or high degree of positive impact.

The impact of ICT on the basic calculation skills is more limited in Sweden, Norway, and Denmark. But in Finland teachers actually see a greater impact from use of ICT for basic calculation skills than for basic reading skills.

Primary schools place the strongest focus on developing pupils' basic skills. Thus it is mainly primary school teachers who, to a large extent, experience a positive impact on the learning of basic skills through use of ICT.

### What impact does ICT have on basic skills?

Impact in Finland

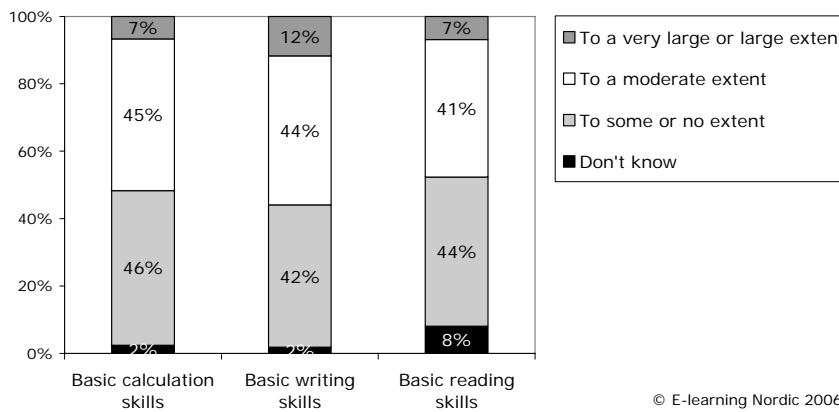
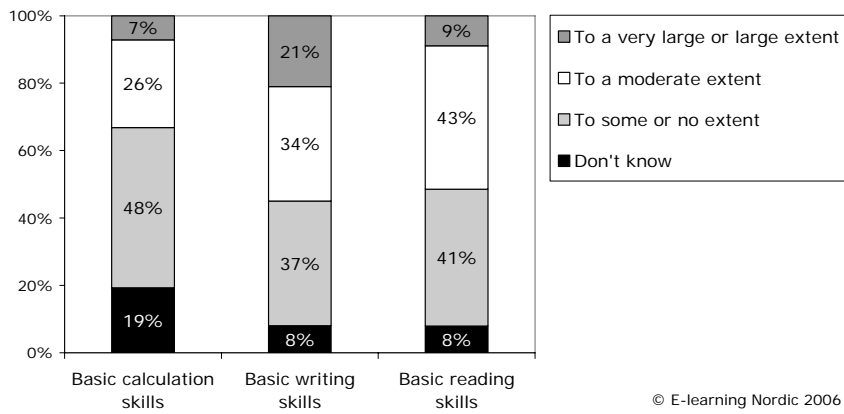


Figure 5: Question 10.1 to 10.3 to teachers: 'Imagine a teaching situation where ICT is used and another equivalent teaching situation without ICT. To what extent do you estimate that the use of ICT actually has contributed to ...' (N=252/281/269)

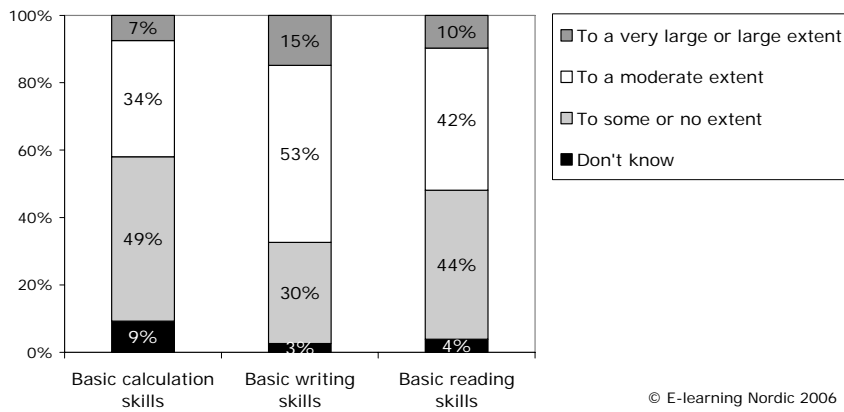
<sup>4</sup> The respondents who have answered 'Not relevant in regard to my teaching' have been removed from the sample. These include e.g. language teachers not answering questions on the impact of ICT on the pupils' calculation skills.





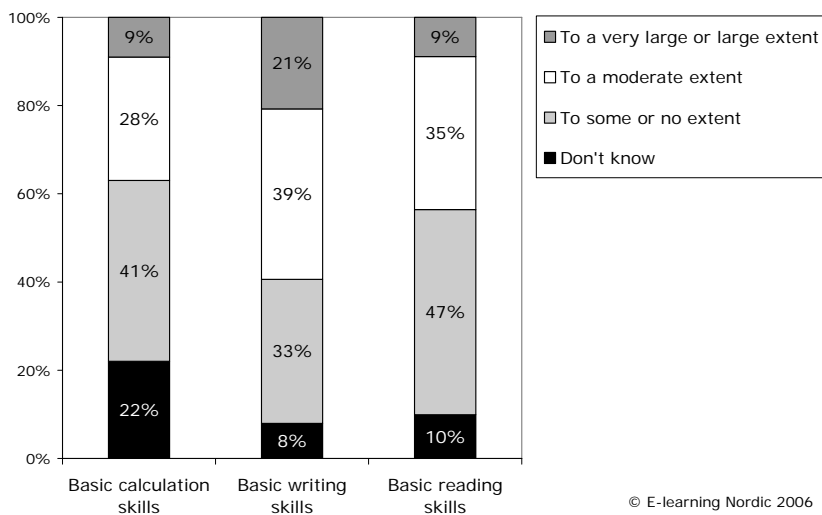
### Impact in Sweden

Figure 6: Ibid. (N=259/286/285)



### Impact in Norway

Figure 7: Ibid. (N=271/297/287)



### Impact in Denmark

Figure 8: Ibid. (N=282/289/251)

### Improved writing skills using ICT

The parent of a child at Langmarkskolen (a primary school in Denmark) reports that her child writes longer and more varied essays when using the computer, as the child dares to use more words when supported by the spell checker.

Teachers with positive assessment of impact ...

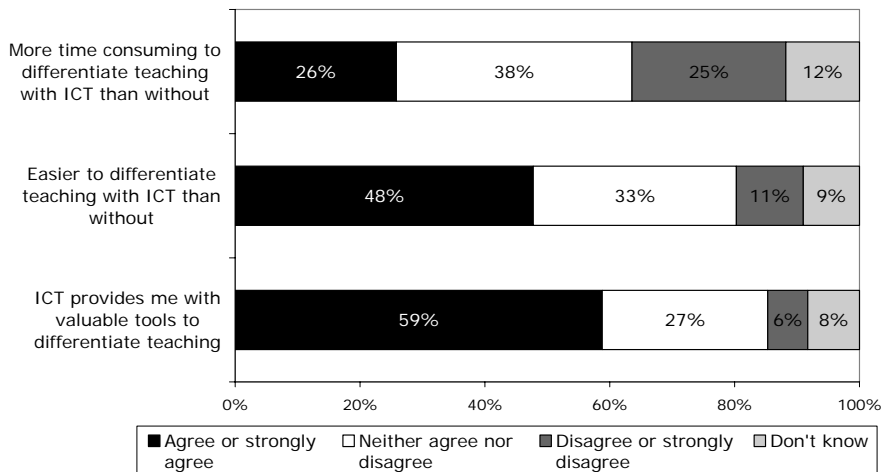
There are differences between the teachers who assess that the use of ICT to a large extent improves the basic skills of their pupils and those who do not. Teachers who experience a higher impact tend to have carried out various learning sequences using ICT in the previous school year (2004-2005), more often than teachers in general. Especially sequences where the pupils have learned to use different standard programmes such as word processing or calculation programmes.

### ICT is a valuable tool to support differentiation

ICT has the potential to support differentiation, e.g. challenging the academically strong pupils in new ways or supporting the academically weak pupils so that they can more easily participate on equal terms with other pupils.

The majority of teachers find that ICT to a large degree provides them with a valuable tool to differentiate their teaching, and indeed many find that it is easier to differentiate their teaching with ICT than without. Only a minority find that it is more time-consuming to differentiate teaching with the use of ICT than without.

Teacher assessment of ICT as a tool to support differentiation



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Figure 9: Question 13 to teachers: 'How much do you agree with the following statement about the impact ICT has on supporting differentiated teaching, ensuring that teaching is adjusted to the needs of the individual pupil?' (N= 1258)

The positive assessment of ICT as a tool to support differentiation is greatest in primary school. It is also in primary school that most teachers have experienced a favourable impact on the academically strong and academically weak pupils when using ICT.

### **Variation supports better understanding**

According to pupils and teachers at Greve Gymnasium (a secondary school in Denmark), ICT supports a more varied learning situation. The teachers experience that the easy integration of pictures, illustrations and simulations in e.g. PowerPoints makes it possible to present a topic in many different ways, which again promotes better understanding. Also the internet makes possible the presentation of a theme in a more varied way.

A pupil who had problems understanding a particularly difficult theme in biology chose to surf the internet where he found material that explained the subject. By using more media – pictures, illustrations, simulations – he was finally able to achieve a strong understanding of the theme. He did not believe he would have understood it without.

The use of ICT to ensure differentiation has an impact. Teachers have been asked to assess to what extent the use of ICT in their own teaching has influenced the performance of the academically strong and the academically weak pupils. The results show that more than 60% of the teachers find that there is a positive impact on both groups and hardly any (1-3%) find that there is a negative impact on the two groups. Neither do the teachers assess that the differences between the academically strong and weak pupils are being increased with the use of ICT.

ICT supports both academically strong and weak pupils

Still, more teachers have experienced a positive impact among the academically strong pupils than among the academically weak. When the teachers are asked to compare a teaching situation where ICT was used and another equivalent teaching situation without ICT, a greater number of teachers assess that the use of ICT in their own teaching has had a positive impact on the performance of the academically strong pupils. A smaller number of teachers find that ICT has supported the academically weak pupils.

More teachers experience improved performance among the academically strong pupils

### **Pupils with special needs**

At Oslo Montessori Skole (a primary school in Norway) it is assessed that ICT specifically has an impact on pupils with special needs in the area of writing and reading. It is the school's experience that ICT has been a valuable tool to support the concentration and motivation among this group of pupils.

Furthermore ICT is used in particular in process writing, where the teacher sits next to the pupil who is working on the computer. In this way the teacher gathers knowledge about the specific challenges for the individual pupil.

The more teachers use and value ICT as a tool for differentiation, the more they see an impact

Teachers who use ICT more than the average and who state that they see ICT as a valuable tool to differentiate their teaching are the ones who most often experience improvement in the performances of the academically strong and academically weak pupils through the use of ICT.

### **ICT used for individualisation and differentiation**

For the pupils at Mörbyskolan (a primary school in Sweden) the computer/internet is perceived as a "one-stop-shop" for learning and working. Pupils find that the main added value with ICT is that they can manage their own learning to a much greater degree. For example, pupils say that they like being able to use the internet to find an answer by themselves, instead of always having to ask their teachers.

From the point of view of the teachers' at Mörbyskolan, the computer is not seen as replacing the teacher, but supporting the pupils in new ways to be able, to a larger extent, to work in their own way.

### **Less positive impact of ICT on girls than on boys**

Even though *E-learning Nordic 2006* shows that there are no differences between how much boys and girls use ICT in school and no differences between boys and girls when it comes to using ICT to do homework<sup>5</sup>, there are differences in the experienced impact.

More teachers observe that the use of ICT in their teaching has improved the scholastic performance of boys more than that of

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<sup>5</sup> The Norwegian study 'ITU Monitor 2003' also show that boys and girls spend the same time using computers in schools and using computers when doing homework. The 2005 study shows the same patterns for grades 7 and 9. In grade 12, boys spend more time with a PC than girls do.

girls. The greatest difference between the impact on boys and girls is seen in Norway and Finland.

And when asking the boys and girls themselves, there are also more boys than girls who feel that they learn more when ICT is used and who would prefer to work more with ICT. This result is also documented in a study by Hayward et al (2003) which showed that boys more often than girls find that the use of ICT helps them get better results.

Based alone on the results from this study, it is not possible to conclude why this is the case. But as argued by Dunn (Dunn, 2003 and 2004) and often discussed in the media the two genders may have different learning styles. The way ordinary or traditional teaching is organised suits girls' better as girls are often better able to sit still and listen to a teacher than boys are. Teaching and learning processes become more varied with the use of ICT, and this might be an explanation of why impact is assessed as more positive for boys.

Why are boys more positive towards ICT in school?

Another explanation could be that boys are more accustomed to and more motivated by the use of ICT. For instance many computer games are solely targeted at boys, and only a minority, such as *The Sims* have a broad appeal to girls.

### **Pupils with other native languages are more dependent on learning ICT at school**

The integration of pupils with other native languages than the national language is an area of special focus in all Nordic countries. The results from this study regarding pupils with other native languages, indicate some interesting tendencies. However, these results must be viewed only as *indications*, as the total number of respondents within this group is limited (8 – 12% of the pupils in Sweden, Norway and Denmark). No analysis is possible on the results from Finland due to the very small number of respondents in this group (2%).

In Sweden and Denmark, pupils with other native languages are less likely to have a computer at home, and in both Norway and Denmark, these pupils tend more often to learn about ICT in school than pupils in general (who learn more about ICT at home/outside school). These results indicate that pupils with other native languages are more dependent on using and learning about ICT at school.

Pupils with other native languages are more dependent on learning about ICT at school

Pupils in this group would like to use ICT more in school

This tendency is critical as these pupils also more often attend schools where ICT is used less frequently than the national average; this is indicated in the results from Sweden and Denmark. However, a greater use of ICT in these schools might show a positive impact. A number of pupils in Sweden and Denmark in this group would like to use the computer more often, and according to an assessment of the teaching situations where they had used ICT, these pupils found that they paid better attention and they helped other pupils more.

The challenges that these results indicate are not new. In Norway the school authorities have been well aware of these issues and already in the years 2000-2003 they carried out a project called 'ICT in multicultural school' to meet some of these challenges (Oslo Kommune, 2004). As part of the project, heavy investments in ICT among teachers and pupils were carried out in three multicultural and challenged schools in Oslo. The goal of the project was to minimise the social divide by smoothing out the digital divide. The results from the project were positive; the use of ICT and ICT competences had increased in the schools together with the pupils' motivation, joy of learning and the reading skills.

### **Use of computers is generally learned outside school, according to the pupils**

According to pupils they use the computer more outside school than in school, but there are also differences between the types of ICT competences they learn in school and those they learn outside school.

Standard office programmes learned in school, the rest outside school

Use of basic applications such as the standard office programmes word processing or calculation sheets are learned in school. The majority of pupils assess that they have learned most about using these programmes in school. But knowledge of the general use of computers and how to surf the internet is mainly learned outside the school setting. This corresponds with the findings of the bi-annual study ITU Monitor carried out in Norway and most recently published in 2005.

One in three teachers experiences that pupils are less critical towards the information they retrieve when they find it on the internet than when they find it elsewhere. This underlines the importance of teaching pupils how to assess and validate internet information and to integrate this into the school setting.

However, parents do not find that schools are actually taking this task upon them, especially when it comes to the safe use of the internet. This was clear in a study carried out by the cross-European project SAFT (Safety, Awareness, Facts and Tools/ SAFT

2006). SAFT conducted a survey among parents in Norway. The results show that 85% of the parents find it very important that schools teach pupils about the safe use of the internet, and the majority of parents are only moderately satisfied when they then assess what the schools are doing to meet this expectation.

### **Are the pupils more or less critical of sources?**

At Århus Statsgymnasium (a secondary school in Denmark), teachers agree that pupils are not critical enough towards the information they find on the internet. This assessment is shared by the majority of respondents in the study. However, a young teacher explained that he has read some essays written by pupils in 1968. His impression from those essays was that pupils then were even less critical and less reflective. This shows that even though pupils today are more critical than before, that it is not enough. The need for critical reflection on information sources has simply increased dramatically.

### **Home use and school use of ICT differ fundamentally**

At Averøy Ungdomsskole (a primary school in Norway), pupils assess that they have learned the most about computers at home, and that they are highly competent at using computers. According to the teachers and school management, this is not the true picture. The pupils do not know enough about using a computer for school purposes – they mainly use the computer for chat and games at home.

The teachers believe that pupils are primarily consumers when using the computer at home, but that they learn the productive and useful competences at school (such as editing photos, writing letters and producing diagrammes in spreadsheets).

The impression is that pupils and teachers have fundamentally different opinions on the purpose and advantages of using a computer. An example of this is that a pupil believes he has improved his English skills by chatting over the internet, but as he says: "But I do not use the same language that I learn in school".

The teachers also do not find that their pupils are capable of gathering information on the internet in a critical way. But the pupils think they are.

Boys seem to some degree to learn more about ICT at home than girls. Or to put it in another way, girls are more dependent on school as a place to learn ICT skills. More girls than boys say that they have learned to use computers in school, and likewise there

Girls are more dependent on school as a place to learn ICT

are more girls than boys who think they get the best advice on using computers at school.

### **Different perceptions of digital competences**

At Knarvik videragående skule (a secondary school in Norway), teachers and pupils have very different perceptions of what constitutes digital competences. They use entirely different software and there is a clear cultural gap between teachers and pupils.

The teachers emphasise that pupils' ICT competences are highly overrated when it comes to school-related software. Furthermore the teachers think that the pupils are not competent when it comes to having a critical perception of information found on the internet. To avoid the clashes about basic technical skills, one teacher states that he deliberately delivers the impression that he is not very good using a computer. This gives the pupils self-confidence.

Another example of the clash of culture is that a teacher received an assignment by e-mail from a pupil in the subject, Norwegian. The attached file was in perfect Norwegian, but the short cover message in the e-mail was in SMS language with a lot of abbreviations.

A great difference between how ICT is used in school and outside school

The study shows a great difference between how ICT is used in school and outside school, as well as indicates a substantial gap between what teachers and pupils view as digital competence. Few teachers probably know what's really going on in the digital world of a 13-year-old pupil: spending hours in chat rooms, authoring their own blog or joining a 'clan' in an internet computer game and buying virtual swords with real money, and constant SMS'ing by mobile phone. On the other hand, teachers are often frustrated by the pupils' lack of critical sense regarding information sources, when it comes to the use of the internet in schools.

These differing opinions show a gap between the generations. There is no shared understanding between pupils and teachers of what digital competence is and what to aim for in terms of an optimal use of ICT in education.

As long as this issue remains untouched, Ramboll Management assesses that there is also a great risk of schools actually increasing "the social divide". While some pupils learn how to navigate in the digital world outside school, there are other groups who do not learn this. The results indicate that certain groups of pupils – girls and pupils with other native languages – are more dependent on learning to use ICT in school and their needs are not being met



satisfactorily. If these pupils do not develop the relevant digital competences, this may become a major barrier for them in their future socialisation, studies and working life.

## 5. Impact of ICT on the teaching and learning processes



The way in which ICT has been used for teaching and learning purposes has changed over time as technology has become more available and more advanced. From being merely another new gadget for individual enthusiastic teachers, ICT is now a part of everyday life for all schools. Focus on ICT in the educational world has moved from *learning how to use* ICT, to using ICT as a catalyst for improving teaching and learning – in other words, how ICT can be used as a tool or medium *with which to learn*.

Some people expect that ICT ideally can help revolutionise teaching and learning processes at school. For instance that ICT can make it easier to differentiate pupils' learning as they can work at their own pace, with lessons at a level that challenge them where they are. And that the use of ICT can directly and indirectly influence the teaching and learning process in ways that would result in more varied and more non-linear learning styles.

Results from this study show that ICT generally has a positive impact on teaching and learning situations, but compared with the ideal expectations, the impact of ICT on teaching and learning processes must still be considered to be limited.

The results of this study point in a number of directions in which schools should move in order to improve the impact of ICT.

The study shows the great potential of ICT. One of the results indicates that the pupils and teachers who experience the greatest impact from ICT are also the ones who use ICT the most often. The same results are found among teachers who integrate a greater number of different technologies. The study also shows that schools where the headmaster systematically follows up on the teachers' use of ICT for teaching and learning processes actually experience a greater impact than the others.

The study furthermore shows that many teachers do not use ICT to introduce new learning methods in which pupils are active producers of new knowledge. Instead they use ICT to support traditional learning methods in which pupils are more passive consumers and receivers of knowledge. More could be done to actively engage pupils in production and co-operation, as the study also shows that the use of ICT has a great impact on pupils' motivation, engagement and creativity. Furthermore the results emphasise that ICT provides teachers with a great opportunity to differentiate the learning process for the benefit of the individual pupil.

### **Results indicate that the more ICT is used, the greater the impact**

The use of ICT in for teaching and learning purposes is still limited, according to the responses from both teachers and pupils. In this study, teachers and pupils are asked how often they used ICT for learning purposes during the week prior to answering the questionnaire.

Around one-third of the teachers had not used ICT at all and about half the teachers had used ICT between 1 and 5 hours. Only between 5% and 17% used ICT for 6 hours or more, and this frequent use of ICT mainly takes place in secondary school, where more teachers than in primary school use ICT this often.

The use of ICT for teaching and learning purposes is still limited, especially in primary school

Frequency of use of ICT by pupils for learning purposes

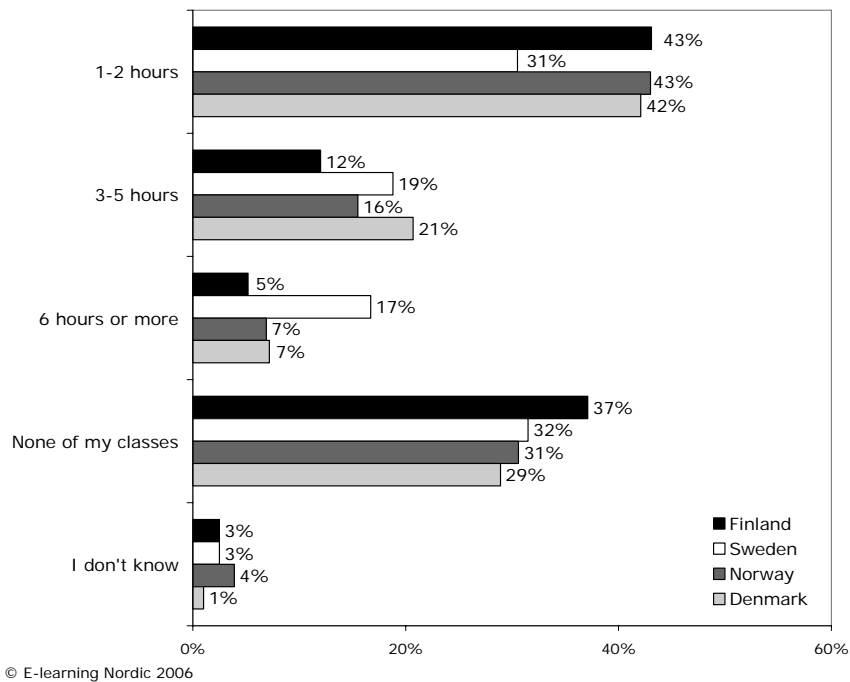


Figure 10: Question 9 to teachers: 'How often did the pupils in your classes use ICT on their own during the past week?' (N=1286)

The more pupils use ICT, the greater impact they experience

The results indicate that there is a correlation between how much ICT is used and the experienced impact of ICT. Pupils who use computers more than 6 hours a week assess to a higher degree that they learn more when using computers than the less frequent users among the pupils.

The study itself does not provide any explanations for these results. But one explanation could be that pupils who seldom use ICT are more focused on the use of the technology itself than the actual assignment. They therefore either focus on learning *how to use* ICT or they do more irrelevant things, for instance, searching internet pages with no connection to the assignment they are working on. Pupils who use computers more often do not need to spend time struggling to find out how to carry out specific tasks and may not find it as interesting 'in itself' to use computers. They can therefore focus better on the actual assignment.

However, the PISA ICT study indicates, on the basis of the math case in the study, that there is no linear correlation between the time spent in front of a PC and the learning outcome. On the other hand, the study also supports the assumption that students must have sufficient familiarity with ICT for learning purposes in order to profit from ICT in the teaching-learning process.

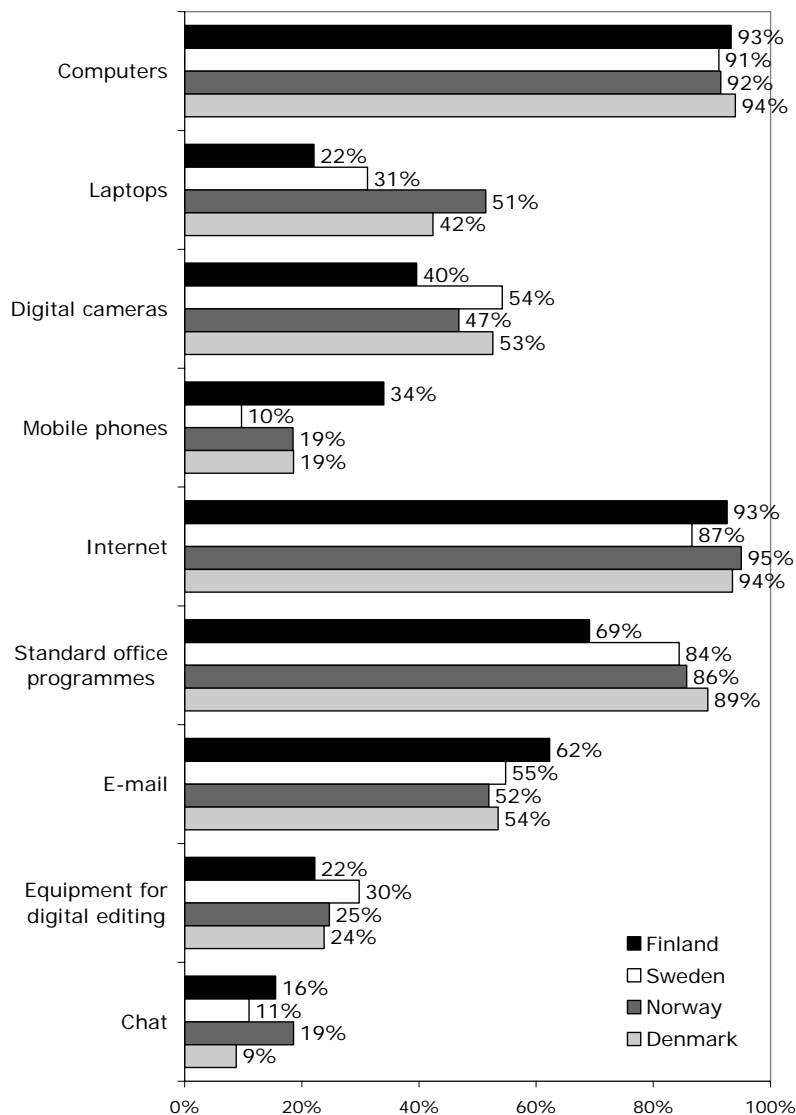
Generally, pupils would like to use computers more in school than they do now. They are not uncritical, however, as there seems to be a saturation point. The demand for more use of computers is greatest in countries that use the computers the least, and the least in the other countries that use the computers the most.

Pupils in general would like to use computers more

### Varied use of ICT results in better performance among pupils

The use of stationary computers and internet is firmly rooted in the school, but new technologies are also getting a foothold. Digital cameras, mobile phones and chat have quickly entered the schools.

Types of ICT that teachers had let their pupils use in class during the previous school year



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Figure 11: Question 8 to teachers (selection): 'Which ICT resources have you let your pupils use in class during the last school year (the school year 2004-2005)?' (N=1289)

Stationary computers, internet and standard office applications are the most used technologies

Stationary computers are without competition the most commonly used type of hardware. More than 90% of teachers in all countries state that they have used stationary computers in their teaching during the last school year. When it comes to software, the internet and standard office applications are – as expected – the software that most teachers say they have integrated into their teaching during the previous school year.

Digital cameras and mobile phones have entered the classroom

The use of new technologies such as digital cameras (for still photos or video) and mobile phones are already common at many schools. More than half of the teachers in Sweden and Denmark have used digital cameras in their teaching last year and approximately one-third of the Finnish teachers have used mobile phones in their teaching during the same period.

### Digital cameras

At Mörbyskolan (a primary school in Sweden), digital cameras are used in *woodwork/carpentry*. The school has set up a database with a number of project descriptions that are used to inspire pupils when selecting what type of product to produce. The project descriptions have been prepared by other pupils who – throughout the process of working with a product – have taken photos. By documenting their own process they at the same time make directions for the future process for other pupils.

The documentation process also has a positive impact on the pupils doing the work in the first place. The pupils report that they are aware that others will be using their photos and viewing their work. They also know that the teacher uses the photos as a basis for giving marks. They find that both aspects inspire them to make an extra effort.

New technologies support differentiation

The use of these new technologies seems to support teachers in differentiating their teaching. There seem to be a correlation between the teachers, who use digital cameras and mobile phones, and the ones who most often experience that ICT supports a better performance among pupils with high and low literacy.

### **Shortage of ordinary equipment inspired the use of mobile phones**

The school, Jokelan yläaste (a primary school in Finland), was renovated last year. Due to the work, there was a period of time when the school was without internet access for teaching and learning purposes. This lack of internet access served as a catalyst for finding new ways to retrieve information.

Since there was no computer access, the pupils went on the internet by using their own mobile phones with WAP instead. Mobile phones were used in one course to retrieve updated information about the stock market and share prices. The pupils enjoy this possibility as it brings an extra and motivating element into the learning process.

Mobile phones are also often used as calculators in mathematics.

### **Using chat as part of language courses**

At Rodengymnasiet (a secondary school in Sweden), one language teacher uses chat regularly in her teaching. The idea is that the individual pupil should get in touch with a native speaker in the language being taught and have a chat dialogue. Because of the fully "live" nature of chat, the pupil has to be fast to keep up in the dialogue. There is no time to search for specific words or formulations. Instead the pupil has to be creative in responding.

The teacher described how chat is not only used as language training, but also in more specific projects. For example, a pupil once carried out a project about culture in New Zealand, and as part of that project, he interviewed a person from New Zealand via chat. The teacher felt that the pupil both enhanced his English skills and got valuable information for his project.

The teacher has used chat in this way for several years and it is now fully integrated into her teaching. However, she notes that chat activity requires some initial research, to make sure that pupils do not get in contact with the wrong persons.

Primary schools use digital cameras (photo and video) and digital editing equipment more than secondary schools. This might be due to the fact that there is a greater focus on creative expression in primary schools than in the secondary schools.

Different use of technologies in primary and secondary schools

Another difference between primary and secondary schools is that digital learning resources developed specifically for teaching purposes are more used in primary schools than in secondary schools. Conversely digital learning resources that are not specifically tar-

geted teaching, e.g. databases, are more often used in secondary than in primary schools.

### **Use of digital learning resources**

At the school, Jokelan yläaste (a primary school in Finland), a physics and mathematics teacher found that the use of digital learning resources (CD-ROM) offered an extra dimension to the learning process.

In mathematics the pupils are provided with a CD-ROM containing exercises which are to be completed at home. The CD-ROM forms a part of the ordinary course material. The exercises are combined with various game sequences. In order to advance in the games, the pupil has to solve the mathematical problems found in the exercises. The teacher says the software provides a smart way to combine learning with playing, which he believes makes the software a valuable asset. The teacher is very pleased with the impact of the use of the software. The same teacher also uses special software for physics instruction.

### **Pupils are far more often consumers than producers**

Teachers have been asked in which pedagogical context and for which teaching and learning purposes they have used ICT. One of the general results is that pupils are more often consumers and users of ICT than producers. This means that ICT is most often used for information retrieval and as a subject in itself where pupils learn how to use different types of standard office applications. Teachers also more often use pre-produced digital learning resources for teaching purposes rather than involving pupils in producing a media product on the basis of what they have learned.

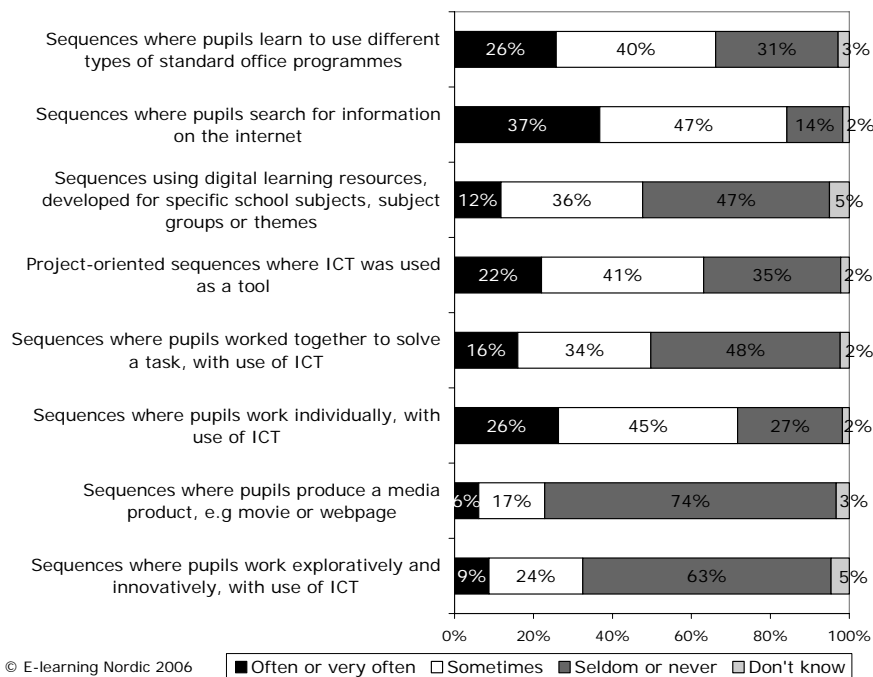
Pedagogical theories – such as constructivism and other related theories, which are widely acknowledged in the Nordic countries – emphasise the importance of working actively with a specific content, communicating and producing new things on the basis of and as part of what you learn. This is based on results that show that you learn more during these processes than by passively receiving information.

Though there are many levels between production of media products and passively receiving information, it is still thought-provoking that over half the teachers in the Nordic schools never involve their pupils in developing a media product and 20% do this only rarely.

Actively searching information on the internet lies somewhere in between the two poles, but from the results of this study it seems



that the teacher is still the person in the classroom who learns the most.



Different types of teaching sequences with ICT

Figure 12: Question 12 to teachers (selection): 'How often did you carry out the following types of teaching sequences with ICT during the previous school year (the school year 2004-2005)?' (N=1264)<sup>6</sup>

### Pupils are more motivated when the output of the teaching is not just learning, but a physical product

At Langmarkskolen (a primary school in Denmark) a class assignment involved learning about using the library and about non-fiction. As part of this they had to write a book themselves about another country. First the pupils read some books to get an overview of the country and then afterwards they searched the internet for more information and pictures. Finally they wrote their own text about the country and designed the layout of a book with pictures. They also had to make a nice front page, a table of contents and an index like in a real non-fiction book.

Afterwards the pupils were very proud of their work and the teachers observed that the pupils were very involved, explorative and reflective in the process. Using ICT as a tool to create a physical product that the pupils can show to others is one of the greatest impacts of ICT, according to the teachers at Lang-

<sup>6</sup> Respondents who have answered 'Not relevant in regard to my teaching' have been removed from this sample. This includes e.g. language teachers not answering questions on the impact of ICT on the pupils' calculation skills.

markskolen. It is their experience that creating something that looks professional also motivates the pupils in the learning situation. The teachers discovered as well that the use of ICT opens up the work process, and that the practical and physical product supports dialogue, collaboration and reflection.

### **Pupils more often work individually than together**

The results from this study show that ICT is very often used to support the individual work and learning processes of the pupils. Many more teachers state that they have let their pupils engage in teaching sequences where pupils work individually using ICT than in sequences where pupils work together in solving a task. There are however great differences between the countries on how much ICT is used for collaborative work. In Denmark 27% of the teachers have often carried out teaching sequences using ICT where pupils work together on solving a task while only 4% have done so in Finland. This might be due to differences in pedagogical traditions in general.

Pupils in secondary education often use ICT when they do their homework

Finally, regarding how ICT is used for teaching and learning purposes, it is important to mention that computers are not only in use in the classroom. Pupils often use a computer to do their homework and to engage in their personal learning process. This is however mainly the case among the older pupils. Two in three pupils in secondary school often use the computer when they do their homework. In the 8<sup>th</sup> grade it is one in three and in the 5<sup>th</sup> grade it is only one in six. The reason for these differences between the grade levels may be due to fact that older pupils more often have their own computer (see Chapter 7) or it may be due to the differences in the types of homework pupils do at the different grade levels. Pupils in the lower grades more often fill in hand-outs, while older pupils are more often asked to turn in assignments they have written themselves.

### **ICT – a strong tool to support group and project work**

At Greve Gymnasium (a secondary school in Denmark), there is a strong focus on creating a learning culture at the school where pupils active taking part in their own learning process. As a consequence, group work and project work are widely used learning methods and according to the pupils, ICT is also primarily used to support these methods.

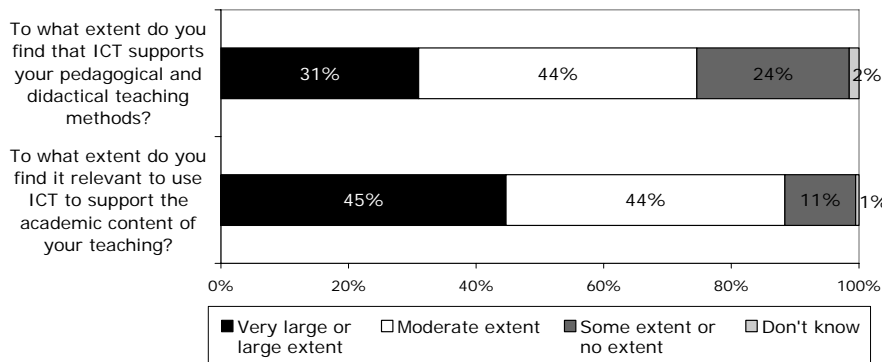
Pupils explain that they prefer using ICT when they work because they like to be able to find more information and to find most updated information on the internet. They experience that

they can go deeper into the subject when they use ICT for these purposes. They also like being able to edit their work until the last minute when using ICT instead of having to spend time re-writing. The teachers assess that the pupils are more serious about their assignments when they have to present their work directly to the class and here they often use for example PowerPoint.

However, on the other hand, some teachers have found that their pupils have not been critical enough towards what they find on the internet, and that the presentation itself has taken over, so that more focus has been placed on the format and less on the content.

**ICT does not revolutionise teaching and learning. Teachers focus on using ICT to support subject content**

From many sides it has been emphasised and proven that ICT can be used as a tool to change the way in which teachers teach, and the way in which pupils learn. But there seems to be a clash between this theory on the one hand and the actual practice on the other.



Teachers see ICT as a tool to support the academic content

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Figure 13: Question 7.1 and 7.2 to teachers: 'To what extent ...' (N=1290)

The results from this study show that teachers are more focused on using ICT where and when it supports the subject content of their teaching, than on using ICT to support their pedagogical methods. Especially among the Finnish teachers, there are few teachers who assess that ICT support their teaching methods.

### **Focus is on the subject itself, not on ICT tools**

Oulun Lyseon Lukio (a secondary school in Finland), is a school with an advanced use of ICT. The teachers at the school emphasise, however, that the main focus will remain on the subject of teaching itself. Among the teachers there is also consciousness about the risk that “all the fancy, new equipment” and the possibilities it provides will distract attention from the essence or the core of the teaching. As one of the teachers explained, “*We must never end up in a situation where the use of ICT tools becomes pure pleasure*”. By this the teacher means that the choice to use ICT tools in education must be based on a sound analysis of whether the use actually can bring another dimension to the learning process. The tools must not be used only because there is a possibility to use them, he continues. Sure, the internet provides the pupils with a “fast track” to knowledge, but this is not always a positive thing since the knowledge that is produced might be more shallow; it is important to give pupils a deep and thorough understanding of the basic elements of a subject.

Looking closer at the results, it stands out that the teachers in primary school more often regard ICT as supporting their pedagogical and didactical teaching methods than the teachers in secondary school.

### **Many headmasters view ICT as a valuable tool for pedagogical development but fewer experience the impact**

Taking the abovementioned results into account, it can be asked whether ICT primarily is used to support traditional teaching and learning methods where the teacher communicates content and where pupils merely learn on their own or – if pedagogical and didactical methods actually have changed with the integration of ICT.

Headmasters view ICT as a tool for pedagogical development but fewer have experienced the impact

More than 90% of all headmasters view ICT as a tool to support pedagogical development and school development, but only 42% have experienced that ICT to *a large degree* has contributed to the inclusion of new pedagogical methods at their own school. The great majority of headmasters assess that ICT to *some degree* has had the effect that new pedagogical methods have been integrated into the teaching.

The ones who experience impact are characterised by ...

The 42% of the headmasters, who experience that ICT to a large degree has contributed to the inclusion of new pedagogical methods, work in schools where most of the teachers have participated in ICT competence development within the last year. They are also

characterised by being the ones in which teachers are regularly asked about their use of ICT in teaching and where the use of ICT is brought up in the staff development interview.

This indicates that headmasters themselves have responsibility for as well as great possibilities to influence the extent to which ICT potential is exploited, not only by giving teachers the necessary competences, but also by following up on the use of ICT.

### **Impact of ICT in teaching can be measured in pupil involvement, differentiation, creativity and less waste of time**

Even though the use of ICT for teaching and learning purposes is not primarily motivated by the didactical advantages, the study shows that teachers, parents and pupils experience a positive impact of the use of ICT that is related to the way in which the teaching and learning processes are planned.

Teachers and pupils were asked to imagine a teaching and learning situation where ICT is used and another equivalent situation where ICT is not used. They were furthermore asked to compare these situations and assess the way in which a pupil's learning process can be influenced by the use of ICT. Parents have been asked to assess how they experience that their children are influenced by the use of ICT in school.

When asked directly, approximately half the teachers and two-thirds of the pupils and parents have experienced the following impact on the teaching situation:

- **Pupils more engaged:** According to the teachers, pupils participate more actively when ICT is used. The pupils themselves assess that they pay more attention during class and this is especially the case for pupils in the 5<sup>th</sup> grade year.
- **Pupils work more their own way:** The pupils themselves find that they do assignments more their own way when using a computer, and their parents assess that they solve assignments more at their own level. According to the teachers, pupils work more in cohesion with their own learning styles and teachers furthermore view ICT as a valuable tool to differentiate teaching and learning.
- **Pupils more creative:** Both teachers and parents experience that the pupils solve assignments more creatively when using ICT.

- **Teaching time not wasted:** The pupils assess themselves that they spend less time on doing things that have no relevance with the lesson, and both pupils and teachers experience that there is less inexpedient noise when ICT is used. This is especially the case in primary school. Another view on the waste of teaching time comes from the teachers. It has been stated in the public debate – in for example Denmark – that a barrier to the integration of ICT has been that too much teaching time is wasted. This because it is very time-consuming to plan and to go to the computer room or that much planning is wasted because computers don't work when they are to be used. The results of the study cannot support this argument. The great majority of teachers do not experience that more teaching time is wasted with the integration of ICT at their schools as only 10% have experienced that.

Results supported by other studies The above results are supported by the results from the studies *ImpaCT2* and *The motivational Effect of ICT on pupils* that showed that the use of ICT in class generally motivates pupils to learn. The pupils' attitudes to and involvement in the learning activities change.

One especially interesting result from *E-learning Nordic 2006* is that a greater number of pupils and parents than teachers experience these positive impacts.

Teachers, pupils and parents who have not experienced the above, do not however experience the opposite. They just assess that the use of ICT has no impact on the teaching and learning process.

#### **Parents experience that their children are more motivated**

The parents of pupils at Langmarkskolen (a primary school in Denmark) explain that they perceive that their children are more motivated, work more creatively, try harder and have more fun when using ICT.

#### **Production of a TV-show supports co-operation**

At Oxhagsskolan (a primary school in Sweden), they broadcast live television at 10 o'clock every second Friday. The show is produced by pupils, aged 12. When the show is on, there is "total silence" at the school. All pupils watch the show in their classroom and one hour after the broadcast, the TV show is uploaded on the homepage of the school.

Throughout a whole year, pupils participate in a course where they learn how to produce a TV show and they all try out the different roles in TV production; host, technician, camera, etc. The themes covered in the show vary and it is up to the pupils to decide themselves.

The pupils experience a number of positive impacts from the activity. A quite interesting comment was made by a pupil, describing why she likes working with the TV show: "You don't have to work!" In comparison with other subjects, she feels that working with the TV show is so much fun that she does not consider it as part of the regular education.

The teacher responsible for this specific course has experienced a number of effects from the production of TV. The pupils really need to cooperate since their end product is so transparent and for real. No one wants to mess up. In line with this, there has never been any disciplinary problem during the course, the teacher says. The pupils feel very proud after a successful show. Some years ago there was a very shy pupil who during one show was the host. He performed very well, and when he went for lunch, the rest of the school applauded him. The concept is currently being spread to other schools as well.

### **Impact of ICT very dependent on how it is used**

The experienced impact of ICT on the teaching and learning processes depends very much on how ICT is used. There seem to be a correlation between the teachers, who experience that the pupils are more creative when they solve assignments and work more in cohesion with their own learning style when they use ICT. These are the teachers who more often than the average teacher engage their pupils in project-oriented sequences, encourage pupils to work together to solve a task as well as to allow pupils to work individually using ICT.

On the other hand, there are also teachers who experience that their pupils do more irrelevant things in a class where ICT is used. These teachers are also the ones who more often than the average teacher allow their pupils to search for information on the internet and let pupils work individually using ICT.

The impact of ICT varies, depending on how ICT is used

### **Whether ICT makes pupils passive or active is up to the teacher**

At Århus Statsgymnasium (a secondary school in Denmark), PowerPoint presentations are used in teaching by a number of teachers. Whether the integration of PowerPoint slides makes the pupils more active or passive is assessed by both teachers and pupils to be very dependent on the individual teacher's teaching style. One teacher explains that she has often experienced teachers in teacher-training using ICT as departure point for a one-way monologue, where the pupils just sit passively as if they are watching TV. She is very aware herself of integrating questions and exercises into her teaching when using PowerPoint.

That there is a relationship between how ICT is used and the impact is not only a result shown in this study. The research project *ImpaCT* also indicated that achieving a positive impact from ICT, in areas such as attainment, motivation and learning, depends on decisions on how ICT is to be deployed.

This suggests that the pedagogical and didactical considerations behind using ICT are very important and that the teachers must be even more aware of this. Benefiting from ICT's potential does not just come by plugging in the computer and continuing with the same teaching styles. However getting inspiration about how ICT can be used in various learning situations to gain a positive impact is not difficult. There is a plethora of books and conferences offering inspiration and practical examples – for example, the book, *'Læringsscenarier – hvor it gør en forskel'* written by Danish professor Bent B. Andresen.



## 6. What characterises teachers who experience the greatest or the least impact of ICT on pupil performance and on the teaching and learning processes? A cluster analysis

Are there any special characteristics to describe the teachers and schools who experience the greatest impact of ICT and the ones who experience the least impact of ICT on pupil performance and on the teaching and learning processes? The answers to that question are key input for focusing strategies and optimising initiatives for improved impact of ICT in the future.

To answer that question, Ramboll Management has carried out a cluster analysis dividing the teachers into three different groups, each representing a level of impact from ICT:

- Teachers, who experience *no impact of ICT* on pupil performance and the teaching and learning processes
- Teachers, who experience a *moderate impact of ICT* on pupil performance and the teaching and learning processes
- Teachers, who experience a *great positive impact of ICT* on pupil performance and the teaching and learning processes.

### What is a cluster analysis?

A cluster analysis is a statistical methodology used to analyse patterns in responses to key questions. With a cluster analysis, Ramboll Management attempt to identify relatively homogeneous groups of cases, based on selected characteristics using statistical methods that can handle large numbers of cases and observations.

The major benefit of a cluster analysis is that it provides a framework for taking advantage of heterogeneous characteristics (e.g. preferences, behaviour, and attitudes) within an overall population/target group. It should be noted though that results from a cluster analysis must be used with caution as the results are analytically generated.

This cluster analysis is based on answers to the following key questions to teachers:

- Assessment of the impact of ICT on the performance of pupils in general, pupils with poor literacy skills, pupils with high literacy skills and the subject-related performance of the pupils<sup>7</sup>
- Assessment of the impact of ICT on the teaching situation<sup>8</sup>
- Assessment of ICT as a tool to support the teachers' pedagogical and didactic teaching methods<sup>9</sup>
- Assessment of ICT as relevant to use to support the subject content in teaching<sup>10</sup>.

Based on the answers to the above questions, we have looked at what characterises the teachers who experience either no impact, a moderate impact or a great positive impact of ICT by placing them in three different clusters.

### Three clusters

Based on an analysis of the replies to the questionnaires, three clusters have been identified. For illustrative purposes we have named them in accordance with their main characteristics:

- *Cluster 1:* Teachers who experience no impact of ICT
- *Cluster 2:* Teachers who experience a moderate impact of ICT
- *Cluster 3:* Teachers who experience a great positive impact of ICT

The next figure presents an overview of how the three clusters differentiate, based on their averaged responses by teachers.

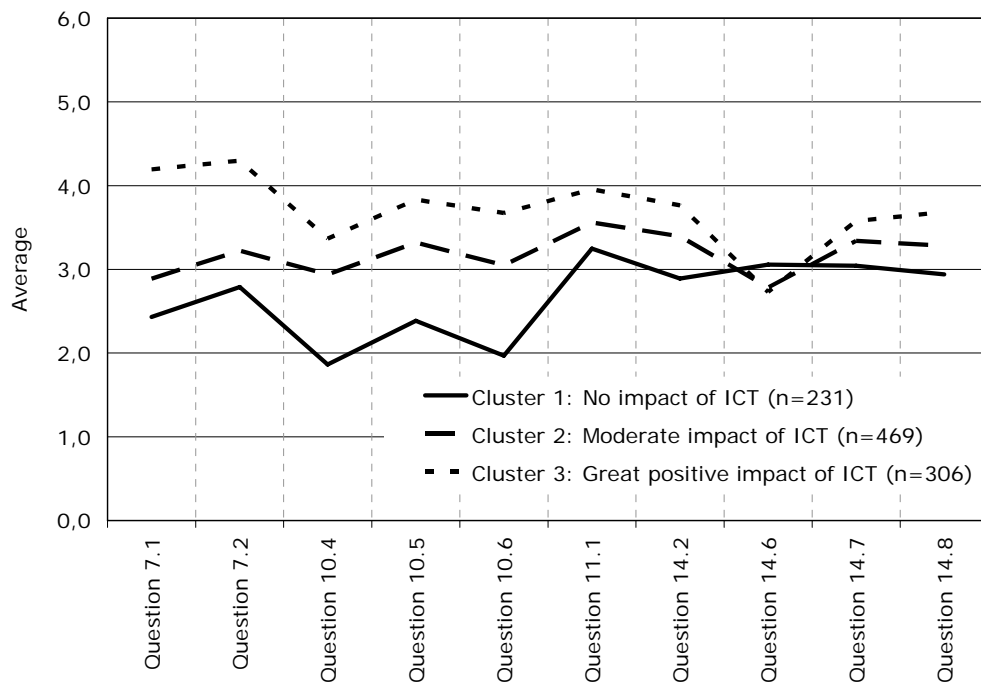
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<sup>7</sup> Questions to teachers: 10.4, 10.5, 10.6 and 11.1

<sup>8</sup> Questions to teachers: 14.2, 14.6, 14.7 and 14.8

<sup>9</sup> Question 7.1 to teachers

<sup>10</sup> Question 7.2 to teachers



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Figure 14: The three clusters distributed according to the teachers' averaged responses to key questions

The figure above shows that the teachers in cluster 2 (moderate impact of ICT) and cluster 3 (great positive impact of ICT) experience a more than average impact of ICT, while the teachers in cluster 1 (no impact of ICT) experience an impact below average (3 is average).

This applies for all questions except for one (question 14.6), which focuses on whether the teachers experience that the pupils do more or less non-relevant work in the teaching situation. Here the teachers in cluster 1 more often experience that the pupils do more non-relevant work in the teaching situation, while the teachers in the two other clusters, experience that this happens less often than the average.

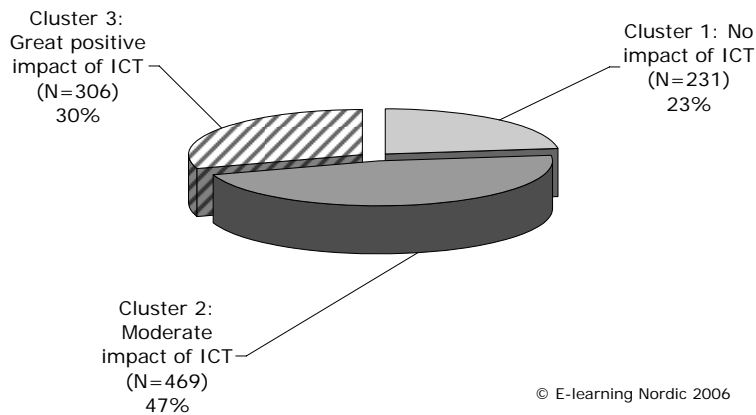


Figure 15: The size of the three clusters compared to one another

The largest cluster is the one with the teachers who experience a moderate impact of ICT (cluster 2). Almost half the teachers are in this cluster. The smallest cluster is the one containing the teachers who experience no impact of ICT (cluster 1). Less than one in four can be found in this cluster. Finally, 30% of the teachers experience a great positive impact of ICT (cluster 3). This indicates that the great majority of the teachers experience a positive impact of ICT on their pupils' performance and on the teaching situation (cluster 2 and cluster 3).

Characteristics such as age, gender or experience do not differentiate the clusters

What then characterises the teachers who experience a great impact of ICT and those who experience no impact of ICT? How is one to spot either kind of teacher? It is not possible just by looking around in the staff room. Personal features such as gender, age or years of experience do not differentiate them. Neither are the teachers in one cluster, compared to the other, more likely to have a computer and internet access at home.

Are there then any special characteristics of schools that indicate where to find more teachers who experience a great positive impact of ICT? No, there is neither any special profile of the headmaster (age, gender or experience) that ensures a positive impact among the majority of the teachers at the schools. Nor is there anything in the schools' written objectives for ICT or in the schools' participation in ICT-projects that could help us distinguish between the level of their experienced impact.

What is the difference between the teachers and schools who experience a greater impact of ICT as opposed to those who experience a lesser impact? This is presented below and in the following sections for the different clusters.

First, it can be noted that the four countries are about equally present in the three clusters. The only exception is that Finland has a

larger presence in cluster 1 and smaller presence in cluster 3 (see figure below).

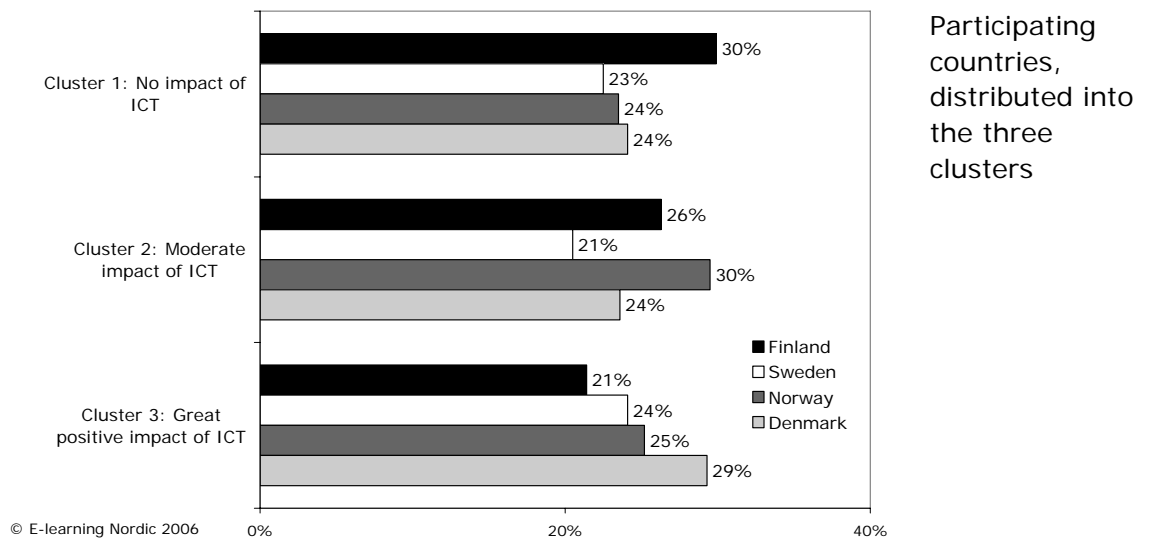


Figure 16: The distribution of the four countries in the three clusters<sup>11</sup>

### Cluster 1: Teachers who experience no impact of ICT

Cluster 1 is the smallest cluster, representing only 23% of the teachers. In cluster 1 are the teachers who experience no impact of ICT. They represent the following experience with ICT:

- ICT has no impact on the performance of the pupils in general.** It is the experience of the majority of teachers in this cluster that ICT does not at all or only to a limited degree have an impact on either the academically strong or weak pupils. Nor has ICT helped improve the pupils' subject-related performance. ICT does not, however, have any negative impact on pupil performance.
- ICT is not a tool to support their pedagogical methods.** The majority of the teachers in this cluster assess that ICT does not support their pedagogical and didactical teaching methods. However, the majority do assess that ICT to some degree supports the subject content in their teaching.
- ICT has no impact on the teaching situation.** When the majority of the teachers in cluster 1 compare a teaching situation with ICT with another without ICT, they experience that ICT has no impact at all on the teaching situation. Also there are more teachers in this cluster than in the

<sup>11</sup> Each cluster does not add up to 100% because of rounding of the numbers.

other clusters who experience negative impacts of ICT, such as the pupils making more unnecessary noise and doing more non-relevant work in the teaching.

Looking closer at the teachers who do not experience any impact of ICT, they can be characterised by the following:

- **Teachers who do not experience any impact of ICT, do not feel ICT-confident.** The majority of teachers in this cluster assess that they only to some or a lesser degree have sufficient ICT competences to integrate ICT into their teaching. However, still the majority have participated in competence development regarding ICT within the last three years – most in courses on the pedagogical use of ICT in teaching. It must be noted that this group of teachers had participated almost as much in ICT competence development as the teachers in the other clusters that have experienced a positive impact.
- **The reason for the teachers not experiencing an impact of ICT is not that they do not use ICT in their teaching.** The teachers in this cluster use ICT the least – and almost four out of ten of the teachers had *not* used ICT the week before they participated in the study. They had, however, in the previous school year, all used a great variety of hardware and software, just as the teachers who experience a moderate impact (cluster 2), and all had for example let their pupils search the internet for information. Hence, the reason for the teachers not experiencing an impact of ICT is not that they do not use ICT in their teaching. Still, this cluster contains the greatest number of teachers who find that the use of ICT in their school has resulted in more teaching time being wasted.
- **Collaborative potential of ICT is not exploited.** The teachers who do not experience any impact of ICT were the one who had least often asked their pupils to collaborate on solving an assignment supported by ICT or to use ICT in project-oriented sequences (about half had never or seldom used ICT in this way).
- **School profile.** Teachers from secondary schools are over-represented in this cluster compared to the other clusters. The teachers in this cluster are most likely found at schools where ICT has only had very limited impact on the pedagogical methods and the development of the schools' basic values and targets.

## **Cluster 2: Teachers who experience a moderate impact of ICT**

Teachers who experience a moderate impact of ICT are the largest group. In this cluster 47% of the teachers can be found. The teachers in cluster 2 represent the large centre group that experiences a moderate impact of ICT, but who also do not use ICT the most.

Cluster 2 is made up of the teachers who experience the following:

- **ICT improves to some degree the performance of pupils in general.** The majority of teachers in this cluster have this perception. They also assess that ICT to some degree improves the performance of pupils with both low and high literacy skills.
- **ICT is to some degree a tool to support subject content as well as the teachers' pedagogical and didactic teaching methods.**
- **ICT has some or no impact on the teaching situation.** The teachers in this cluster are divided between experiencing no impact on the teaching situation or a positive impact. Around half the teachers have experienced that pupils are more active and they help their classmates more when ICT is used.

Then what characterises this large group of teachers who experience a moderate impact of ICT?

- **The teachers have participated in competence development, but they do not feel ICT-confident.** The majority of teachers who experience a moderate impact of ICT, have participated in ICT competence development within the last three years. This was mostly in the format of courses on pedagogical use of ICT in the teaching. However, the majority of the teachers in this cluster do not feel that she/he has sufficient competence to integrate ICT into their teaching.
- **Moderate use of ICT in their teaching.** Of the teachers who experience a moderate impact of ICT, the majority had used ICT 1-5 hours the week before they filled out the questionnaire. Hardly any had used it more, while about one in three had not used ICT at all. However, looking back at the previous school year, they had all used a great variety of hardware and software.

- **Teachers who experience a moderate impact, use ICT in a variety of ways.** Most of them let their pupils work independently with the use of ICT, but half have, during the previous school year, also asked their pupils to work on projects alone or collaboratively, supported by ICT. This however is somewhat less than teachers who have experienced a greater impact of ICT. Still, the teachers in this cluster very seldom ask their pupils to produce a media product such as a webpage or use ICT to encourage the pupils to work more exploratively.
- **School profile:** In this cluster, teachers from both primary and secondary schools are almost equally represented.

### **Cluster 3: Teachers who experience a great positive impact of ICT**

Cluster 3 is made up of teachers who experience the greatest positive impact of ICT. Cluster 3 is defined by teachers who experience the following:

- **ICT improves the performance of pupils in general to a high degree,** as well as the performance of pupils with low and high literacy skills. This is the assessment of the teachers in cluster 3. The majority also assess that ICT to a high degree improves the pupils' subject-related performance.
- **ICT is to a large degree a tool to support both subject content and pedagogy.** The teachers in this cluster assess that ICT to a large degree is a tool to support the subject content in the teaching as well as the teacher's pedagogical and didactic teaching methods.
- **ICT has a positive impact on the teaching situation.** The majority of the teachers in this cluster assess that when using ICT the pupils are more active, help their classmates more, work more in accordance with their own learning style and are more creative.

What special characteristics do these teachers have? Do they work at schools where there are any special conditions?

- **Teachers, who experience a great positive impact of ICT, are ICT-confident.** The majority of teachers in this cluster assess that they to a high degree have sufficient competences to integrate ICT in their teaching. Only a few more teachers in cluster 3 than in the other clusters have participated in competence development within the last



three years. This group of teachers has most often taken courses in more advanced uses of ICT in teaching, and have less often taken courses in basic use of ICT and pedagogical use of ICT. This probably because they know this already or have completed those courses several years ago.

- **Teachers, who experience the greatest impact of ICT, use ICT the most.** The great majority of teachers in this cluster had used ICT the week before they participated in the study and this cluster contains the most teachers who had used ICT more than six hours a week. They not only use ICT a lot, they also do it in a quite varied way; they had within the last school year used the greatest variety of hardware and software in their teaching.
- **Teachers, who experience the greatest positive impact of ICT, use ICT in the most project-oriented, collaborative and most experimental ways.** The majority of teachers in this cluster had the previous school year carried out project-oriented teaching sequences supported by ICT, while half the teachers who experienced no impact of ICT (cluster 1) seldom or never did this. In this cluster also, four times more teachers often had their pupils collaborate on a project supported by ICT than teachers who experienced no impact of ICT. It is also the teachers who experience the greatest impact of ICT, who are those who most often engage their pupils in teaching sequences where the pupils are asked to work exploratively and innovatively supported by ICT (half had done so) and twice as many teachers in this cluster have used digital portfolio as in the two other clusters.
- **School profile:** There are a few more primary schools than secondary schools in this cluster. The teachers are most likely found at a school where the headmaster has used ICT to support the school's development of its values and goals, and the headmasters have more often experienced a large degree of new pedagogical methods that have been integrated into the teaching with the use of ICT.

## 7. Impact of ICT on knowledge-sharing, communication and home-school co-operation



ICT is a very powerful organisational tool. However, if not used with determination and focus, as well as versatility, it will not deliver or, in best case, only provide fragmented organisational impact and benefits. This applies to all types of organisations, also schools.

When looking at the impact of ICT on the organisational situation, the results from *E-learning Nordic 2006* show a multi-faceted picture:

The basic elements of the technical infrastructure are at hand – i.e. computers, internet and intranets, e-mail and various software tools, both at school and at home, and available to the large majority of teachers, pupils and parents.

And there *are* encouraging indications that a growing number of schools, teachers, pupils and parents use the ICT infrastructure for informational and collaborative purposes.

But the picture also shows that organisationally the infrastructure is mostly used for communication among teachers, while the potential to a much more limited degree is used to support dialogue between teachers and pupils and in the home-school co-operation. Furthermore, in spite of a high availability of both public websites (homepages), intranets, Learning Management Systems and e-mail, primary school stakeholders – teachers, pupils and parents – report moderate organisational impact and fewer benefits in their daily activities and communication with each other.

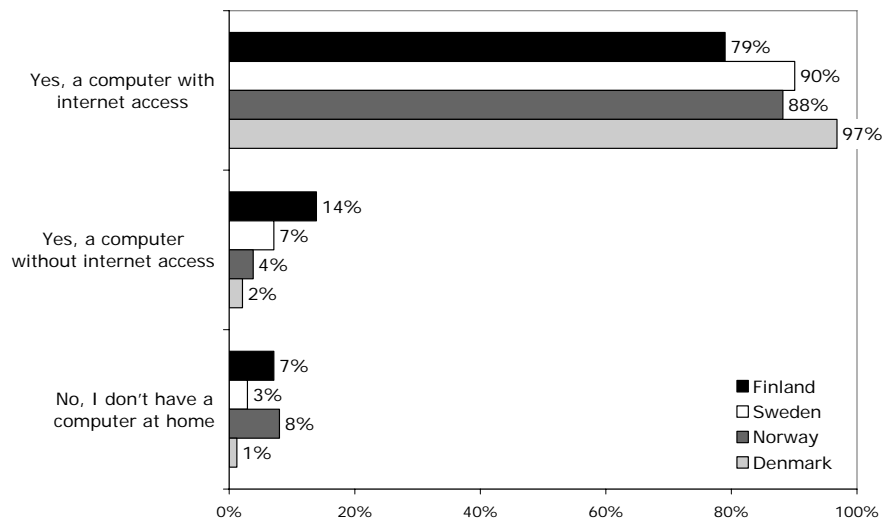
Ramboll Management believes however that these results should be regarded as a sign of limited maturity. Nordic schools have only just begun in the last few years to purchase intranets and learning management systems. Developing routines for the use of these systems, moving from one-way information distribution to a shared collaborative platform takes at least several years. This is the experience from both public and private organisations that have integrated these systems. Thus we can expect the growing impact of ICT for knowledge-sharing, communication and home-school collaboration in the years to come.

However, organisational implementation and reaping the benefits of these systems will not come automatically. Ramboll Management believes that successful organisational implementation is in the hands of the school management who must strive to ensure a link between the use of systems and the core strategic development of the school. Otherwise, the systems will just be an extra task without any added value, which will only de-motivate the users regarding both the use of ICT and organisational development.

### **Infrastructure is at hand: The majority of pupils and teachers have home access to computers and internet**

The Nordic countries are among the world leaders in terms of the general demographic distribution and availability of ICT among their citizens. *E-learning Nordic 2006* confirms that this also applies to teachers and pupils.

Teachers' access to computers at home



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Figure 17: Question 16 to teachers: 'Do you have access to a computer at home?' (N= 1166)

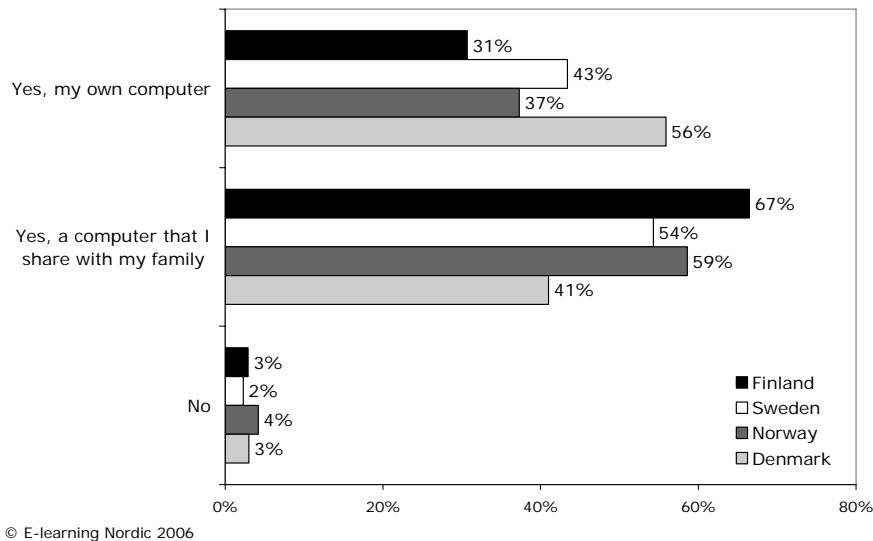
A very large majority of teachers have access to a computer and the internet at home. This applies to 90% of Swedish teachers and 97% of Danish teachers. The group of connected teachers is slightly lower in Norway (88%) and Finland (79%). Comparing these numbers with the respective national averages according to *Nordic Information Society Statistics 2005* shows that Nordic teachers score somewhat higher on infrastructure access than national averages<sup>12</sup>.

A computer at home supplements the use in school

The teachers' home access to computers and the internet is important in terms of their use of ICT to support communication and knowledge-sharing with their colleagues, as well as to use ICT in their teaching. Teachers with home access seem to pursue new ICT-based teaching methods more often, whereas teachers without home access feel less confident about their ICT competences and therefore are less inclined to use ICT in their teaching. The high level of home access among Nordic teachers, therefore, is seen as a positive factor.

<sup>12</sup> When assessing this high percentage, it must on the one hand be noted that the national averages for households with two adults and children are far higher than the general average, and as 70% of the teachers participating in the study are below 50 years of age and therefore may live with children, then this may also just reflect this trend in the numbers. On the other hand it must also be noted that there might be a bias in the sample with an overrepresentation of teachers with internet access at home. Based on this the percentage of teachers with internet access must be expected to be a little lower, but still high.

Furthermore, connectivity is significantly higher among the pupils than among the teachers. The pupils' home access to computers is in the high nineties in all four countries and the average home access to the internet is 95%. All things equal, the fact that ICT home access among children and among families with children is significantly higher than the national averages is in itself a positive factor and confirms that pupils and parents have access to the basic infrastructure components.



Pupils' access to computers at home

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Figure 18: Question 6 to pupils: 'Do you have access to a computer at home?' (N= 4997)

The number of pupils who have their own computer is, not surprisingly, higher in secondary schools than in primary schools, where most pupils still share access with their families. This indicates that the concept of a personal computer and internet access as a personal (learning) tool becomes more relevant with age.

There are also gender-related differences in this access. While both boys and girls have access to a computer at home, boys more often have their own computer, while the girls more often share it with the rest of the family.

Girls more often than boys have to share a computer

### Organisational ICT-tools are at hand: Many schools have intranet/LMS

Nordic schools are well equipped with tools which support co-operation, knowledge-sharing and communication – both internally and externally.

Most schools have public homepages and many schools, particularly in Denmark and Norway, have implemented intranets (including Learning Management Systems), with Finland as the significant

exception. Only as little as 14% of the Finnish schools who participated in *E-learning Nordic 2006* have established intranets/LMS.

Types of technologies used in schools to support communication

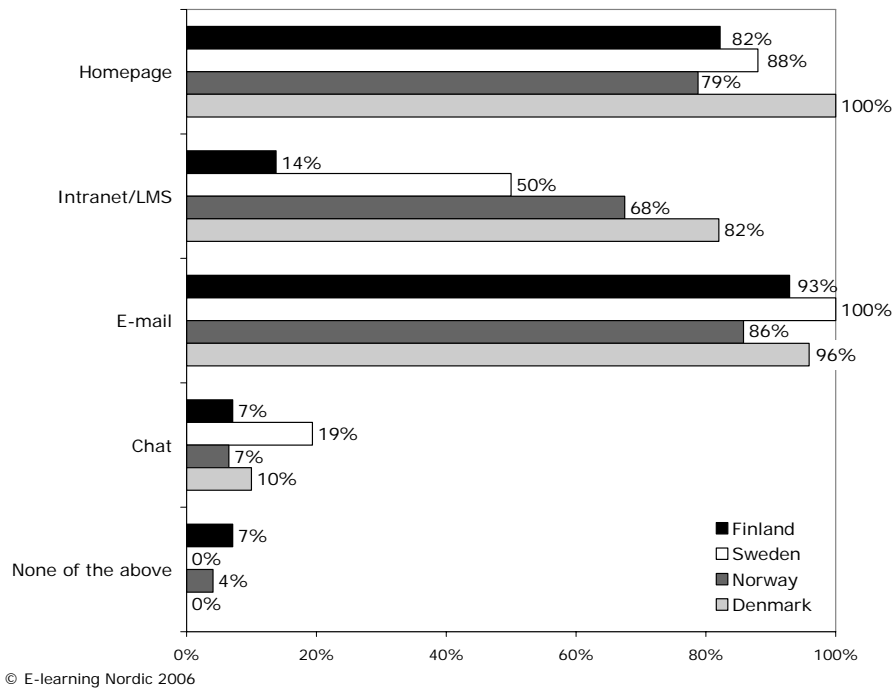


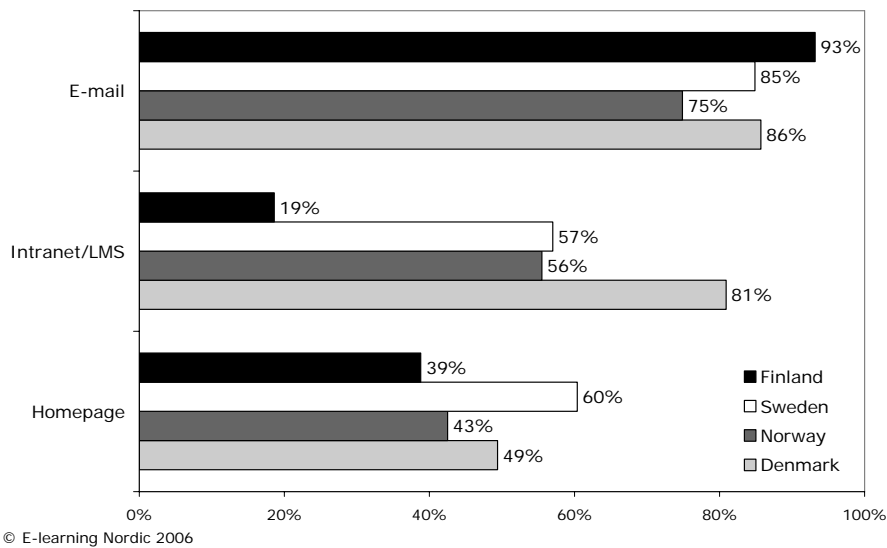
Figure 19: Question 13 to headmasters: 'What types of ICT are used at your school to support communication between stakeholders of the school, e.g. employees, pupils and parents?' (N=182)

**Homepage:** School website which is publicly accessible for everyone on the internet

**Intranet/Learning Management System (LMS):**

Website/learning management system which can only be viewed by people related to the school (teachers, pupils, parents, etc.) who have received login capabilities (password, etc.)

*Definition of 'homepage' and intranet/LMS' used in the questionnaire to teachers.*



Teachers' preferred means of communication

Figure 20: Question 15 to teachers: 'Which types of ICT do you use to support contact with colleagues, pupils and parents?' (N=1253)

Teachers, however, still prefer e-mail as their favourite means of communication and co-operation in all four countries. An average of 85% of all teachers use e-mail for communication with their colleagues, school management, pupils and parents.

It is interesting to observe that there are significant differences in media choice and in use patterns between the four countries. Whereas 81% of Danish teachers state that they use their school intranets regularly, the numbers are significantly lower in Sweden and Norway, and as low as 19% for the Finnish teachers.

Big differences in use patterns between the four countries

The large number of school homepages in Denmark is based on the fact that it now is mandatory for all schools to have a homepage. The large number of intranets/LMS must in addition be viewed in relation to the Danish government's 2004-2007 programme for ICT in Primary Education (*IT i Folkeskolen*) which has stimulated the comparatively high availability and use of intranets at Danish schools. One of the programme strands offered is financial support to primary schools that purchase knowledge-sharing systems.

When usage patterns and media choice among teachers are linked with local media availability, one can observe some consistency between availability and use of intranets in the schools. Also, data shows that intranets are more available and more used in secondary schools than in primary schools.

## Despite massive ICT-based communication among the teaching staff, the positive impact on knowledge-sharing and co-operation is moderate

In spite of the fact that ICT offers great potential for increasing and improving communication among all school stakeholders – teachers, pupils and parents – ICT is predominantly used by the teaching staff for communication among themselves and to a lesser degree for communication with pupils and parents.

How often do teachers use ICT to communicate with colleagues

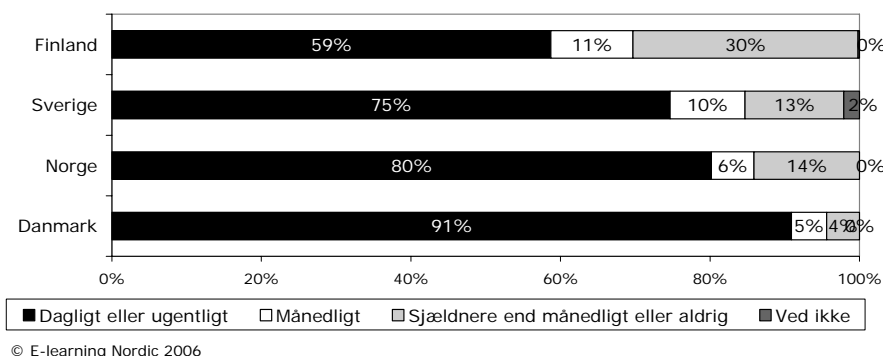


Figure 21: Question 17.1 to teachers: 'How often do you use ICT to communicate with colleagues' (N=1166)

... with pupils

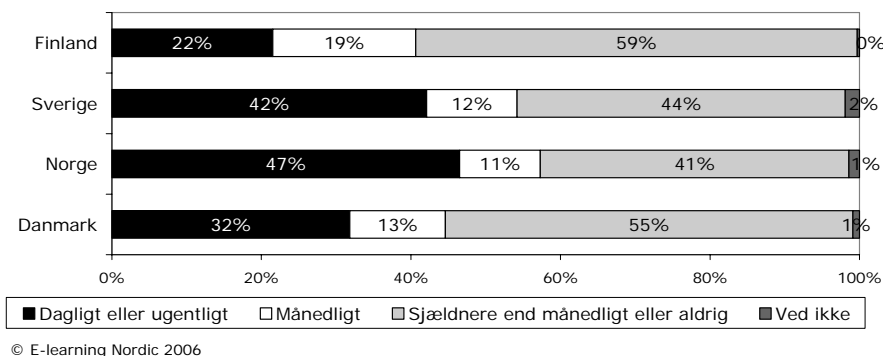


Figure 22: Question 17.2 to teachers: 'How often do you use ICT to communicate with pupils' (N=1166)

... with pupils' parents

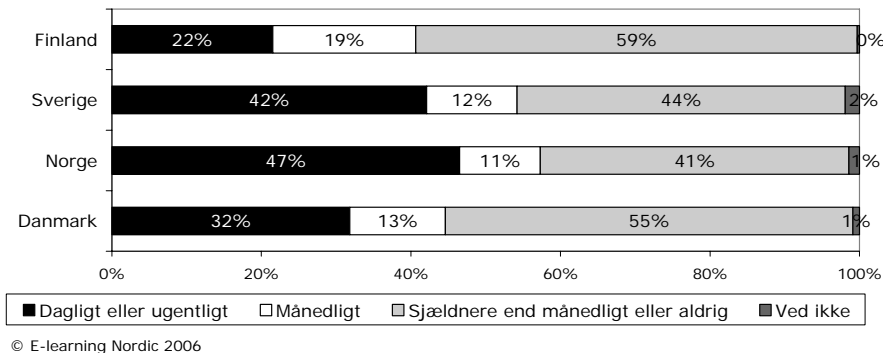


Figure 23: Question 17.3 to teachers: 'How often do you use ICT to communicate with the pupils' parents' (N=1166)



The use of ICT to support communication among colleagues is massive. While the great majority of teachers use ICT daily or weekly to communicate with colleagues, they have still only to a moderate degree experienced a positive impact from ICT on co-operation.

The results from *E-learning Nordic 2006* show that the positive impact on communication and co-operation is moderate. Less than 30% of the teachers feel that collaboration, e.g. in subject- and inter-disciplinary teams, has improved to a high degree, and only a minority – albeit a large minority – of 40% of the teachers consider knowledge -sharing to have become easier as a result of ICT. The majority of teachers have only *to some degree* experienced the positive impact of ICT in communication and co-operation.

ICT has only improved communication and co-operation to a moderate degree

Still, it is encouraging to note that only between 5% and 7% of the teachers point out that important information did not reach them.

### **Strong teacher collaboration using an intranet**

Langmarkskolen (a primary school in Denmark), has extensive and very positive experience using an intranet to support communication among the teaching staff.

School management and teaching staff at Langmarkskolen have deployed the intranet for internal communication and co-ordination purposes for several years now and have become dependent on the service, to the extent, as one teacher puts it, that “when the intranet occasionally is unavailable, we may as well close down the school for the day.”

The teachers use it to exchange information about all sorts of practical, teaching and pupil-related issues that come up during the day at school – “*This or that pupil went home because of ...*”, for internal distribution of minutes from meetings and to share teaching materials. The teachers at Langmarkskolen emphasise that the intranet makes it easier for them to follow activities in classes they do not teach themselves and that it provides a better overview for all the teachers about what is going on at their school. They note that the general level of information has been raised considerably thanks to the intranet, and that without it, much information would never reach all those concerned.

Indeed, many school intranets are implemented without generating much use and seemingly without delivering significant benefits. Why such good results at Langmarkskolen? The teachers point at two factors: Information is exclusively disseminated via the intranet, and the school management strongly supports and encourages the use of the system. The way was paved for the strong uptake of the intranet at Langmarkskolen by the fact that home computers with internet access were made available to all teachers, as part of their participation in the national Danish in-service training programme *The Pedagogical ICT Licence (School ICT)*.

Impact of ICT on knowledge-sharing is greater in secondary schools

The impact of ICT on knowledge-sharing is more prevalent in secondary schools than in primary schools. 84% of secondary school teachers and 72% of primary school teachers daily or weekly use ICT to communicate with colleagues. This may be due to the fact that secondary schools in for example Denmark started some years earlier than primary schools to implement intranets and LMS' in schools.

Also more teachers and headmasters in secondary schools assess that knowledge-sharing among the teaching staff has become easier with ICT. However, in spite of the wider use of ICT for internal communication purposes, a greater number of secondary headmasters assess that the employees have often NOT received important information.

The more ICT is used to support knowledge-sharing, the greater the impact

Not surprisingly, there seems to be some symmetry between the level of ICT usage and the perceived impact. At the schools where the headmaster has stated that she/ he daily or weekly use ICT to communicate messages to all teachers, there are more teachers (and as well the headmasters themselves) who assess that knowledge-sharing among the teaching staff has become easier.

### **Use of intranets is maturing**

Teachers and pupils at Århus Statsgymnasium (a secondary school in Denmark) have had access for several years to an intranet which is now widely used by all. However, the success of the intranet has created a new challenge, that of information management and information structuring. Important and less important information is all piled together, and information navigation and structured information searches have become somewhat of a hassle, according to the teachers.

School management is aware of this challenge and considers it a natural and positive next step in the development of the intranet as an open and unconstrained environment for infor-

mation dissemination and exchange. The school's intranet has gained momentum and now is the time to develop a more structured information management policy.

### **Secondary schools are more actively using ICT for teacher-pupil communication purposes than primary schools**

Secondary schools are significantly ahead of primary schools in their use of ICT for teacher-pupil communication. Whereas 57% of secondary school teachers use ICT on a weekly basis in their communication with their pupils, only 25% of primary school teachers do so.

While secondary schools are also more positive in their assessment of the impact of this communication than primary schools, the overall impact is still considered to be only moderate. Only one in three secondary school teachers find that ICT *to a high degree* has helped ensure that pupils receive important information about planned activities, e.g. homework assignments or excursions. For primary schools, the number is even lower. And again, not surprisingly – we can observe symmetry between the level of usage and the perceived impact: those teachers who use ICT the most in their communication with their pupils experience the biggest impact.

### **Pupils are better informed about homework assignments; doing them, however, is a different matter**

At Århus Statsgymnasium (a secondary school in Denmark), the intranet is used to help pupils keep track of current and forthcoming homework assignments. The intranet has helped pupils stay better informed about their homework, however, subsequent improvements in performance have not been observed. The pupils are not better prepared for their classes. Knowing is one thing, doing is still another.

This is not surprising as secondary schools and pupils in secondary schools demonstrate a somewhat more elaborate and mature exploitation of the organisational potential of ICT than primary schools and primary school pupils. The growing use of team-organised teaching, the growth of interdisciplinary teaching and the use of project-oriented learning processes in secondary schools are clearly supported by the growing use of ICT among teachers and pupils. Also, the age profile of secondary school pupils favours a more structured and organised use of ICT. An explanation in Denmark is also that intranets in secondary schools were pur-

chased several years earlier and now are well implemented. In the majority of primary schools in Denmark, intranets are still new and deployment has only just begun.

**Knowledge-sharing is not necessarily easier with ICT, but as complexity increases, ICT is the only way to handle the intensified complexity**

At Greve Gymnasium (a secondary school in Denmark), the headmaster has not found that ICT has made it easier to share knowledge or to manage administrative tasks. However, as the complexity of the school organisation and the management of daily activities increases, access to effective ICT tools becomes vital. The headmaster at Greve Gymnasium considers the administration of a modern school to be impossible without effective ICT.

At Greve Gymnasium class and activity schedules change regularly and almost on a daily basis, e.g. due to meetings, illness and other unscheduled events. Furthermore, every second week on the average, regular class schedules are put on hold to allow for interdisciplinary teaching sessions, excursions or special projects. To manage such flexibility and complexity requires powerful planning and information tools.

Greve Gymnasium uses a system that, among other things, helps school administrators revise and update class schedules. It is updated daily with changes and cancellations and all information is personalised. The system is web-based and can be accessed anywhere. At school, a terminal is designated for use by pupils checking their personal schedule. Alternatively the pupils can do it from any computer at school and at home. Pupils use the system daily and they report that sometimes their parents also use it to check their schedules: Have the two first classes Monday morning really been cancelled?

Both pupils and teachers find the system to be very helpful. It is described as simple, user-friendly and an effective tool in the daily planning activities. Greve Gymnasium recently purchased a more advanced LMS, but the headmaster and teachers assessed it to be too complex, not as much 'needed' and therefore used much less.

## ICT is a collaborative tool for pupils: E-mail, chat and mobile phones used for communication with classmates when doing homework

ICT can be used effectively to support individual learning needs and as a means to personalise learning processes. The results from *E-learning Nordic 2006* show that the pupils very much are aware of this and use ICT to facilitate communication, collaboration and mutual help.

When working with home assignments, almost half of secondary school pupils state that they use e-mail, chat and mobile phones to communicate with classmates, to get help and give help. This pattern is more developed in secondary schools than in primary schools.

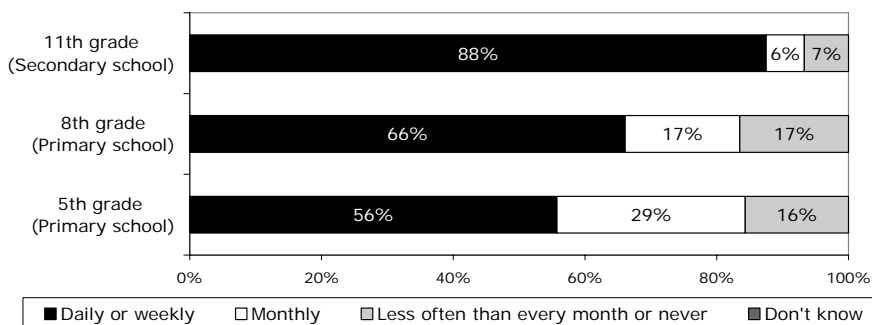
### E-mail and chat when doing homework

Using chat and e-mail when doing homework is a standard procedure for the pupils at Greve Gymnasium (a secondary school in Denmark). This has not been encouraged by the school's teachers, but they all find it positive. The teachers at Greve Gymnasium remember with a smile their own school years with late night telephone conversations the day before an assignment was due, and they can't help being a little envious of the communication tools available to today's pupils.

## Parents applaud the benefits produced by ICT in their communication with school

About 50% of the parents use ICT in their communication with their children's school. There are, though, variations in the ways in which ICT is used in primary and secondary schools.

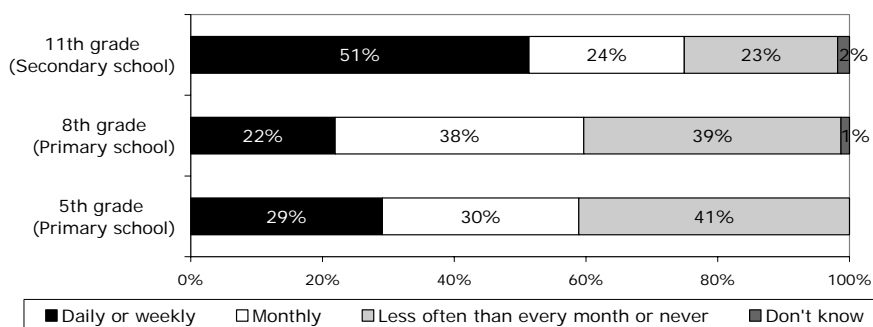
How often is ICT used to inform about activities before they take place?



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Figure 24: Question 14.3 to headmasters: 'How often is ICT at your school used to inform about activities at the school before they take place, e.g. on the school's homepage or intranet?' (N=177)

How often is ICT used to inform about activities *after* they have taken place?



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Figure 25: Question 14.4 to headmasters: 'How often is ICT at your school used to show what already has occurred at school, e.g. with photos on the school website or intranet?' (N=177)

In secondary school, ICT is mostly used to inform about upcoming activities at the school?

As explained above, more secondary schools than primary schools have a website and intranet compared to primary schools and they use it more often to inform about activities at the school. Nine out of ten headmasters in secondary school state that they use the school's homepage or intranet weekly to inform about upcoming activities at the school and upwards of 50% publicise events and activities already undertaken. In primary school, the numbers are somewhat lower. 60% of primary school headmasters state that they use the school's homepage or intranet weekly to inform about upcoming activities, and 25% report about activities which have already taken place.

In primary school ICT is mostly used to support direct dialogue

On the other hand, in primary schools ICT is used much more to support the direct and personal communication. Almost 50% of the teachers in primary school use ICT on at least a monthly basis to communicate with the pupils' parents. The numbers for secondary school are significantly lower. This probably reflects that home-school communication in general is much more frequent and multi-faceted in primary schools than in secondary schools.

### An intranet has supported transparency

At Mörbyskolan (a primary school in Sweden), they have an intranet system where teachers, pupils and parents can see activities at school, homework, upcoming tests, test results, etc. The system was launched two years ago and initially in the form of a pilot project. Now it is in full-scale operation.

The teachers say that they experience a transparency regarding their ICT readiness, so that parents can easily see how active teachers are in using the system. The system thereby also becomes a way of showing parents that the school is ICT ready.

There are different levels in how ambitious teachers are using the system to publish information, but it is more or less impossible not to use it. Although some teachers are assessed to be afraid of using the system, instead of old, analogue routines, it is the general experience of teachers at the school that in order to get good return on investment from these kinds of initiatives, all teachers have to work with it.

The parents with children at the school report that they find that the system is a very good way to keep track of their children's daily life in school. They also see it as an instrument to stimulate dialogue with their child about their school work. They furthermore believe that the transparency stimulates a better performance from their child.

The system was also a response to increasing demands from the parents, who wanted to be able to get a better overview of their children's performance. The system is seen as a way of responding to these demands, without imposing extra work on the teachers.

What is then the impact on the use of ICT to support school home dialogue? Almost half the parents who use ICT in their communication with the school, assess that communication with the teachers/school has to a large degree become easier.

The impact of ICT on home-school dialogue considered to be moderate

However, on other areas, the impact seems more moderate. The majority of parents, headmasters and teachers assess that the use of ICT has supported an improved impact in the following areas:

- Parents feel better informed to *a moderate degree* about activities at the school
- Parents experience to *a moderate degree* improvement in the dialogue they have with the school about their child
- Parents assess that they only to *a moderate degree* engage themselves more often in activities at the school. This is supported by headmasters and teachers. They also assess that there is only a moderate degree of greater involvement of parents in their children's schoolwork.

### **Parents' view of ICT at school**

Langmarkskolen (a primary school in Denmark), has given high priority to the innovative use of ICT. The parents at Langmarkskolen support this and consider ICT in schools to be for today, not for tomorrow. However, the parents state that ICT was not the first priority or selection criterion when deciding in which school to enrol their kids. But the absence of innovative use of ICT may very well be a reason for not selecting a school.

Finally it must be noted as positive that despite the wide use of ICT to support the school home collaboration, the majority of teachers and headmasters do not at all or only to lesser degree perceive that the home-school collaboration has become more time-consuming.



## 8. Conditions for the use of ICT in schools



Conditions at the individual schools are an important factor influencing the actual use and impact of ICT. This has been shown in this study and in many other studies. However, many of the results about what makes an impact are based on old data. As the possibilities and experiences with ICT have developed during the past years, so have the conditions that are important to ensuring an impact of ICT. The *E-learning Nordic 2006* study shows a very interesting development in terms of the kinds of conditions that have an impact on the use of ICT.

Does the ICT infrastructure have an impact on the use of ICT? Yes, it does, according to *E-learning Nordic 2006*. At schools with a low number of pupils per computer, a greater pedagogical impact of ICT is experienced.

Does the ICT infrastructure have an impact on the use of ICT?

Do written objectives for ICT or an ICT strategy ensure the integration of ICT? For many years, much work has been put into the development of ICT strategies, and the majority of schools also have written strategies for the use of ICT. Many of these cover areas such as pupils' ICT competences, teachers' development of competences in relation to ICT and pupils' access and use of ICT at school.

Do written objectives for ICT or an ICT strategy ensure the integration of ICT?

ICT strategies have been important for setting focus on the integration of ICT. However, time seems to have made them obsolete. Our study shows that no special impact can be seen in schools with

written objectives for ICT compared to the ones without. Ramboll Management assess that this is due to the fact that ICT is no longer an isolated phenomenon requiring a special strategy. Instead ICT must be integrated into the schools' overall strategies and used to support the schools' goals, not as a goal in itself. ICT has a great potential to be a catalyst for change and the study also indicates that at schools where the headmaster uses ICT to support school development, there are more teachers and parents who experience a positive impact of ICT.

What is the impact of teachers' participation in competence development?

What impact does teachers' participation in competence development have? Competence development of teachers is an important area and many resources and time have been put into developing the teachers' ICT competences in all countries. However, the results from the study show that even though two out of three teachers have participated in competence development regarding ICT within the last three years, only one in three of these teachers feel confident when using ICT and no special impact on the use of ICT can be registered. There seem to be a gap between participating in the course and the actual use afterwards at the school. Access to an ICT-responsible or help from colleagues at most schools does not seem to be enough to support use of ICT. Ramboll Management assesses that there is a lack of clear targets for the use of ICT at schools as well as follow-up on this (perhaps lack of) use.

Is ICT used more in schools that have participated in an ICT-project?

Is ICT used more in schools that have participated in an ICT-project? In many countries, ICT projects have been initiated to give teachers some hands-on experience with the use of ICT and inspire others to use ICT. However, comparing schools that have participated in ICT projects with those that have not, there is no difference in the level of experienced use by teachers and pupils. To this it must though be noted that there are multiple examples of interesting project and evaluations showing effect of these projects, however the projects were not continued after the period end and the experiences have not been disseminated to other teachers. Ramboll Management finds that this lack of anchoring of the results and dissemination is a great problem for the impact of the ICT projects.

What are the drivers and barriers for achieving a greater impact of ICT?

Then what do headmasters and teachers themselves assess to be the greatest *driving force* for achieving a greater impact of ICT? Here they point to '*Easy accessible ICT-equipment*'. As the major barriers for achieving a greater impact they see '*Too little ICT-equipment at the school*' and that '*The teachers do not have sufficient ICT competencies to teach with ICT*'.

In their selection of drivers and barriers, the headmasters and teachers have put great focus on access to ICT and competence development, which has also been shown in several earlier studies.

This may be because these are areas that continuously need investments or it may simply be 'auto-pilot' answers. As this study shows, Ramboll Management finds that there is probably some truth in both assumptions.

### Relationship between good access to ICT and pedagogical impact of ICT

What is status on access to ICT equipment and what impact does access to ICT have at a school? We have in the study chosen to focus only on ICT equipment that pupils have access to in relation to the teaching and when doing school work. Computers, which are only used by teachers or for administrative work, are not included.

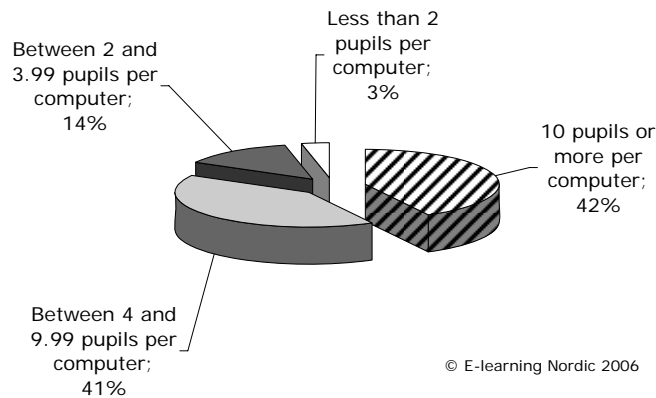


Figure 26: Question 5 to headmasters: Number of pupils per computer with internet access (N=177)

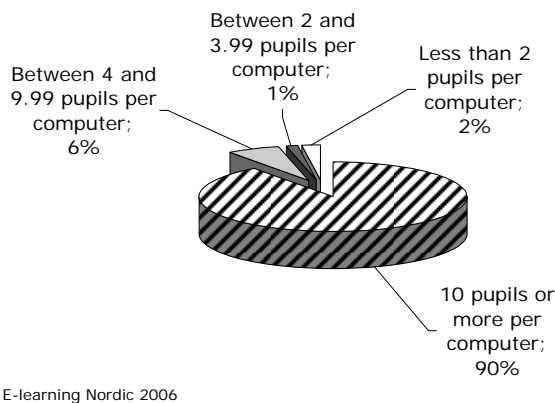


Figure 27: Question 5 to headmasters: Number of pupils per laptop (N=173)

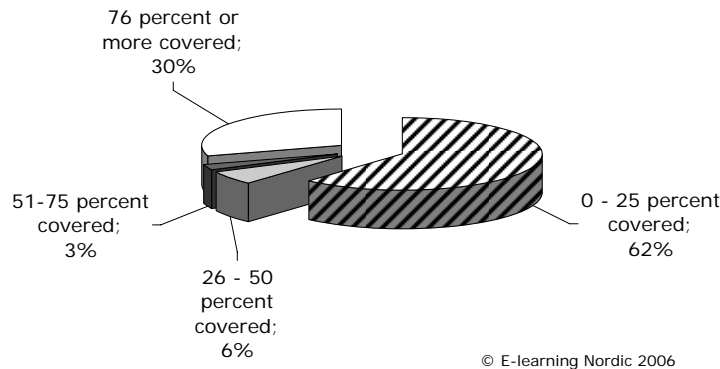


Figure 28: Percentage of the school teaching areas covered by wireless network (app.) (N=159)

Computers with internet access For computers with internet access, the 'pupils per computer ratio' is an average of 5.8. This number covers that at 17% of the schools, there are four pupils or less per computer. At other schools there are more pupils for every computer. At 41% of the schools there are between four and ten pupils for every computer with internet access and at the last 42% of the schools there are more than 10 pupils for every computer.

Computers with internet access seem to take over from computers without internet access. There are very few computers without internet access left in the schools ('pupil per computer ratio' is 82.6).

The study indicates a correlation between access to computers with internet and pedagogical impact. At schools that have the greatest number of computers per pupil (fewer than 4 pupils for every computer), the headmasters there have more often observed that ICT to a large degree has supported the integration of new pedagogical methods into the teaching. At these schools, most teachers also have had competence development regarding ICT and the headmasters follow up on the use of these skills. The headmasters at these schools also reply that they emphasise in the staff development interviews the importance of ICT in teaching, and that they regularly ask the teachers about how they use ICT in their teaching.

However there are no variations between schools with more or less computers with internet access and the experienced impact of ICT on the communication and knowledge-sharing.

When numbers showing access to computers at school are compared with the great majority of pupils and teachers who have access to computers at home (see Chapter 7), it is clear that the use of ICT as a personal learning tool is seldom possible at school. It is much more likely to be possible outside school. Indeed Ramboll

Management sees this problem as a great challenge if digital competences are to be a basic cultural technique, while preventing the widening of "the social divide".

Laptops have been purchased for schools in the past years, but it seems mostly just as one class set for the whole school. At 90% of the schools, there are more than 10 pupils for every laptop. This is however expected to change dramatically in the years to come in a country such as Denmark. In Denmark, the national initiative '*IT i Folkeskolen*' subsidises part of the purchase of computers for pupils in 3<sup>rd</sup> grade. Here almost all schools have chosen to buy laptops instead of stationary computers. This will in the years to come change the distribution in favour of laptops in Denmark.

Laptops

Wireless network/ internet in the schools' teaching areas is beginning to be available. At almost one in three schools, more than 75% of the schools' teaching areas support wireless networks. At the majority of the other schools, it is less than 25% of the teaching areas that support wireless network. The numbers indicate that either all the teaching areas are being covered or not at all alternatively a minor area.

Wireless network/  
internet

#### **Wireless network improved use**

At Oslo Montessori School (a primary school in Norway), the implementation of a wireless network has boosted the use of ICT at the school. The wireless network is assessed to have supported a more flexible use of computers in the project-based school culture.

Of other types of ICT equipment, the results show that most schools have projectors and digital cameras, but very few have yet purchased interactive whiteboards at any scale.

Other types of  
equipment

### **Pupils involved actively in the maintenance and development of the school's computer network**

At Oulun Lyseon Lukio, (a secondary school in Finland), the pupils are involved actively in the maintenance and development of the school's computer network.

The school has its own e-mail and webpage server. Maintenance of the server and the network is performed by a support group made up of pupils under the guidance of a staff member. One of the tasks of the participating pupils is to introduce and educate new pupils who are interested in taking part in and keeping the tradition of pupil support alive; the function was started some 15 years ago by pupils having a special interest in network applications. Some of the founding pupils still act as mentors!

For the pupils, the involvement in the support function offers a possibility to deepen their knowledge of network maintenance and development. The school is a member of the Cisco Networking Academy that offers advanced web-based courses in network technology.

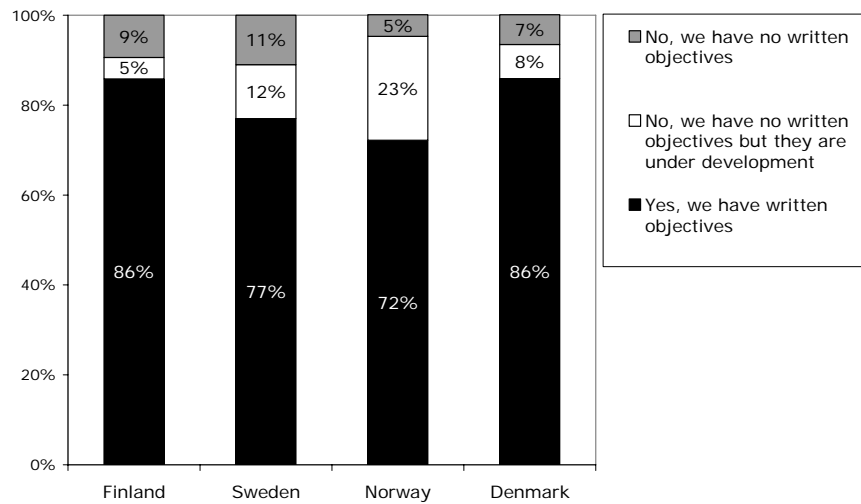
Characteristics of schools that have more than average amount of equipment

Looking at what characterises the schools that have more than the average amount of equipment – for example of laptops or wireless networks – then there is an interesting trend. At these schools, the headmasters to a higher degree assess that ICT has encouraged the integration of new pedagogical methods into the teaching. However, if this is caused by the fact that access to more equipment simply has inspired the teachers to use ICT more in new ways – or because new pedagogical methods have been demanded by headmasters we do not know. However, it is clearly not written in the ICT strategies. There are no differences in the types of ICT strategies used at schools that differ in the amount of ICT equipment.

Good access to ICT is not only important to improve pedagogy, it also has an impact on pupil performance. This has been the focus in a study, carried out in the UK (Becta, 2003a). In that study, data on pupil achievements and Ofsted inspection data on quality of ICT has been linked, and the results show that pupils at schools where ICT resources were judged to be very good achieve better test scores than pupils at schools with poor ICT resources.

## Majority of schools have written objectives for ICT, but this does not seem to make a great difference

At the strategic level, there is focus on ICT in the schools. Around 80% of schools have written objectives for the use of ICT, according to the headmasters.



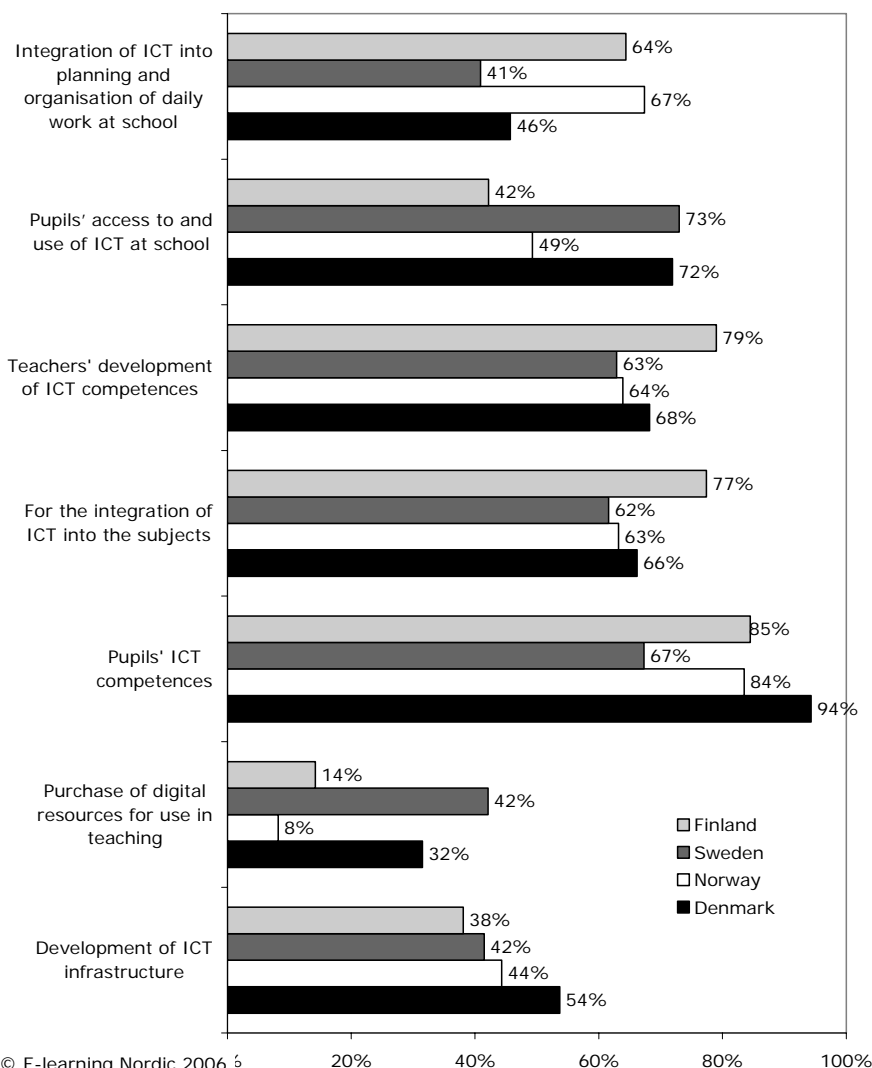
Majority of schools have written objectives for ICT

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Figure 29: Question 7 to headmaster: 'Are there any written objectives for the use of ICT at your school?' (N=180)

In all countries, the majority of schools have set objectives for the pupils' ICT competences, however there are also differences. In Finland and Norway, many set objectives for the teachers' competence development, while in Denmark there is more focus on setting objectives for the pupils' access and use of ICT at the school.

Areas covered by school ICT strategies



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 Figure 30: Question 8 to headmaster: 'In which areas are there written objectives for the use of ICT at your school?' (N=144)

Having a written set of objectives for ICT does not make a difference

However, either having or not having a written set of objectives for ICT does not seem to have an impact on the use and experienced impact of ICT in the school. A more in-depth analysis of the relationship between the schools that have set ICT objectives and the schools that do not, show no difference in the use and experienced impact of ICT from the teachers and parents.

Greater impact of ICT where headmasters use ICT to support school development

What does make a difference is the headmaster's focus on using ICT to support school development. This difference can clearly be seen among teachers and parents at schools where the headmaster has used ICT to support the development of school values and targets. At these schools, more teachers than average assess that the performance of pupils in general has improved with the use of ICT, and likewise, more parents report improved communication with the school.



### **ICT frontrunner school without an ICT strategy**

Oulun Lyseon Lukio, (a secondary school in Finland) is a front-runner in the Finnish school system when it comes to the use of ICT tools in education, but there is no explicit and written strategy for the use of ICT in education at the school.

Even though there is no written strategy for the use of different ICT tools in education, it is strongly supported, explains the headmaster of the school. The headmaster sees it as having a bottom-up perspective regarding the use of ICT in education. It is the teachers who decide what tools to use and how to use them. The teachers are free to use different supportive tools when they feel it to be appropriate in order to bring an added value to the teaching and learning.

Questions regarding the use of ICT and methods and ways to improve the use of ICT in education are discussed among the teachers and school management on a regular basis; it is a continuous and decentralised process, explains the headmaster.

These results show that although setting specific objectives for ICT has for many years been the way to encourage ICT integration, this is not the case anymore. ICT is no longer an isolated phenomenon that needs a special strategy. Instead ICT must be integrated into the schools' overall strategies and used to support the general school goals where ICT has a great potential to be a catalyst for change.

A perspective  
on ICT  
strategies

### **Two in three teachers have participated in ICT competence development within the last three years, but only one in three feel that they to a great extent have sufficient competences in using ICT in their teaching**

Competence development of teachers has high priority in schools. Around 70% of all ICT strategies in schools included objectives for the teachers' competence development in relation to ICT, and two out of three teachers have also participated in ICT competence development within the last three years.

### **Investments in ICT must be supported by competence development**

At Borgå Gymnasium (a secondary school in Finland), it is the view that no matter what investments have been made in new technology, it is extremely difficult to use without hands-on, competence development. The teachers emphasise the importance of feeling confident if they are to use ICT in education.

The types of competence development in which most teachers have participated are courses focusing on the pedagogical use of ICT and in local workshops held at the school.

Teachers who have participated in different types of competence development within the last three years

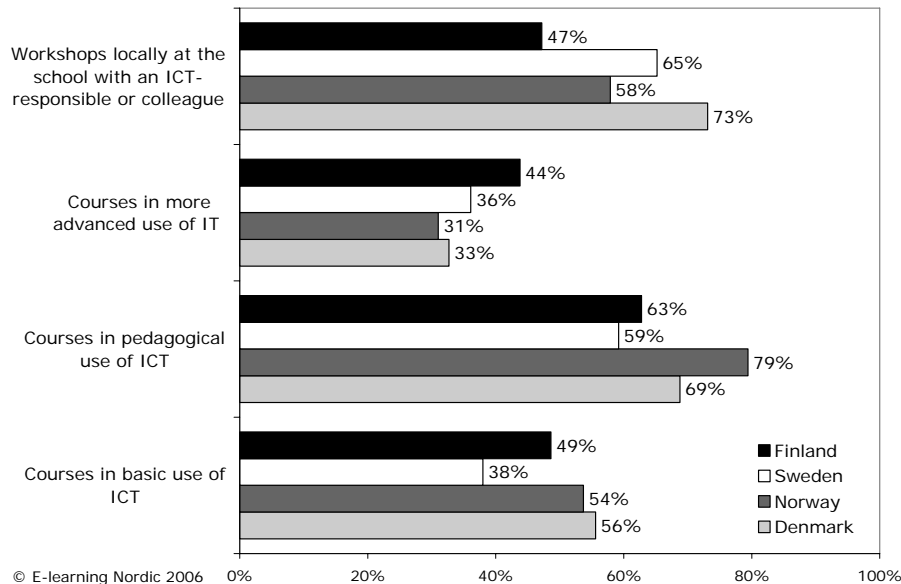


Figure 31: Question 6 to teachers: 'How much competence development have you participated in during the last 3 years? This refers to ICT competence development related to your work as a teacher' (selection only of teachers who have participated in competence development/N= 842)

Competence development does not make teachers ICT-confident

However, even though two thirds of the teachers have participated in competence development within the last three years, only a little more than one-third of the teachers assess that they to a great extent have sufficient competences in using ICT in their teaching. Here it is especially the female teachers who feel that they do not have good enough ICT competences. The great majority assess that they only to a moderate degree have sufficient competence to integrate ICT into their teaching.

Competence development does not make teachers ICT users

Furthermore, the impact of competence development seems to be limited, in terms of the teachers' actual use of ICT. Teachers who have participated in competence development within the last three years have not used ICT more than other teachers, and there is only a slight tendency towards that they experience a greater positive impact of ICT.

### **Teachers require a high 'comfortability zone' before they integrate ICT in their teaching**

Many teachers are not comfortable enough using ICT and therefore many often do not integrate ICT in their teaching. They are not sure about how to use ICT themselves and they do not dare let the pupils 'loose' without being able to control the situation. They are afraid of what can go wrong. This is the experience of pupils and the self-acknowledgement of the teachers at Greve Gymnasium (a secondary school in Denmark).

However, teachers at Greve Gymnasium mention that what has helped them is participation in the course 'Gymnasie-IT', which is a course in both practical use of standard ICT as well as pedagogical use.

A further analysis of the results shows an interesting dichotomy. It is in Sweden that the fewest teachers have participated in competence development within the last three years, but it is also in Sweden that there are the most teachers who, to a great extent, assess that they have sufficient ICT competences. In Norway it is just the opposite. The majority of teachers in Norway find that they do not have sufficient competences even though that most of them have participated in competence development within the last three years.

One explanation for this could be that in Sweden, the grand national initiative 'ITiS' (IT i skolan) was carried out more than three years ago, hence it is more than three years since the teachers were trained. In Norway a national initiative on the pedagogical ICT competence development has been carried out within these last three years. The teachers in Sweden have thus had over three years to practice what they learned under 'IT i Skolan' and they now feel more confident. On the other hand, the teachers who have just participated in training – as is the case in Norway – have only recently become aware of the possibilities as well what they do not know, this causing them to feel more uncomfortable. This explanation indicates that it takes a very long time before the impact of competence development can be seen.

Another explanation could be that the teachers who have not participated in competence development within the last three years have become self-sufficient and do not question their (perhaps lacking) skill level, and therefore feel more confident.

Explanation A:  
It takes a long time before the impact of competence development shows

Explanation B:  
Competence development to challenge teachers

Perspectives on competence development

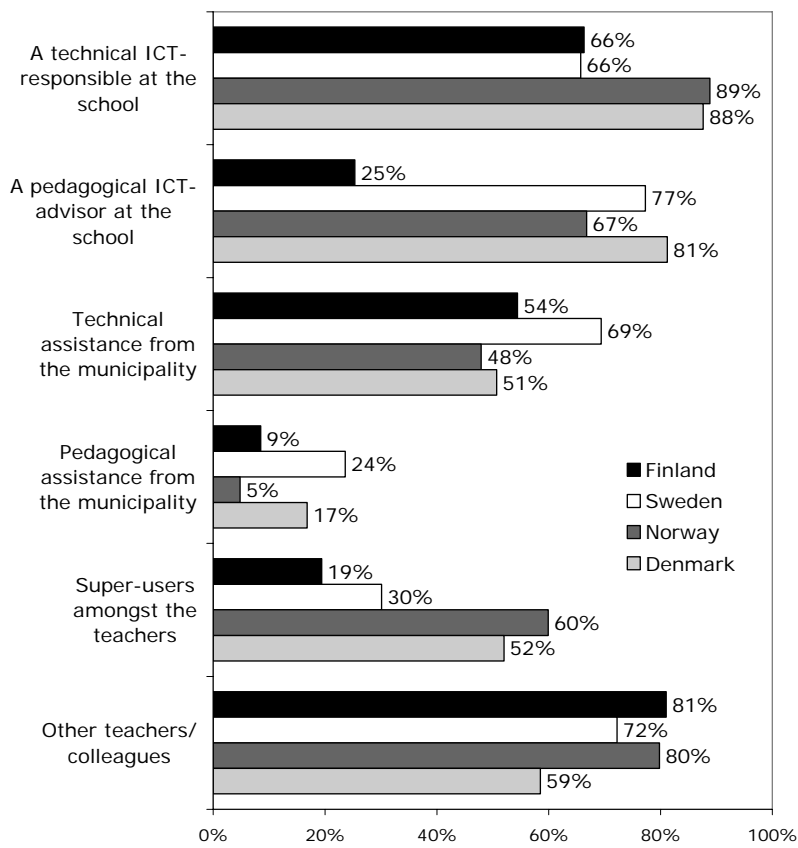
When assessing these results, it must be noted that different competence development initiatives have been initiated in all countries such as for example Ope.fi in Finland, ITiS in Sweden, LærerIKT in Norway and the pedagogical ICT-drivers licences in Denmark. Many resources and much time have been put into these initiatives and other types of competence development.

However, the impact of these investments in competence development seems to be limited. This does not mean that the resources spent have been wasted. They have been necessary to bring up the general level. However, the impact of the competence development could have been even stronger. There seem to be a gap between participating in a course and the actual use afterwards at a school. The various competence development initiatives have been frequently evaluated, however an overall analysis of the impact of competence development has not yet been carried out. Ramboll Management recommends that such an analysis be made future before new competence development initiatives are launched.

**Teachers can get help from resource persons such as the technical ICT-responsible or other colleagues, but super-users tend to be the ones who ensure integration of new pedagogical methods**

After the teachers have participated in competence development, what kind of support can they draw on when they want to integrate ICT in their teaching in new ways?

According to the headmasters, a technical ICT-responsible and other colleagues are the resource persons that most teachers can contact for assistance. In Sweden, Norway and Denmark, the majority of teachers can also turn to a pedagogical ICT-responsible at the school, while this is seldom the case in Finland.



Resource persons that teachers can contact for help with using ICT in their teaching

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Figure 32: Question 10 to headmasters: 'Which resource persons can the teachers turn to regarding the use of ICT in teaching?' (N=182)

A more in-depth analysis indicates that at schools, where super-users amongst the teachers provide ICT help a larger number of headmasters assess that ICT has ensured the integration of new pedagogical methods into the teaching.

Super-users support new pedagogical methods

### Resources

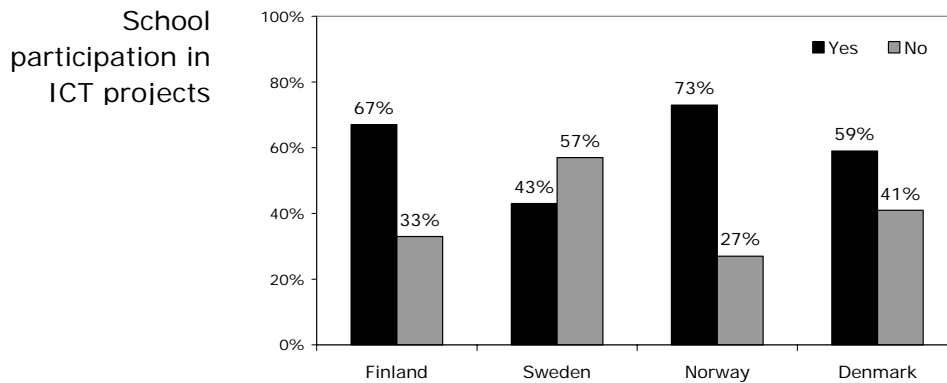
At Mörbyskolan (a primary school in Sweden), there are three teachers who help other teachers with the use of ICT.

It is considered a good decision that *a total of three* teachers have each been allotted 50% of their time to ICT, thus making the school less vulnerable if someone should get sick, find a new job or new assignments, etc.

One of the key experiences at the school is that ICT help has to be immediate help. If a teacher runs into an ICT problem, for example, in the middle of a class lecture and does not get instant support, then some teachers go back to the old way of teaching and are negative regarding the further use of ICT.

## School participation in an ICT project does not have an impact on the general use of ICT at the school

Many ICT projects have been carried out within the last few years in all four countries and at national, regional and local levels. For example, in Sweden 'IT i skolan', in Norway 'PILOT' (Prosjekt Innovasjon i Læring, Organisasjon og Teknologi) and in Denmark 'ITMF' (IT og Medier i Folkeskolen).



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Figure 33: Question 6 to headmasters: 'Has your school participated in one or more projects concerning the use of ICT during the last 3 years?' (N=176)

The majority of schools in Finland, Norway and Denmark, participating in *E-learning Nordic 2006* have also been a part of one or more projects focused on the use of ICT within the last three years. In Sweden the numbers are significantly lower which is most likely due to the fact that it is now more than three years since the grand Swedish initiative 'IT i Skolan' was completed (ITiS ran 1999-2002), and no new national initiatives have been started.

No general impact from participation in ICT-projects

Much money and time has been spent on these projects and therefore it is interesting to ask whether a school's participation in one or more ICT -projects leads to show an improved impact on the participating schools use and experienced impact of ICT? The answer to that question is though negative, however. An analysis of the results show no sign of that teachers, pupils or parents at schools, which have participated in an ICT project within the last three years, use ICT more or have experienced a greater impact of ICT.

Can a general impact of ICT projects be expected?

To this it must be noted that while some of these projects concentrate on general school development with the use of ICT, others focus 'only' the use of ICT in specific subjects. Therefore it can be argued that it cannot be expected that the whole school should have experienced an impact from participating in a project.

However, it has been an underlying goal in many projects that concrete experiences and examples of use should inspire other teachers to use ICT and lead to more use in general. This for example in the Finnish project 'Snöballen'. If this has been a goal then this study shows that it has not succeeded. This is supported by other studies e.g., the evaluation of the grand Danish initiative 'IT and Medias in Primary School' (ITMF ran 2002-2005). The evaluation of ITMF showed that projects often are 'isolated islands' in the school.

While the projects may be very interesting for the participants, but the projects are not extended after the project period ends, the experiences are not shared with others at the school and a greater impact is not seen. If this is to happen, then disseminating and anchoring the best experiences from a project should be a key focus in the project, and school management must to be committed to integrating the results in the daily routines of the school.

### What are drivers and barriers for achieving a greater impact from ICT?

Introducing new procedures in schools and changing daily practices is a complex process. A number of organisational factors can influence the use of ICT both as drivers and as barriers and can refer to factors both internally at the school and outside the school. Examples of internal factors are displayed in the model below within the inner ring, while external examples of factors are depicted in the outer ring.

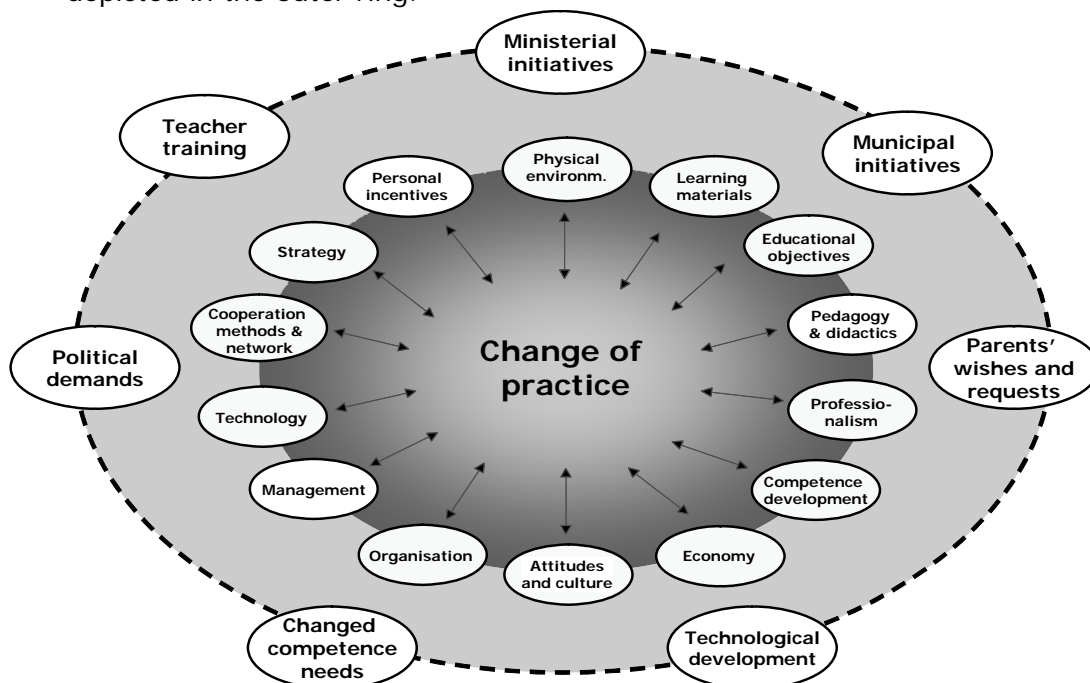


Figure 34: Drivers and barriers for the change of practice at schools

In the study, both headmasters and teachers were asked what they experienced as the barriers and drivers for achieving a greater impact of ICT in the teaching at the school. This varies of course, depending on the schools ICT maturity and country, but still some trends clearly stand out, together with a great conjunction in the replies from headmasters and teachers.

Driving forces for greater impact of ICT      The all-encompassing *driving force* for achieving a greater impact of ICT in teaching according to the majority of both headmasters and teachers in all countries is '*Easily accessible ICT-equipment*'.

### Driving forces for integration of ICT at schools as assessed by headmasters and teachers

	Finland	Sweden	Norway	Denmark
Easily accessible ICT equipment	<b>Headmasters 61%</b> <b>Teachers 57%</b>	<b>Headmasters 62%</b> <b>Teachers 72%</b>	<b>Headmasters 62%</b> <b>Teachers 49%</b>	<b>Headmasters 66%</b> <b>Teachers 73%</b>
Good selection of interesting learning software	<b>Headmasters 57%</b> <b>Teachers 56%</b>	Headmasters 7% Teachers 24%	Headmasters 4% Teachers 14%	Headmasters 18% <b>Teachers 31%</b>
Clear pedagogical objectives for use of ICT at the school	Headmasters 23% Teachers 22%	<b>Headmasters 51%</b> <b>Teachers 28%</b>	<b>Headmasters 38%</b> <b>Teachers 26%</b>	Headmasters 30% Teachers 21%
New pedagogical opportunities	Headmasters 37% Teachers 22%	Headmasters 34% <b>Teachers 25%</b>	Headmasters 37% Teachers 25%	Headmasters 21% Teachers 13%
Inspiration from committed enthusiasts	<b>Headmasters 44%</b> <b>Teachers 23%</b>	<b>Headmasters 46%</b> Teachers 17%	Headmasters 28% Teachers 22%	Headmasters 17% Teachers 19%
Inspiration from courses	Headmasters 12% Teachers 21%	Headmasters 12% Teachers 25%	Headmasters 2% Teachers 19%	Headmasters 21% <b>Teachers 31%</b>
Pupil motivation for using ICT	Headmasters 20% Teachers 18%	Headmasters 23% Teachers 15%	Headmasters 33% <b>Teachers 36%</b>	Headmasters 18% Teachers 16%
Good collaboration and support from colleagues when using ICT in teaching	Headmasters 14% Teachers 20%	Headmasters 15% Teachers 24%	Headmasters 31% Teachers 17%	<b>Headmasters 43%</b> Teachers 22%
Support and focus from school management on the use of ICT in teaching	Headmasters 15% Teachers 17%	Headmasters 38% Teachers 15%	<b>Headmasters 42%</b> Teachers 24%	<b>Headmasters 30%</b> Teachers 8%

Figure 35: Question 17 to headmasters/Question 20 to teachers: 'What do you assess to be the 3 major driving forces for achieving a greater impact of ICT in teaching at your school? Please provide only 3 answers in total' (selection – N for headmasters=181/N for teachers=1245). Replies marked in **bold** are the top three driving forces for each respondent group in each country.



However, otherwise there are great differences in what is assessed to be most important driving forces for a greater impact of ICT on teaching in schools. In both Sweden and Norway, many headmasters and teachers point to '*Clear pedagogical objectives for use of ICT at the school*', while this is to a lesser degree the focus in Finland and Denmark.

In Finland '*The selection of interesting learning software*' is seen as a major driving force for both headmasters and teachers, while this is not the experience by very many in Sweden and Norway. The responses from Denmark are very dispersed. Headmasters and teachers seem to have very different views on what are the major driving forces in Denmark.

#### **A driver: School has to be on track with society**

At Mörbyskolan (a primary school in Sweden), a major driving force for the integration of ICT is assessed to be the demand for the school to be on track, and preferably ahead, in society in the use of ICT.

At the school, there is a focus on the need for offering the same ICT environment at school as the one offered in the pupils' homes. If not, it is assessed that there is the risk that pupils and their parents will "look down" on the school. Currently there are some examples at the school where the pupils are ahead and they help the teachers in their endeavours to use ICT. This is mostly experienced as a positive impact, but still the school has to assure that it can meet the competence level of all pupils.

#### **A driver: Clear demands for the use of ICT**

At Århus Statsgymnasium (a secondary school in Denmark), the headmaster sees the new curriculum as a strong driver for the integration of ICT into all subjects. This is because the new curriculum plan sets very clear goals for how ICT must be used. The use of ICT was also written into the former curriculum plan, but in a more unclear way. The new more precise demands make it easier to follow-up on whether the goals have been achieved.

Two barriers mentioned by most headmasters and teachers for achieving a greater impact from ICT are:

- Too little ICT equipment at the school
- The teachers do not have sufficient ICT competences to teach with ICT.

Barriers for greater impact of ICT

## Barriers for integration of ICT at schools as assessed by headmasters and teachers

	Finland	Sweden	Norway	Denmark
ICT equipment at the school is too old	Headmasters 15% <i>Teachers 16%</i>	Headmasters 23% <i>Teachers 16%</i>	Headmasters 18% <i>Teachers 28%</i>	Headmasters 18% <i>Teachers 24%</i>
Too little ICT equipment at the school	<b>Headmasters 40%</b> <b>Teachers 53%</b>	<b>Headmasters 32%</b> <b>Teachers 52%</b>	Headmasters 27% <b>Teachers 44%</b>	<b>Headmasters 36%</b> <b>Teachers 52%</b>
The school's physical layout is a barrier for easy access to ICT equipment when it is need in relevant teaching situations.	Headmasters 16% <i>Teachers 16%</i>	Headmasters 22% <i>Teachers 24%</i>	Headmasters 15% <i>Teachers 25%</i>	<b>Headmasters 40%</b> <i>Teachers 38%</i>
Lack of knowledge of pedagogical opportunities among the teachers	Headmasters 29% <i>Teachers 19%</i>	<b>Headmasters 43%</b> <b>Teachers 41%</b>	<b>Headmasters 44%</b> <b>Teachers 40%</b>	<b>Headmasters 31%</b> <i>Teachers 21%</i>
Limited focus in the school board on using ICT in teaching	Headmasters 0% <i>Teachers 2%</i>	Headmasters 12% <i>Teachers 10%</i>	Headmasters 7% <i>Teachers 5%</i>	Headmasters 7% <i>Teachers 3%</i>
Limited focus among the teachers on using ICT in teaching	<b>Headmasters 39%</b> <i>Teachers 21%</i>	Headmasters 30% <i>Teachers 23%</i>	<b>Headmasters 46%</b> <i>Teachers 16%</i>	Headmasters 24% <i>Teachers 14%</i>
Teachers do not have sufficient ICT competences to teach with ICT	<b>Headmasters 50%</b> <b>Teachers 46%</b>	<b>Headmasters 58%</b> <b>Teachers 32%</b>	<b>Headmasters 38%</b> <b>Teachers 35%</b>	Headmasters 26% <b>Teachers 29%</b>
Lack of pedagogical advice to teachers about how ICT can be used in teaching	Headmasters 25% <i>Teachers 23%</i>	Headmasters 7% <i>Teachers 25%</i>	Headmasters 21% <i>Teachers 21%</i>	Headmasters 12% <i>Teachers 17%</i>
Limited opportunities for technical advice and support	Headmasters 25% <b>Teachers 27%</b>	Headmasters 7% <i>Teachers 14%</i>	Headmasters 21% <i>Teachers 21%</i>	Headmasters 12% <i>Teachers 14%</i>

Figure 36: Question 16 to headmasters/Question 19 to teachers: 'What do you assess to be the 3 major barriers for achieving a greater impact of ICT in teaching at your school? Please provide only 3 answers in total' (selection – N for headmasters=182/ N for teachers=1251). Replies marked with **bold** are the top three barriers for each respondent group in each country.

'Too little ICT equipment at the school' is especially a barrier for the headmasters at schools with more than 10 pupils per computer. While 'The teachers do not have sufficient ICT competencies to teach with ICT' is a major barrier not only in schools with little equipment, but also at schools that have invested heavily in ICT.

Otherwise, there are great differences between the countries on what is assessed to be the major barriers. It is only in Finland that 'Limited opportunities for technical advice and support' is seen as a major barrier by many teachers, while only in Denmark many headmasters experience that 'The schools physical layout is a barrier for an easy access to ICT equipment when it is need in relevant teaching situations'. This focus in Denmark may very well be

due to the fact that the national initiative 'IT i Folkeskolen' – supporting the purchase of ICT-equipment for pupils in 3<sup>rd</sup> grade – requires that the equipment must be placed in the classroom or in the vicinity of the classroom.

### **Lack of municipal resources leaves the initiative to fiery souls**

Averøy Ungdomsskole (a primary school in Norway) is situated in a small municipality with fairly limited economic resources. In the education area, long-term strategic thinking has not been the key issue. A local curriculum for training and education for the purpose of using a computer has been developed for the schools in Averøya, however the development has still very much been in the hands of some committed enthusiasts. A number of teachers has obtained the pedagogical ICT driver's licence "Lærer-IKT", but have only been partly compensated for the time resources spent on the course. The purchase of hardware and software in the municipality has not been coordinated, which has resulted in very varied technological standards at the schools. Competence development has also not been coordinated in the municipality which has resulted in very varied competences among the teachers.

In the 1980's and 1990's, just getting access to a computer was a barrier, but during the last decades there have been heavy investments in infrastructure and competence development and therefore the drivers and barriers have also changed – or have they? This study shows that there is still a great focus on access to the technology and competence development as the drivers and barriers for the integration of ICT.

Why do we see these well-known drivers and barriers?

The reasons for this can either be that this is an area requiring continuous investment because equipment and demands change so fast, or that the respondents answer by 'auto-pilot' simply pointing to the well-known arguments and excuses.

## 9. Methodology

Developing a methodology to show the impact of ICT is a challenge, as discussed in the Chapter 3 (*'What do we mean by 'impact'?*). Assessing the methods possible, Ramboll Management decided to carry out *E-learning Nordic 2006* by asking the key respondents about their assessment of the impact of ICT. In this chapter, the methodology finally used in the study is presented in more detail.

The study was developed in co-operation between the four ministries and Ramboll Management. As part of the study, the following data collection activities were carried out:

Data collection activities in the study

- **Internet-based survey:** A survey was conducted among 224 Nordic schools. More than 8000 persons participated in the survey. Respondents were teachers in 5<sup>th</sup> grade and 8<sup>th</sup> grade in primary education and the 11<sup>th</sup> grade in secondary education, pupils in all three of these grades, their parents, and headmasters responsible for these schools. Different questionnaires were developed for the different types of respondents.
- **Twelve school visits:** Follow-up visits at schools in all four Nordic countries were carried out. Interviews were held with teachers, pupils, school management, parents, and municipal representatives. Focus in the visits was on an assessment of the results from the survey, as well as putting the results into further perspective. The schools were selected from the total 224 schools.

Throughout the study, the study design, themes and draft questionnaires as well as results were assessed and commented on by teachers, private companies, policy makers, and researchers.

Timeplan for the study

Data collection was mostly carried out in 2005. In August the survey was initiated with an invitation to schools regarding participation in the project, and in September questionnaires were sent out. Filling out the questionnaires took place in October to December, and school visits were carried out in December. One final school visit was held in January 2006.

### Schools as key unit

Throughout the study and analysis, schools have been the key to the data material. Headmasters, teachers, pupils and parents could have been selected at random at different schools, but instead schools have been the point of departure for the analysis. A

total of 224 schools have participated in the survey. At these schools, pupils in the 5<sup>th</sup>, 8<sup>th</sup> or 11<sup>th</sup> grades have participated in the study, these pupils' teachers and their parents and finally the headmasters of the school.

Having respondents relating to the same unit (the school) has made it possible to triangulate the answers on school level. For example, the headmasters' answers regarding the schools' ICT infrastructure was crossed and compared to the teachers' use of different types of ICT. Furthermore, this method has made it possible to shorten the questionnaires without losing depth in the results.

School as unit to triangulate results on school level

### **Recruiting schools to study**

To recruit the schools, an invitation was sent to 1200 Nordic schools. The schools were divided evenly between the four countries, from all parts of the respective countries and along each of the three grade levels.

The recruiting of the schools was split up in different phases. First, an invitation signed by the respective ministry in each country was sent via ordinary mail to the headmaster. One week later, the invitation was also sent via e-mail, assuring that as many as possible of the headmasters would receive the invitation. In order to reach a sufficient number of participating schools (having 30 schools in each country as the minimum level) there were also carried out recruitment of schools via telephone.

Phases in school recruitment

Approximately 20% of the schools that were asked to participate responded positively. To ensure representativity with regard to the selection parameters (country, geography and grade level), the characteristics of the selection of schools were analysed and the final telephone recruiting was targeted departing in the results.

Representativity in sample

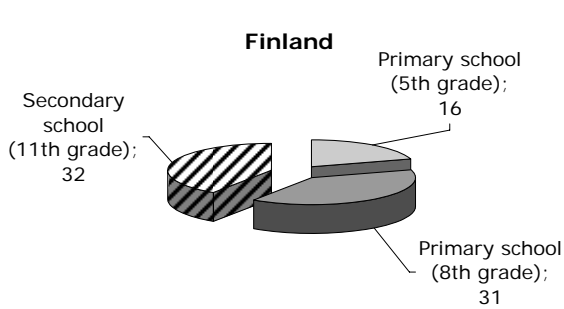


Figure 37: (N=79)

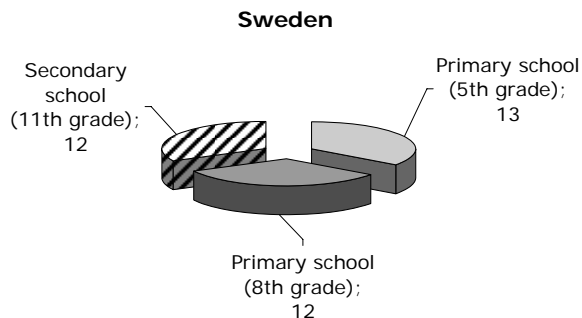


Figure 38: (N=37)

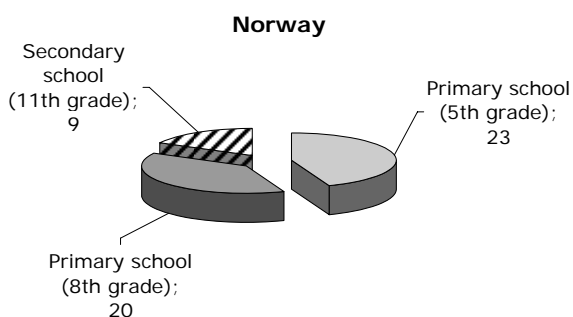


Figure 39: (N=52)

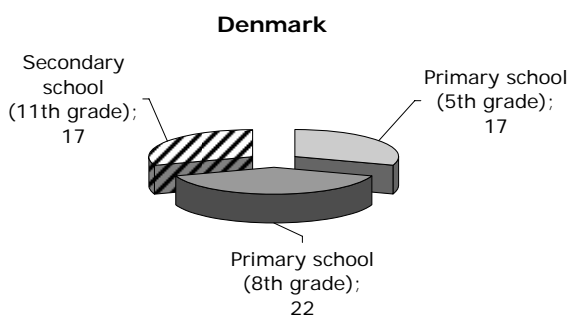


Figure 40: (N=56)

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Number of schools participating in the survey. Viewed by country and by school level.

An analysis of the profile of the final selection of schools regarding the selection parameters was carried out and it showed that the distribution was satisfactory.

### Development of questionnaires

Four different questionnaires were developed, one for each of the respondent groups (teachers, pupils, parents and headmasters). Each questionnaire was adapted to the frame of reference for each respondent group. Still, some themes and questions were relevant for more than one respondent group, and in those situations, closely identical questions were asked to support comparativity in the responses.

In the development of questionnaires special care was taken to ensure that the questions to pupils would be understandable at all levels.

In the development of the questionnaires, the key themes and draft questions were commented on by policy makers, researchers, private companies and teachers.

The questionnaires were finally translated to the national languages (Finnish, Swedish, Norwegian and Danish).

The four questionnaires used in the survey are made available on the websites of the participating ministries and agencies in the national language, as well on the website of Ramboll Management in all languages.

### **Practical implementation of questionnaire-based survey**

As part of responding positively to participate in the project, the headmaster appointed him/herself or a colleague to be responsible for the practical carrying out of the questionnaire survey at the school.

Some weeks after the sufficient number of schools had chosen to participate in the study, the contact person at the school received personal information letters to be handed out to teachers, pupils, their parents, as well as the headmasters together with precise instructions for this distribution and the further management of the survey. The personal information letters included information about the study, a user name and a password for entering the study on the web.

Time plan for questionnaire

At each school, as a maximum, 1 headmaster, 60 teachers, 60 pupils and 60 parents received an information letter. This upper level of number of respondents was chosen in order to keep distribution of information letters and management of filling out the questionnaires on a manageable level for the schools.

Each group of respondents responded to questionnaires adjusted to their specific respondent group.

Among the schools with the highest response rate a draw was made to win eight projectors sponsored by InFocus® Corporation<sup>13</sup>. The following schools won a projector:

- Kauppi-Heikin koulu, Peltosalmi in Finland
- Kaarilan koulu, Tampere in Finland
- Kallingskolan LM, Kallinge in Sweden
- Malmö Borgarskola, Malmö in Sweden

**InFocus**

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<sup>13</sup> InFocus® Corporation is a manufacturer of projectors that offers custom-made functionality to the educational sector.

- Averøy ungdomsskole, Averøy in Norway
- Verket skole, Moss in Norway
- Uhre Skole, Brande in Denmark
- Blovstrød Skole, Allerød in Denmark

The results from the survey are made available on the websites of the participating ministries and agencies, as well on the website of Ramboll Management.

### **Respondents in the questionnaire based survey**

A total of more than 8000 persons have participated in *E-learning Nordic 2006* representing different views on the impact of ICT in the Nordic schools:

- 183 headmasters
- 1312 teachers
- 5023 pupils
- 1876 parents.

Measures taken to secure high response rate Different measures were taken to secure a response rate as high as possible. Initially, to motivate the headmasters to involve their school in the survey, various incentives were presented:

- The schools obtaining the highest response rates could win a projector.
- The schools would receive the final report.
- The school would receive an account of their ranking in relation to other schools.
- To assist teachers, Ramboll Management developed information material on how questionnaires generally are carried out, in order for teachers to use this in the teaching.

After the survey was initiated different measures were taken to encourage respondents, who had yet not filled out the questionnaire, to do so:

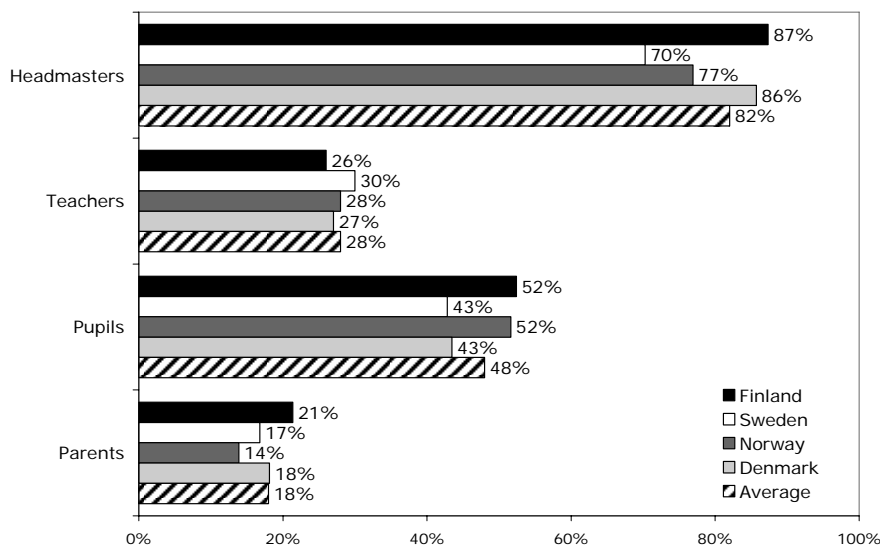
- The contact person received an e-mail informing him/her to remind the respondents. At this stage we also prolonged the deadline for answering the questionnaire.
- Calling our contact persons asking them to further remind their colleagues to fill out the questionnaire.
- Contacting our contact persons, asking them to send us the e-mail addresses of the teachers participating in the study (it was primarily among teachers more respondents were needed). This effort provided us with the e-mail addresses of 869 teachers. Then the questionnaire was sent directly to the e-mail addresses of the teachers who so far had not answered.



## Uncertainty in responses and representativity of response group

Various measures were taken to assess whether the respondents participating in the study are representative of the whole population of headmasters, teachers, pupils or parents.

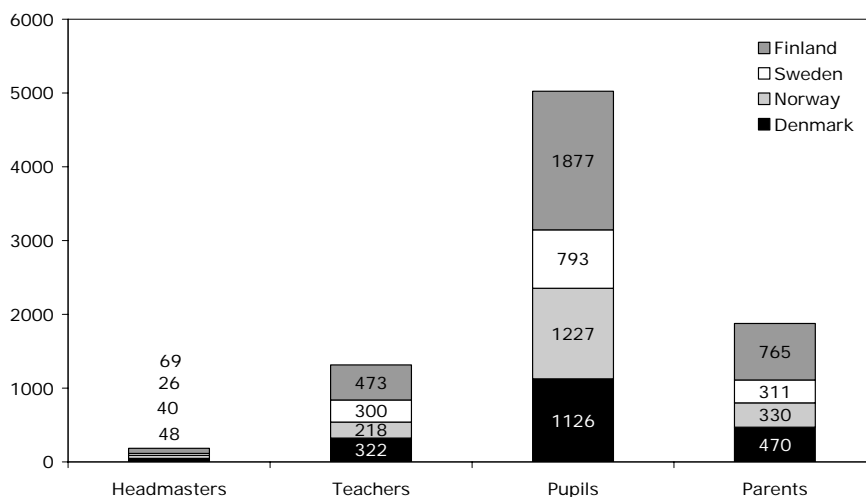
First, the number of respondents was calculated in relation to the total number of persons invited to participate in the study (response rate).



Response rate viewed by respondent group and country

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Figure 41: Response rate viewed by respondent group and country



Number of respondents viewed by respondent group and country

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Figure 42: Number of respondents participating in the survey viewed by respondent group and country

'Weights' on results

Second, it was noted that there are differences between how many respondents finally filled out the questionnaires in the different countries and at the different school levels. To ensure that a special high or low number of respondents in one country or at one school level would not distort the overall results, 'weights' have been calculated and put on the data. 5th grade in Denmark has been set as basis. So if you look at the distribution between countries, all 4 countries constitute 25% of the sample. Likewise if you look at the distribution between grades, all three grades constitute 33% of the sample.

Based on the above, the statistical uncertainty was calculated for each response group. The statistical uncertainty is calculated by a 95% confidence interval. This means that the result will be within this interval in 95 of 100 samples.

General statistical uncertainty

Total	Head-masters	Teachers	Parents	Pupils
Number of replies	184	1313	1876	5023
Percentage	50%	50%	50%	50%
Uncertainty in percentage point +/-	7.2%	2.7%	2.3%	1.4%

Figure 43: General statistical uncertainty

The uncertainty will vary depending on the calculated share. However, the uncertainty will be the greatest when 50% select a given response, therefore the calculation is based on that premise.

It can be seen that the uncertainty and response rate varies for the different response groups, hence the results for each response group must be assessed separately.

Headmasters: responses and assessment of representativity

The response rate among the headmasters is very high (average 82%). As this is the group that has accepted their schools' participation in the first place and therefore must be seen as the most committed, this is as expected.

Even though the response rate is high the total number of schools – and therefore headmasters – participating in the study is limited (N=183). Therefore the uncertainty in the results is very high, as presented in the figure above and below. Based on this, the results and variation in the results from the headmasters has been viewed critically in the analysis.

<b>Headmasters</b>				
	<b>Finland</b>	<b>Sweden</b>	<b>Norway</b>	<b>Denmark</b>
Number of replies	69	26	41	48
Percentage	50%	50%	50%	50%
Uncertainty in percentage point +/-	11.8%	19.2%	15.3%	14.1%

	<b>Primary school/ 5th grade</b>	<b>Primary school/ 8th grade</b>	<b>Secondary school/ 11th grade</b>
Number of replies	56	68	60
Percentage	50%	50%	50%
Uncertainty in percentage point +/-	13.1%	11.9%	12.7%

Figure 44: Statistical uncertainty for headmasters in the participating countries and at school level

The average headmaster answering the survey is male, above 50 years of age and with more than 6 years of experience. It has not been possible to collect statistical information on gender, age or experience of headmasters in the whole population of headmasters in the participating countries in order to assess the representativity of the participating headmasters' characteristics. However, as the selection of schools is representative with regard to the selection parameters (country, geography and grade level), the sample of headmasters is assessed to be representative.

The response rate among teachers is only 28%. That is not a satisfactory response rate. A low response rate among teachers was to some degree expected as other surveys involving teachers have also shown low response rates. With this in mind, varied measures were taken to motivate and encourage teachers to participate, as presented earlier in this chapter. This was however not sufficient.

Teachers:  
uncertainty in responses and assessment of representativity

Very aware of this challenge, another strategy was also used to ensure validity. This strategy was inviting a larger sample of teachers to participate in the survey. This was to ensure that *if* the response rate would be low, *then* the total number of participants would still be high ensuring less uncertainty in the responses. This strategy proved successful. The total number of teachers participating in the survey is 1312, which is a satisfactory number of respondents.

<b>Teachers</b>				
	<b>Finland</b>	<b>Sweden</b>	<b>Norway</b>	<b>Denmark</b>
Number of replies	473	300	218	322
Percentage	50%	50%	50%	50%
Uncertainty in percentage point +/-	4.5%	5.7%	6.6%	5.5%

	<b>Primary school/ 5th grade</b>	<b>Primary school/ 8th grade</b>	<b>Secondary school/ 11th grade</b>
Number of replies	147	497	669
Percentage	50%	50%	50%
Uncertainty in percentage point +/-	8.1%	4.4%	3.8%

Figure 45: Statistical uncertainty for teachers in the participating countries and at school level

Then, efforts were made to assess whether the respondents having participated in the survey were representative for the whole population of teachers. The profile (age and gender) of the teachers participating were thus compared with the profile of teachers in general, as described in OECD's *Education at a glance* (2005)<sup>14</sup>. The variations on gender at the different school levels are within the calculated uncertainty except for there being a slight over-representation of female teachers in secondary school in Norway<sup>15</sup>. Regarding age there is a slight over-representation of teachers below 40 years of age in Swedish, Norwegian and Danish primary schools having participated in the survey, at the expense of teachers above 50 years of age, while in secondary school it is the opposite. There the teachers above 50 years of age are slightly over-represented<sup>16</sup>. These differences are assessed to be minor and not significant, and the response group is as regards age and gender assessed to be representative.

Next it can be suggested that as the questionnaire was web-based, then it might be the more ICT-enthusiastic teachers who have taken time to answer the questionnaire. Furthermore, the fact that the teachers could choose to answer the questionnaire at home instead of at school may have led to more teachers with a computer at home having answered the questionnaire. Taking this into consideration, there might be an over-representation of ICT-enthusiasts in the response group. To test for this hypothesis we would like to have compared the access to a computer and the

<sup>14</sup> *Education at a glance 2005*/ indicator D7. Please note, these numbers in the 2005 edition are from 2003

<sup>15</sup> Numbers for gender distribution in secondary school in Denmark has not been found.

<sup>16</sup> Numbers for age distribution in secondary school in Denmark has not been found.

internet at home for the teachers participating in the survey with teachers in general. However, such numbers are not available. Instead we have compared the numbers for the general population in the participating countries with the teachers participating in the survey.

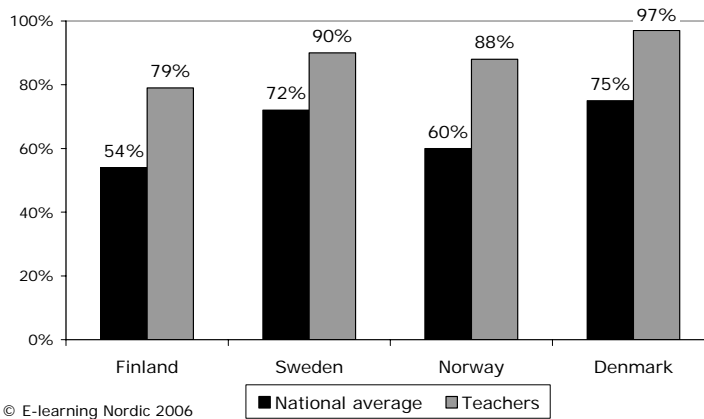


Figure 46: National average of access to internet at home, according to 'Nordic Information Society Statistics 2005' and of teachers participating in E-learning Nordic 2006

The above figure shows that the response group scores significantly higher on infrastructure access than their respective national averages. However, as the national averages for households with two adults and children are far greater than the average presented above, and as 70% of the teachers participating in the study are below 50 years of age, and therefore may be living with children, then this may also just be this trend showing in the numbers. Based on this the percentage of teachers with internet access must be expected to be a little lower, but still high.

Taking these considerations into account, there is a tendency towards an overrepresentation of teachers with internet access at home, though not as striking as first expected, however still leading to a potential over-representation of ICT enthusiasts in the response group. This bias may again lead to an inflated picture of the impact of ICT. Therefore in the analysis of the results, a slight over-representation of ICT enthusiasts has been taken into account when assessing the results and this must also be considered when reading the figures.

Almost half the pupils have answered the questionnaire. That totals to more than 5000 pupils having answered the questionnaire. Considering that the teachers had to take time to let the pupils answer the questionnaire within a limited time period, this is assessed to be a satisfactory response rate giving a very low uncertainty in the responses.

Pupils:  
uncertainty in responses and assessment of representativity

<b>Pupils</b>				
	<b>Finland</b>	<b>Sweden</b>	<b>Norway</b>	<b>Denmark</b>
Number of replies	1877	793	1227	1126
Percentage	50%	50%	50%	50%
Uncertainty in percentage point +/-	2.3%	3.5%	2.8%	2.9%

	<b>Primary school/ 5th grade</b>	<b>Primary school/ 8th grade</b>	<b>Secondary school/ 11th grade</b>
Number of replies	1190	2377	1456
Percentage	50%	50%	50%
Uncertainty in percentage point +/-	2.8%	2.0%	2.6%

Figure 47: Statistical uncertainty for pupils in the participating countries and at school level

Looking at the profile of the pupils, there are just as many boys and girls having answered the questionnaire, indicating that it is whole classes that have participated and not just the enthusiastic ICT boys. Furthermore it can be noted that as the schools are selected to be representative, the pupils will also be so regarding country, geographical distribution in the country and school level. The response group of pupils is assessed to be representative.

Parents: The response rate among the parents is very low. An average of only 18% has filled out the questionnaire. That is not satisfactory. However, as the sample size has been very large, this has meant that 1876 parents have participated. This is assessed to be a satisfactory number of respondents.

<b>Parents</b>				
	<b>Finland</b>	<b>Sweden</b>	<b>Norway</b>	<b>Denmark</b>
Number of replies	765	311	330	470
Percentage	50%	50%	50%	50%
Uncertainty in percentage point +/-	3.5%	5.6%	5.4%	4.5%

	<b>Primary school/ 5th grade</b>	<b>Primary school/ 8th grade</b>	<b>Secondary school/ 11th grade</b>
Number of replies	492	725	659
Percentage	50%	50%	50%
Uncertainty in percentage point +/-	4.4%	3.6%	3.8%

Figure 48: Statistical uncertainty for parents in the participating countries and at school level

Of the parents two out of three are women and only one third men. Slightly more parents in primary school than in secondary school have answered the questionnaire. However, this is seen as

inevitable, as the parents in primary school are also more involved in the school than parents in secondary school.

The fact that the parents have to motivate themselves to participate as well as the fact that filling out the questionnaire required internet access may have caused a bias in the sample with more parents with extra reserves economically (having a computer with internet or a job with internet access) and personally (motivate themselves to participate).

Taking the above into account, the results from the parents must be viewed as less statistically reliable and this has been taken into consideration when analysing the results. The results from the parents have been assessed more critically and been used to a lesser degree, however the reader must also take this into consideration when reading the results.

Finally the results from the questionnaire have been presented to headmasters, teachers, pupils, parents and municipal representatives during school visits (see below). During these visits, various participants have been asked to assess the representativity of the results. From these interviews there are no indications that the results in general should not be representative.

General  
assessment

### **School visits – for assessing and putting into perspective the results from the questionnaire-based survey**

In addition to the survey, 12 school visits (three in each country) were carried out. The following schools participated in school visits:

- Jokelan yläaste, a primary school in Finland
- Oulun lyseon lukio, a secondary school in Finland
- Borgå Gymnasium, a secondary school in Finland
- Mörbyskolan, a primary school in Sweden
- Oxhagsskolan, a primary school in Sweden
- Rodengymnasiet, a secondary school in Sweden
- Oslo Montessori Skole, a primary school in Norway
- Averøy ungdomsskole, a primary school in Norway
- Knarvik vidaregåande skule, a secondary school in Norway
- Langmarkskolen, a primary school in Denmark
- Århus Statsgymnasium, a secondary school in Denmark
- Greve Gymnasium, a secondary school in Denmark.

The schools were chosen from among the 224 schools that participated in the survey, showing different characteristics in their use of ICT.

Assessing and putting into perspective the results from the survey

The school visits had as their main purpose to assess and put into perspective the results from the survey, primarily the different areas of impact. Hence, a selection of the trends seen in the survey was further dealt with at the school visit.

Headmasters, teachers, pupils, and parents were interviewed. In addition, municipal representatives and staff responsible for ICT pedagogy or technology at the school were also interviewed.

Municipal representatives, staff responsible for ICT pedagogy or technology at the school, and headmasters were interviewed individually, whereas the other groups of respondents were interviewed in groups.

The results from the school visits have been used in the assessment of the results from the survey, but they have also been used as short examples presented throughout the report in the grey boxes.



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## *E-learning Nordic 2006*

The Nordic countries are known as world leaders in the area of ICT in education. Ever since the early nineties, the Nordic countries have invested in ICT in the educational sector, based on the strong belief that the realm of ICT goes far beyond the immediate business and industry applications and ICT is seen as an essential cultural technique which can significantly improve the quality of education. However, at the same time, there is a lack of measurable evidence showing the overall impact of ICT on education. Until now, no Nordic studies have been undertaken on a general level with this focus.

E-learning Nordic 2006 is the first inter-Nordic study specifically concentrating on the impact of ICT on education. It was carried out in Finland, Sweden, Norway and Denmark, and more than 8000 persons (pupils, teachers, headmasters and parents in primary and secondary schools) have participated. This study offers very important answers to the major questions: What has actually been the return on investment from the investments in ICT? And what educational challenges do the Nordic countries face in a globalized world?

The E-learning Nordic 2006 study was designed and launched as a partnership between The Finnish National Board of Education, The Swedish National Agency for School Improvement, The Norwegian Ministry of Education and Research, The Danish Ministry of Education, and Ramboll Management. Ramboll Management is responsible for the study.



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