OECD/CERI ICT AND THE QUALITY OF LEARNING PROGRAMME

A Case Study of ICT and Organisational Change at Hjortespring Skole – Denmark

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1 Presentation of Hjortespring Skole

Skole is a folkeskole (primary and lower secondary school) run by the local authorities (municipality) and situated in a Copenhagen suburb. Abt. 800 students are distributed on about 40 classes (grades 0 - 10) and are recruited from a social district divided into one neighbourhood with one-family houses and one consisting of municipal blocks of flats. The two areas are equally represented at Hjortespring Skole.

Abt. 70 persons are employed at the school which above ordinary teaching comprises a 'remedial centre' for students with learning difficulties and a 'language centre' for children of immigrants and refugees. In addition are attached: psychologists (four days a week, social workers (twice a week) and a visiting nurse (twice a week).

The school is divided into four sections[i] each with a staff room for the attached teachers, who are organized in teams around each class. The teaching also comprises occasional courses where the entire school breaks up the timetable and devotes its time to cross curricular and project activities.

The school's ICT equipment comprises 225 computers of which abt. one third are constantly out of order owing to wanton destruction, general wear and tear etc. The computers are distributed on two computer rooms, various classrooms, administration, the teachers' preparation room and the pedagogical service centre (PSC). Abt. 70 of the computers have access to the world wide web. Thus, the student/computer ratio at Hjortespring Skole is abt. 5,3 students per operational computer and abt. 11,3 students per computer with internet access.

Three of the teachers also act as ICT instructors, one of which solely devotes his time to technical problems, while the other two are in charge of the pedagogical aspects of the implementation. Moreover, a number of teachers are assigned to the PSC as teacher's aides and planners of teaching courses for teachers and students. Of these teachers two are in charge of ICT-related courses. 10 hours a week have been set aside for each of the teacher's aides.

[i] Section 1, school start, comprises kindergarten class – grade 2. Section 2 covers grades 3-4; section 3 grades 5-7; section 4 grades 8-10. Grade 10 is divided into three subsections, which in the previous school year was academic line, media line and technical line.

2 The past

At Hjortespring Skole ICT did not really form part of the agenda until the present principal was appointed about 10 years ago. He considered the scanty ICT equipment at the school's disposal neither adequate nor sufficiently professional, for which reason he took care that up-to-date computers were purchased for the administration and for the establishment of one computer room. The teachers attended training courses in WordPerfect which then was the word processing programme mostly used. In the course of time it became obvious that one computer room was insufficient, and the principal decided tentatively to place a few computers in all the 1st grade classrooms, which did not arouse unambiguous enthusiasm among the teachers. At the same time a vice-head was appointed who involved himself deeply in the diffusion of the new media, and since then the school's ICT equipment has been considerably extended; also it has been attempted to inspire the teaching staff to using ICT.

The first formalized ICT project in which the school participated was the 'Janus Project'. By the start of the 1990es there was a budding wish to focus more on the pedagogical aspects of ICT, and a small group of teachers took their own initiative to contacting the Ministry of Education applying for support in connection with an ICT project of that kind. The outcome of the application was that the school was offered participation in the 'Janus Project', and in the mid-nineties the project was started with the objective of studying how it influences the teaching, the teachers and the students that a reletively large amount of ICT equipment is put at disposal in a class.

On the part of the planners of the Janus Project it was intended to let two classes participate, but Hjortespring Skole wanted to qualify the entire grade level and, consequently, demanded that all classes of the grade level in question participated. Thus, two 2nd grade classes with three teachers each became official Janus classes, while the remaining 2nd grade classes continued the project originally defined by the teachers, before the 'Janus Project' was established. All the teachers attended the relevant courses of the project.

Financed by the Ministry of Education the Janus classes had 12 computers installed in each classroom, and the teachers were asked to set objectives for how ICT should be applied in their teaching in accordance with the general objectives of the subjects. The project lasted for two years, and the teaching in classroooms was closely followed by a team of researchers from the then existing Royal Danish School of Teacher Training.

Taking off from the experiences the Janus teachers had accumulated during the two years they conducted courses both externally at the local pedagogical centre and internally at the school. A series of courses was arranged and the leadership demanded that all teachers attended at least three of these courses. Even today two of the Janus teachers from time to time arrrange ICT-related training courses. This takes place, among other things, via their attachment to the school's pedagogical service centre (PSC) where they act as teachers' aides who can be 'booked' by the other teachers. After the termination of the project the computers originally assigned to the Janus classes were distributed on several classes, which meant to the Janus classes that their use of ICT was considerably toned down as like everybody else they had to depend on the school's computer rooms.

After the 'Janus Project' Hjortespring Skole was approached by a group under the auspicies of the association of municipalities in Denmark wanting to engage the school as a collaborative partner in an internet project, the objective of which was to develop teaching courses to instruct teachers in the use of the world wide web in their teaching. The school obtained financial support from the Ministry of Education's centre for technology aided teaching (now abolished) amounting to half a million D.kr.

Concretely, this project ended up in an 18 hour nationwide teacher training programme. Taking place at Hjortespring Skole it was attended by 85 percent of its teachers on a voluntary basis. To attend the course the teachers had to integrate the www in their teaching along with the course and subsequently produce a report on their experiences, from which other teachers could benefit.

At the time of the study Hjortespring Skole was becoming engaged in the European Network of Innovative Schools (ENIS), and in this connection some teachers were attending training courses aiming at enabling

them to communicate their participation in ENIS to the other teachers of the school in the future.

3 The present

3.1 ICT in organization innovation

According to the leadership one of the general objectives of the efforts of Hjortespring Skole is the continued and extended sustenance of the innovation. The leadership consciously insists on participance in various projects to promote the innovation – for instance, the 'Janus Project' was considered an opportunity of having the staff educated and being referred to in the media in a positive way. This was important to the school, as it has often been in the focus of the local media as a school with many social problems. Generally, Hjortespring Skole appears as a dynamic school continuously realizing the perspectives of various efforts and involving itself in innovative work within several fields at the same time. The school culture is open, and the school in general is characterized as one thinking ahead. According to the leadership it is an expression of the fact that the school is moving towards being more innovatively oriented that apparently it is relatively easy to make the staff try new ways and methods.

School culture and school innovation

The school's co-operation with the local community is given a high priority. The leadership would like the school to become an asset to the surrounding society, and to that end a homework café has been established in a nearby municipal block of flats, which apart from the students also attract other inhabitants of the block. The geographical position of the school and the ensuing composition of the student group also influence the working lives of the teachers, as they often have to take up an attitude to various social problems and co-operate with many authorities. However, this is not something entirely negative, as it urges the teachers to develop new teaching and conflict-solving methods, which in a long-term perspective may become an advantage to the innovation of the school.

The number of students and teachers at Hjortespring Skole is steadily increasing. Where earlier the teachers might be seated around one table discussing various problems, they are now distributed on five staff

rooms: one common and four small rooms placed in each of the four sections of the school. The division is considered as well a strength as a weakness for the organization. According to the leadership it is strengthening the pedagogical work with the children, the teachers working more closely together in the small staff rooms; however, at the same time it is a handicap for the organization, as many teachers have no dealings with each other in the everyday school life.

The ICT projects in which the school has participated have been significant to the school culture on several levels. In connection with the 'Janus Project', for instance, time was set aside for working goal-directedly with the team structure which on demand from the Ministry of Education had been established in advance. The attention to the team as the factor around which the planning of teaching was concentrated had great effect on the mutual co-operation, as the teachers discovered the value of colleques as sparring partners. Where the teachers earlier had been sitting by themselves making preparations for their teaching they "... *suddenly got to discussing matters in a different way. The significance of the team and the energy there is in such a team rubs off - more and more ...*" (Teacher). Through the implementation of the team structure the responsibility for the subject related and social contents of the classes was also dispersed among more persons who, at the same time, obliged themselves to each other. "*So the team structure is more important that one would imagine ... maybe it is exactly what may carry it (ICT) far into the primary and lower secondary school.*" (ICT co-ordinator).

The school has not made goal-directed efforts to using ICT as part of an innovation of the organization to the same extent as has been the case in relation to teaching. However, it seems evident that the participation in the ICT projects made room for innovation of the school; the engagement of the staff was strengthened and they felt like renewing themselves. As ICT is capable of changing the traditional teaching patterns the implementation of ICT also had the effect that the way in which the teaching environment functioned was questioned – many habits were critically scrutinized.

Communication

Due to the fact that in everyday life the teachers are relatively dispersed throughout the school, the school is acknowledging certain advantages of developing the communicative potentials of ICT to a wider extent than is the case today. At the time of the study it had not been possible to make use of the school's homepage or the nationwide school communication network (SkoleKom), both offering possibilities of communicative fora where the teachers do not have to be physically present to participate in a discussion.

In order to remediate this the school's ICT co-ordinator is engaged in the development of an internal conference which is intended to be both a place where pedagogical discussion can unfold and at the same time contribute to establishing a wider general view on the activities of the organization.[ii] One attempt at preparing the teachers for a situation where more and more information is communicated electronically are the plans for publishing the weekly newsletter on www as well as paper. This had not been possible a year earlier, where it would have been met with massive resistance from the teaching staff.[iii] Today there is more readiness among the members of the organization, and the assumption is that in a few years the electronic version will prevail.

Staff development

Primarily, the upgrading of staff qualifications in the ICT field has taken place in connection with the projects in which the school has been involved. Prior to the participation in the 'Janus Project' the majority of the staff did attend WordPerfect courses, but not until the 'Janus Project' was the ICT education made part of a structure.

The Janus teachers were very much aware of the fact that their experiences had to be communicated, which was also the idea behind the internal courses " *... or else it may happen that the accumulated knowledge is not spread – and it sure is important that we inspire each other.*" (Teacher). The Janus teachers are also represented in the pedagogical committee, where they have had the opportunity to let their

[ii] It is intended that the internal conference may become a place for notice of meetings, reports, relevant legal information, duty rolls, mutual contacts, inspired teaching programmes etc.

[iii] A year ago it was announced as an all fools' day joke that the weekly newslettter in future would appear electronically, which raised an outcry among the teachers.

methods diffuse to other parts of the organization. As it has been described the Janus group was very " ... *goal-directed in its attempts to establish a strategy of application for ICT, and this happened to diffuse into other areas.*" (Teacher).

Many teachers and others find that being able to draw on other teachers' experiences is very lucrative, be it in the shape of courses or via the PSC teacher arrangement. Among other things it is said that the teacher's aid arrangement is a major plus; that one learns by looking at others; and that it creates an athmosphere of security to have a fellow teacher at hand, if one is not in possession of the prerequisites of using ICT. According to one teacher: "*... PSC teachers should be full time employed for five years, then the teachers would feel sufficiently on top for venturing on their own*." Further it is emphasized that the Janus teachers have established the possibilities of proper guidance, and that the teachers' courses are good, because one has the possibility of asking silly questions. Many have become familiar with ICT after the CTU Project and often use it in their teaching, and to many teachers ICT is no longer 'dangerous'. Finally is said about the external courses that they were good, but the internal courses gave the larger benefit.

Thus, during recent years a culture and an informal network have been established, where colleagues draw on each other, among other things the teachers' preparation room has been of great significance: "*It is a place where people help each other, where exchange takes place – you constantly learn from each other*." (Teacher).

It is the general opinion that the pedagogical support the teachers get from internal courses, PSC and colleagues is sufficient in the daily work. However, collegial support cannot do for a teacher's long-term planning of an upgrading of his or her ICT competences. In this respect you still have to draw on somebody outside school. As regards the technical problems the support also looks somewhat inadequate – it takes too much time to get assistance, once a technical error has been detected.[iv]

[iv] Mostly the ICT co-ordinators' time is occupied by maintenance, which, however, to some extent has been changed by the new 'new-born' cards – now it is the computer, not the ICT co-ordinator, which re-establishes the original set-up, thus leaving time for pedagogical support etc.

Obstacles

Even though the major part of the staff has backed up on the integration of ICT, the implementation initially was met with resistance from parts of the group of teachers. According to several staff members the resistance was based, among other things, on a general ill will against changes as such and a certain fear of technology; worry that data would disappear and an idea that the entire process was unpredictable. Some teachers failed to recognize the idea of getting started even knowing that they would be left behind, and others found that priority was given to the wrong things – that the implementation of ICT meant taking away resources from school camps and book purchase.

It is pointed out that primarily it was the senior part of the teacher group who found it problematic to give a high priority to the implementation of ICT. "*Most often it was the senior teachers ... those who had been teachers for many years and did not find it was part of their teaching*." (Teacher). However, it is the general opinion at Hjortespring Skole that a condition to be considered when entering a new field of effort is that people are different and, consequently, take different time to accept things.

As regards the ENIS Project which, at the time of the study, was sought integrated, the school anticipated problems caused by the fact that all material developed by the teachers for ENIS has to be translated into English before it is conveyed to the www. So even though the teachers believe that they have acquired experiences, examples of teaching etc. worth sharing with others, it may seem impossible in a stressed everyday life to find the time for translation, and the leadership has no intention of committing the teachers to participate in the project; instead it is carried through on a voluntary basis.

3.2 ICT in teaching

At Hjortespring Skole the general attitude is that ICT is an important field of skill which the students have to be taught. The general objective is that the students should learn how to use ICT as a natural instrument in their everyday life. Technology is considered a means for obtaining certain teaching objectives and not an objective in itself.

The efforts to have ICT integrated into teaching has resulted in the construction of a school curriculum

describing, what ICT courses the students should attend and when.[v] Besides, the plan describes a series of pedagogical considerations giving further directions as to how teaching might be organized most expediently along with argumentation for the latter. Among other things it is mentioned that often it will be expedient to let the students co-operate at the computers, as "*this will lead to co-operational abilities, creativity and helpfulness, as they help each other naturally.*"[vi] Within the frames set by the Ministry of Education and the school curriculum, however, it is left to the individual teacher to assess whether and when ICT is an obvious instrument in the teaching; it is also emphasized that the students learn how to assess whether ICT is an expedient instrument for a given assignment. Consequently, to what extent and how ICT is applied in the teaching will often depend on the subject, as, according to several staff members, it is not equally obvious to use ICT in all subjects.

Above the usual programmes and functions of ICT Hjortespring Skole also sets the focus on teaching the students how to achieve an awareness towards the computer as a media, and what potentials and shortcomings it comprises. A more general objective, also related to ICT, is teaching the students responsibility and respect for each other and for the equipment of the school.[vii]

In other words, the actual use of ICT in teaching also depends on the individual teacher's competences and attitude to ICT, and there are examples both of teachers using ICT to a great extent and of classes where ICT

[v] Moreover, it is stated in the school curriculum that the students should use the computer for accumulating new knowledge and work independently with new programmes. Consequently, when the students are leaving school after grade 9 or 10 they must have gone through courses introducing them to painting programmes, various training programmes, image editing, spreadsheets, seeking of information, multi media programmes, communicative programmes, lay-out programmes and word processing. The latter is introduced in the kindergarten class and grade 1 and is carried on all the subsequent class levels as a very essential field of skills.

[vi] The school curriculum also states that the teacher must make the students reflect on the solution of various problems, as they arise during instruction and that they should be trained in planning their work process in order to be able to estimate its progress.

[vii] For instance ruined computers in the classrooom are not automatically replaced. The class must discuss the problem and reach the conclusion that there is a real need for new computers. Another aspect of responsibility refers to the use of the www, where, among other things, ethic guidelines have been made for the students' use of the www, stating, how they should behave in relation to others on the web and also how it may be dangerous to release personal information.

is not yet integrated to any particularly great extent. The use of ICT also changes in relation to what kinds of teaching are planned – there may be periods where ICT is not in use and others where it is the main instrument.

It is estimated that the function most used in the teaching is the world wide web in connection with the seeking of information, whereas just a few classes have experimented with the communicative aspect of the web – for instance via projects where the students are communicating by e-mail with students abroad. Generally, most teachers are trying to observe the school curriculum using ICT whenever they find it relevant, and for the teachers who have not yet worked up a routine procedure relating to ICT there is good help to be derived from the PSC teachers.

One of the explanations as to why not all teachers of the school seem to be able to communicate the use of ICT to the students is that there is a lack of competence as regards the pedagogical aspects of using ICT – "*The equipment being available does not mean that now we can use it.*" (Teacher). At Hjortespring Skole experience shows that if ICT is to be integrated into the teaching it is essential that the teachers are trained in using it, and to that end one training course is not enough. Being able to use a computer does not mean that you are able to teach others how to use it. Therefore, first and foremost, the focus should be set on the training of teachers and not on the student computer/ratio, which according to some of the staff members tends to be the case.

The school expects that eventually the differences in the teachers' ICT competences will be straigthened out. Many teachers realize that they must keep up with the ICT development, as the latter forms part of teaching today and is an area which will remain in focus.[viii] So after all it is the prevailing impression that ICT is currently becoming more and more integrated in the daily teaching, where previously it was something used only on special occasions (for instance in connection with school camp planning).

[viii] In this connection it has caused surprise at the school that the newly graduated teachers have not obtained adequate ICT skills at the teacher training colleges. The consequence of this is that the individual schools must use resources on in-service-training of the newly graduated teachers they apply.

Advantages at ICT in teaching

One of the aspects of ICT rendering consiberable advantages to the students and, consequently, is considered a greatly motivating factor is the access to word processing programmes. Via the programmes the students can write more in a shorter time, it is far easier to edit the text, and as far as the higher grade levels are concerned, this implies that the teachers receive some "*... really good papers of much better quality than was the case before.*" (Teacher).

Generally the students take much pleasure in new ICT activities in the teaching, and since ICT is not used every day it may represent a welcomed variation in the curriculum; likewise new programmes can be fascinating.[ix] The world wide web gives access to updated and varied types of information, and being able to draw relevant material is also considered something that makes the school work more relevant to the students.

Not only does ICT offer the possibility of arranging a different teaching situation for the students: Technology can also be a catalyst for a maceration of the traditional roles of teacher and students. "*If it is properly organized and pedagogically used, it (ICT) is a perfect locomotive for restructuring teaching into something up-to-date.*" (Teacher).

Socially, ICT holds good potentials if the students are sharing a computer thus demanding a creative co-operation among the students. Most often the students work in pairs at the computers, and they are very apt in helping each other in this situation. At Hjortespring Skole experience shows that often the students act as consultants to their peers, when working with ICT.

[ix] ICT is also applied in the so-called workshop teaching, where the students split up in groups co-operating on different tasks. Wherever it is obvious the classroom computers are used thus contributing to varying the student activities.

Disadvantages at ICT in teaching

It may be significant to how much ICT is used in teaching that there is limited access to the few computer rooms. Thus, the teaching has to be planned and the computer room booked well in advance. Some teachers find that this is a great disadvantage, but generally, it is accepted that it is a question of the school not having sufficient resources for establishing more computer rooms.[x] The lack of resources also appears in the school computers' programmes which may be older than the programmes the students have at home. This may lead to conversion problems, when a student presents his homework on a computer disc.

All things considered it takes much time to plan a teaching course comprising ICT. In order not to take this time from more important things it is always necessary to assess the expediency of using ICT.

Formerly, the students of Hjortespring Skole had access to the computer rooms during breaks also, but too often the computers were wantonly damaged, or the students involuntarily sabotaged them through misuse, which implied that the students are no longer permitted to use the computer rooms/PSC unattented. Moreover, the school has been burgled a couple of times which also has limited the access to operational computers.

Generally, technical problems are a great obstacle and leads to many vexations. It may prove more difficult to establish fluent teaching when using ICT, as technical problems are not always easily solved. "*Go and sharpen your pencil, if it's broken – but it is not that easy if the things you have written are gone – where are they?*" If the users are not very able, and the computers not very stable it may limit the use of ICT which also means that often the teachers must have alternative teaching prepared and ready, if anything goes wrong with the computers.

The teachers may find that with 24 students in a class it is difficult to get a comprehensive view on what the students achieve, and whether they actually develop their skills. At Hjortespring Skole this is not

[x] One example of the significance of computer access is the situation of the former Janus classes. Where ICT was frequently used at the beginning of the project, the use is now limited among other things due to the few operational computers in the classrooms and because the computer rooms may only be used by several students at the same time. Today is estimated that the students of the Janus classes are not characterized by being more able at the computers than other students, nor are the teachers particularly focussed on applying ICT, which is considered rather problematic by their students.

considered a disadvantage solely related to the ICT implementation – a certain degree of control is generally necessary whenever students work independently.

Academic rigour and equity

At Hjortespring Skole no definite answer is given to the question whether technology in general is capable of contributing to the level of academic standards in the various subjects. On the other hand, it is pointed out that ICT is a new field of skills which may permit new learning possibilities. Properly used ICT may raise the quality of teaching, in which way ICT will have an indirect influence on the level of academic standards.

At Hjortespring Skole nothing indicates that ICT may contribute to levelling differences between competent and less competent students. On the contrary, there is a tendency that already academically able students benefit more from ICT, whereas students with massive learning disabilities still need remedial teaching with more direct contact between teacher and student. Likewise, there is a tendency that those students having the vast majority of difficulties at the computers often step back and leave the keyboard to the more competent students, when working in couples, which implies that the teachers must be very much aware of, how the students should be coupled.

Generally, the students are considered competent ICT users, and no large differences are observed between students who have access to a computer at home and students who have not, apart from the fact that apparently the first group approaches ICT with less fear and uses it more as a routine for major assignments. In a gender perspective boys tend to be more interested in the technical aspects and games, while no difference worth mentioning is observed when it comes to competence in for instance word processing.

3.3 The diffusion pattern of the innovation

Originally, the idea of making an effort in the ICT field was forwarded by the school leadership, which, however, was soon supported by a small group of teachers who were also fascinated by the possibilities of the media. Some of these joined the 'Janus Project' and quickly became the front figures, who subsequently were in charge of a major part of the teachers' in-service training in the ICT field. Thus, the 'Janus Project' did not end up as a limited and isolated project – on the contrary, it gave rise to entering into developing more systematized methods for the diffusion of knowledge into the organization. "*Then we wanted to have it spread like rings in the water, so we arranged some courses at the school focussing each on our area, in which we instructed our colleagues*." (ICT co-ordinator).[xi]

The experiences of the Janus teachers influenced several levels of the organization. One thing is that they taught their colleagues actual ICT skills thus letting their knowledge diffuse, another is that actually the group had picked up methodological experience as to how teaching and development could be structured, how objectives strategies for action etc. could be put forward, which subsequently has made up the basis of other kinds of innovation of the school.[xii] "*In the Janus group they sat down and discussed everything thoroughly, set up objectives and sub-objectives and carried through some teaching ... they have taken care to sort of lifting some of those things up into a mutual awareness of having some objectives, and all these things are drummed in practically in all situations.*" (Teacher).

According to the leadership it is characteristic to much of the school innovation that it is a small group of persons who are in front and are the first to claim ownership. Then the remaining staff is joining up currently, and only a small group resists the innovation as such. However, it is important to understand that radical innovative processes cannot be carried forth by the front figures solely, but must have as a precondition that the staff in general supports it, as the staff has to carry out the practical work.

[xi] Among other things the Janus teachers made courses in word processing, data bases, presentation programes, spreadsheets etc.

[xii] At present such courses have been taken, among other things through a supervision project, where teachers of the 7th grade level supervise each other; also in connection with a so-called well-being project in which the entire school participates, the staff of the remedial centre possessing relevant education and experience has developed a programme in which they visit the classes arranging courses of social training.

The role of leadership

At Hjortespring Skole the leadership appears very much in focus and is generally considered progressive by staff and parents. The leadership works on the basis of a clear strategy. "*An essential part of innovation within any field, and no matter whether it concerns ICT or whatever, is to make the people who are doing the work ... claim a co-ownership ... and of course they should participate in the processes of decision-making.*" (Principal). Thus, the employees' taking responsibility and involving themselves in the innovation is considered important, if the implementation should be successful. According to the leadership of Hjortespring Skole one expression of the teachers claiming co-ownership as regards the implementation of ICT is that it is no longer questioned whether ICT should be given priority and resources. Another precondition of a successful implementation is – according to the principal – that the right people are assigned to every task and that the premisses are made clear, so that the persons in question are given a realistic frame for their work and professional development.

At the start of a new school year each team of teachers must set up a plan for the year describing the pedagogical objectives for the teaching of their class. By means of these plans the leadership attempts to ensure that each staff member is relating and obliging himself to integrating ICT in his or her teaching, demanding that the plan contains certain reflections and objectives for the application of ICT. "*... it is important to seek the educator's awareness of what he or she wants from their subject and the social life of the class. And where ICT comes in, they must also become aware of how ICT should be integrated in their teaching.*" (Teacher). Also in connection with individual staff discussions the leadership tries to dicuss the teacher's integration of ICT, for instance, possible obstacles or maybe a need for more in-service-training.

Seen from the employee's angle it is considered important that the school has an active leadership, which 'does the thinking and plans the strategy'. Part of the innovation would not be set in motion, if the teachers were to take the initiative, because in a busy school life it is not only time consuming but it will also be hard to foresee what will be the actual consequences of entering a certain line of innovation. The leadership must be in charge of the general management and orientation – so, although it is important that the staff is involved, not all decisions should be open for discussion.

Sustainability and scalability

According to the principal one precondition of a successful innovative process is to use as a starting point a definition of what conditions form the basis of the innovation. This does not imply that the school should desist from for instance initiating the implementation on the basis of modest resources – it is a question of setting realistic objectives within the existing financial frames. At the same time it is important to reflect consciously and keep asking: "Why and for what is this a benefit?"

As it will often be a problem to provide the necessary resources one must use the instances available, for example the local school authorities, and take care that those teachers possessing some knowledge communicate this knowledge to their colleagues. Establishing the opportunities for teachers of co-operation mutual inspiration often leads to good results, and it is the experience of Hjortespring Skole that this is not only true of ICT integration but can also be advantageously transferred to other fields of effort.

To ensure a stable innovation it is also necessary to make sure that to some degree or other the staff has the necessary competences to sustain the innovation after the training has ended, which means that it is decisive that the necessary conditions are present for the teachers to keep their knowledge up-to-date. Thus, having a plan for in-service training of the staff is necessary, even though the employees may already have acquired some knowledge.

Thus, the frames must be present for the teachers to involve themselves in the innovation, which for instance may be promoted through 'inspiration days' where the teachers can exchange experience. However, the teachers taking co-ownership also depends on how much influence they have on the innovative process: "*The interesting thing is to make people make decisions – this leads to involvement and makes them want to do something.*" (Principal).

One effort which will probably strengthen the ongoing innovation is that the local school authorities have established a forum for ICT co-ordinators from all the schools of the municipality. The work of this group shall contribute to sustaining and carrying on the ICT development of the schools. Hjortespring Skole has had good experience with this initiative as it sets the stage for co-operation and diffusion of experience

across the schools, and it may contribute to upgrading the quality of the ICT co-ordinators' knowledge.

4 Discussion of hypotheses

4.1 Hypothesis 1

Technology is a strong catalyst for educational innovation and improvement, especially when the World Wide Web is involved. The rival hypothesis is that where true school-wide improvement is found, technology served only as an additional resource and not as a catalyst, that the forces that drove the improvements also drove the application of technology to specific educational problems.

Material supporting hypothesis 1

XOne of the important experiences derived from the ICT projects is related to the innovation of implementation strategies and processes of reflection applied for goal-directing the intended innovation. The experience is now being incorporated in other fields of innovation.

XGenerally the ICT related projects have established a basis for an upgrading of teacher qualifications, and in order to make the ICT competences diffuse in the organization supportive arrangements have been made, where the teachers instruct and inspire each other.

XIn an effort to improve communication the school has an internal web under construction, and the teachers have been gradually prepared for the fact that shortly much information will be communicated electronically. In this way the school intends to use ICT as a catalyst for upgrading the quality of communication and internal co-operation, which today is often problematic owing to the size of the school.

Material supporting the rival hypothesis

XAt present ICT is a constructive resource in teaching where technology may give rise to motivation and opportunities of differentiation of teaching. Further, the teachers have experienced that ICT has moved their traditional understanding of teaching, and the school is aware of the fact that technology has certain potentials related to the innovation of teaching which the teachers may advantageously use for experimenting in the future.

Hjortespring Skole can be characterized as a dynamic organization seeking innovation within several areas at the same time, and ICT has been one of many fields of effort.This has implied that the energy has been dispersed on several spots, and in fact the school is still seeking and experimenting with the potentials of ICT as related to the organization. To that end the school has implemented a series of ICT arrangements which, collectedly, at least in some respects support the hypothesis that technology acts as a catalyst for innovation of the school organization.

4.2 Hypothesis 2

The diffusion of the innovation/improvement (and therefore of ICT) followed the traditional diffusion pattern for innovations, as outlined by Rogers (1995). The rival hypothesis is that technology functions differently from traditional innovations and that therefore different diffusion patterns occur.

Description of the diffusion pattern

On both the organizational and the educational level Hjortespring Skole has reached far in its implementation of ICT, even though there are still differences in the individual teachers' activity in the process and in the competences they have.

Right from the start the leadership has been set on integrating ICT into the organization and has worked hard to establish the conditions for the stimulation of diffusion. The leadership has also actively supported new initiatives as they appeared, for instance a small group of enthusiastic teachers ('the entrepreneurs'), who were fascinated by the media and whose commitment resulted in the school's participation in an ICT project.

The ICT related projects in which the school has participated have been the starting point of establishment of a network of ICT diffusion in the school – both through the involved teachers' actual ICT competence derived from the projects, and through their development of working methods which appeared expedient in relation to the process of diffusion. Among other things, this group of front figures subsequently have been in charge of motivating their colleagues and have contributed to arranging training courses and various supportive efforts helping the teachers to integrate technology into their teaching. By

now the diffusion takes place gradually, and one has succeeded in involving an increasing number of teachers.

4.3 Hypothesis 3

Successful implementation of ICT depends mostly upon staff competence in the integration of ICT into instruction and learning. This hypothesis assumes that teachers mediate ICT applications when they are successful, and that ICT's academic value relates positively to teacher competence. The rival hypothesis is that the school 's technological infrastructure and student ICT competence rather than staff competence determine ICT implementation outcomes.

Material supporting hypothesis 3

XHjortespring Skole expects the teachers to include in an annual plan of action, how they will integrate ICT into their teaching, and that they commit themselves in relation to the school's objectives. That the actual use of ICT in the school still varies is explained by the fact that the teachers have different competences and attitudes as regards ICT.

XExperience shows that if a teacher finds that ICT is an uncontrollable factor in teaching he or she tends to not choosing the technology.

XThe teachers' ICT competences are considered essential when ICT is integrated, and it is found important that the pedagogical aspects of using ICT in teaching are included in the teacher training programmes. Several teachers mention that ICT knowledge on the user level is not sufficient to be able to integrate ICT in a teaching situation.

XThat the teachers' competences are considered a prerequisite of a successful implementation is also traceable in the expressed regret that newly graduated teachers do not possess the necessary competences, so that the school must start with educating its new teachers in the ICT field.

Material supporting the rival hypothesis

XGenerally, the access to computers is mentioned as a factor highly influencing the degree of ICT integration in teaching, as it is necessary to book facilities and, thus, ICT cannot be used spontaneously. A concrete example in this connection is the Janus classes who after the termination of the project had to renounce the large amount of computers in their classrooms, which were distributed on several classrooms. Subsequently, like everybody else the Janus classes had to book time in the computer rooms, which had the effect that the use of computers was considerably reduced.

XTechnical problems are considered an obstacle for the teaching as most often the teachers are unable to solve the problems themselves, which will imply limitation of the use of computers and less benefit from the teaching. Also the school has had much wanton destruction of equipment, many computers thus being out of operation.

At Hjortespring Skole it is a distinctive attitude that the teachers must posess both ICT competences and pedagogical qualifications before they are able to integrate ICT, and this attitude is translated into offers of training courses and supportive arrangements. A second factor described as important to a successful implementation is that the teachers take up responsibility for and co-ownership of the innovation, which is supported and demanded by the leadership by putting forward as a must that ICT is included in the teachers' annual plans of action for their teaching.

However, to carry through the teaching a sufficient number of computers is also necessary, and most of the teachers find that the access to computers may influence the integration, as it demands a kind of planning that is not open to spontaneity as regards the use of ICT.

Several teachers have noticed that whenever ICT is involved the students are often very willing to help each other and act as consultants of their peers. This is not considered directly decisive for the outcome of the implementation, but it is of importance to the teacher who will not spend so much time on solving small problems, which the students take care of between themselves, and moreover it is useful to the social climate of the class.

On the background of the material from Hjortespring Skole it must be concluded that teacher competence as well as technological infrastructure have decisive influence on the outcome of ICT implementation.

4.4 Hypothesis 4

Gaps in academic performance between high and low poverty students will not increase when all students have equal access to ICT. The rival hypothesis is that equal access to ICT will lead to more advantaged students increasing the performance gap with disadvantaged (high poverty) students.

Material supporting hypothesis 4

XThe teachers of Hjortespring Skole describe ICT as containing various potentials and advantages from which in principle all students may benefit. It is true that in practice there are differences in the individual students' benefit, but there is no unambiguous connection between these differences and the students' general level of academic standards.

Material supporting the rival hypothesis

XA few teachers find that primarily the highly performing students benefit from ICT, and in group work the students tend to let the more capable use the keyboard, which may increase the differences in ICT competences.

Generally, the teachers of Hjortespring Skole are cautious when speaking of how ICT influences the students' academic standards – they point out that as teachers they can do much through their planning of the teaching to take care that all students profit equally from ICT; however, there seems to be a tendency towards the highly performing students to benefit the most.

Another aspect of what students benefit particularly from ICT are those students who have access to a computer at home, and those who have not. There is no staggering difference between the two groups of students; however, it is pointed out that the students having access to computers at home are often more fearless and experimenting in their approach to ICT.

Even though no unambiguous conclusions can be drawn from the above material, experience indicates that immediately the integration of ICT in teaching may grant the most able students an advantage. In practice, however, this tendency is often countered by the teachers' focussing on developing those potentials of

technology that support a levelling of the differences in the students' academic standards.

4.5 Hypothesis 5

Successful implementation of ICT will lead to the same or higher academic standards in spite of the low quality of many ICT materials. Academic standards are a function of teacher and school expectations and not of the standards of textbooks, ICT materials, and the like. The alternative hypothesis is that ICT use will lead to a lowering of academic standards as students spend more time on marginally beneficial searches and in browsing poor quality Web and courseware content.

Material supporting hypothesis 5

XVia the school curriculum it is attempted to ensure that the teachers put forward relatively uniform demands to what the students should learn, which relates to the firm belief that a teacher's expectations are of crucial importance.

XThe teachers try to communicate guidelines for how the students may use the www in en expedient way, thus, being conscious of the fact that ICT-related material applied in teaching should be of a certain quality.

Material supporting the rival hypothesis

XSome teachers may feel that they lose control of what the students are doing when they work independently with ICT, and the students have many possibilities of doing other things than what the teacher intended.

XThe school is making efforts to establish in the students a consciousness of quality by teaching them what kind of media ICT is and what possibilities it offers, in order that the students themselves become able to assess when ICT is a relevant instrument.

Some teachers point out that lack of control is a condition whenever the students work independently, for which reason it is not especially characteristic for the use of ICT. Generally it is found that the world wide web may add something positive to the teaching, for instance by giving access to much and updated information. However, one is aware of the fact that the web may offer contents which cannot be said to have

any educational qualities, and in this connection it is attempted (e.g. via ethic guidelines) to make the students responsible and critical in their use of the www.

Nothing in the material from Hjortespring Skole indicates that the quality of ICT programmes or www material is unimportant to the students' academic standards level. However, in practice it is almost impossible to test these hypotheses, as the teachers work hard to precisely ensure that good quality material is used in their teaching. Thus, the conclusion as regards hypothesis 5 must be that actually the students' academic standards level is influenced by the school's and the teachers' expectations.

The future

At Hjortespring Skole one is very much aware of the fact that the point is not yet reached where all teachers master and integrate ICT as a natural part of their teaching. Also in an organizational perspective the teachers use ICT very differently and some still very rarely. Efforts to the effect of remedying this are being planned; on the communicative side, for instance, the construction of the school's internal conference and the weekly newsletters. Moreover is planned an upgrading of the pedagogical discussions by strengthening the co-operation of the teams.This implies that the teachers must be trained in setting up and reflecting upon pedagogical objectives and argumentation for these objectives.

All things considered there is no fear that the ICT innovation of Hjortespring Skole should stagnate. There is a general confidence that eventually ICT will become a more matter-of-fact part of everyday school life for everybody. How fast the innovation will take place depends on the commitment and the resources available among the actual instances and involved persons.

Appendix A

In Denmark the team behind ‘Case studies – organisational change’ comprised project leader Arne Carlsen, project researcher Lotte Broe and project assistants Lea Holst Spenceley and Ulla Milner Drewsen – all employees of the Danish University of Education. The study was carried through on the basis of the OECD/CERI design “A workbook for case studies of organisation change. Version 9b-August 8, 2000”.

At an initial meeting the school was informed on the study in general, the requested amount of interviews, observations, additional material and the questionnaire part.

The school visit was carried through by the project assistants and lasted for five days. The programme was arranged by the school and consisted of two observation sessions of abt. 60 minutes and a total of 15 interviews. Two further observations were on the agenda, but being ‘ordinary lessons’ they were not considered relevant in an ICT perspective.

The informants were: school principal (3 hrs. In 2 sessions), vice-head (35 min.), 2 ICT co-ordinators (abt. 1 hour each), 5 teachers (1 hour each), 3 groups of students in total abt. 15 (30 min. each), 2 parents (30 min. each). All the interviews were tape recorded and transcribed.

Out of 70 questionnaires 37 were answered. The school chose to let the answering of questionnaires be optional for the teachers.

The additional material consisted of 4 appendixes comprising among other things an ICT school curriculum and a pamphlet on available supportive arrangements and activities in the PSC.

Appendix B

((Please insert Appendix B – Hjortespring Skole))

Notes