

OECD/CERI ICT AND THE QUALITY OF LEARNING PROGRAMME

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

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1 Presentation of Kærby Skole

Kærby Skole is situated in the outskirts of a large provincial town and is a relatively small school with app. 300 students distributed on grade levels 0 to 7. The school also comprises a series of remedial classes ('the contact classes') for autistic students whose primary problem is failing contact. The school employs 38 teachers, and is located in an area of mainly middle class families for which reason the student population is rather homogeneous.

The school has at its disposal 111 computers including those based at the teachers' homes. 46 of the school-based computers have www access, and 12 of them are placed in the school's computer room. At the school's pedagogical service centre five more computers are placed, and the teachers have access to four computers in a small preparation room. Furthermore, there are one or two computers in each classroom. Thus, the student computer ratio is abt. 4,2 students per computer and abt. 6,6 students per computer with www access.

It is estimated that abt. 90 percent of the students have computer access at home, and moreover the students have access to the school computers during the long noon break; the school arranges ICT-café twice a week where students may apply for any assistance needed. From grade 4 all students are given an e-mail address via the school.

Since the late 1980es the school has had one ICT co-ordinator and two years ago a second teacher was given the assignment. At the time of the study the first teacher had been appointed elsewhere, and the second was in charge alone. The school intends to have two persons permanently in charge of the general technical and pedagogical matters related to the ICT innovation. In addition to their work at school the ICT co-ordinators have acted as lecturers and consultants to various educational institutions wanting to integrate ICT.

The school is located in an administrative area (municipality) which for many years has had ICT as a field of effort. A special data department is aiming at having ICT integrated in the 37 municipal schools.

This is carried out in the shape of pedagogical and technical support as well as construction of plans of action, training courses etc. for the entire school personnel. Moreover, the municipal authorities have earmarked a pool of funds in which the schools can have a share only if they invest in ICT.

2 The past

Kærby Skole is located in an municipality, where as early as the late 1970es a data department was established to assist the schools in the implementation of ICT. However, after a couple of years it became evident that this assignment not only consisted in providing hardware for the schools but that it was also necessary to focus on the implementation as a whole comprising the education of teachers, purchase of software, allocation of time etc. From the mid-1980es competent staff members of the data department started arranging training courses in basic ICT skills which all teachers in the municipality had to attend.

In spite of the good intentions it was obvious after a few years that the courses did not give the expected results, for which reason was established a supplementary experiment where during a certain period the schools were to provide a data consultant for at least three hours weekly.ⁱ At Kærby Skole they had long time ago found an enterprising and competent teacher for the role of ICT co-ordinator, which meant that both the innovation and the in-service training of the teachers had been running for some years before the consultative arrangement was implemented. As far back as the late 1980es the ICT co-ordinator has arranged training courses in word processing and spreadsheets, which for many years have formed part of the school's teaching. Therefore, this ICT co-ordinator, who has now been appointed elsewhere, stands out as an important key person in the description of the ICT implementation at Kærby Skole, as he has accomplished gradually to educate and to inspire his colleagues to integrating ICT in their teaching to a steadily increasing extent.

At the beginning of the 1990es the municipal data department established a 'First-class system' which implied that all the municipal schools were given access to the world wide web, and a conference and mail

ⁱ Moreover, an arrangement was made to the effect that in case a school supplied the funds for extra time for the ICT co-ordinator, the local school authorities would contribute financially by doubling the number of lessons set aside by the school. This arrangements has now been cancelled, however, the authorities ended up by paying for abt. 9000 lessons a year which was the number of lessons by which the 37 municipal schools chose to exceed the compulsory three lessons. By now the authorities are curious to see how the situation of ICT co-ordinators will develop without financial support.

system for the staffs was established.ⁱⁱ Today there is a brisk traffic on the municipal server, where many persons related to the school world communicate internally and externally.

In the mid-1990es the former ICT co-ordinator took the initiative to having a class of 6th-graders join the 'Pathfinder Project' under the Ministry of Education – a project aiming at examining how www, e-mail and homepage presentation might be used in the teaching. The project implied that seven of the school's computers were connected with the www, but as the other teachers became aware of the work of the class the interest spread, and the following year collaborative projects with other schools on the 'Pathfinder Project' had been started from grade four and up. Concurrently were established municipal innovation projects focussing on the www, in which part of the school was also involved. In 1998 a plan of action for the ICT integration was constructed outlining to the teachers to what skills the students should be introduced and when.

On the background of these initial projects and courses it was uncomplicated in 1998 to make the staff of Kærby Skole support an application for participation in the 'IT-springet' (the leap into ICT), which seriously brought home the integration of ICT to the school. Joining the 'IT-springet' meant that the entire staff got a home-based computer at their disposal and were committed to attending in-service training in ICT. Via the Pedagogical ICT Driving License established around their own teams the teachers got a mutual basis to start working from, which meant a further upgrading of the quality of the teamwork through ICT.

In 1999 the school was selected as ENIS school, however, this project is not particularly visible at Kærby Skole, and it is not obvious whether this project will have any influence on the ICT innovation.

The latest project in which the school is involved is a project of the Ministry of Education 'Banebryder II' ('Pioneer II'). Its objective is to examine how the teaching is influenced when all the students of a class are connected with the school web via home-based computers. Thus, one grade 5-class has been supplied with home-based computers, and mail as well as conference system have been established for both students and parents, which has implied arranging ICT courses for the parents.

ⁱⁱ The municipal conference system was established three to four years before the national Sektornet.

Generally it appears that today the school has integrated ICT in practically all subjects and to an extent which implies that the students are guaranteed ICT competences at a rather high level when leaving school.

3 The present

3.1 ICT in organization innovation

ICT was introduced to the organization at a very early stage and today is considered the school's 'flagship', the main image of the school which may contribute to attracting highly qualified staff. The school has made ICT its primary field of effort, but otherwise has no apparent tradition for innovative work as such. On the leadership level the implementation process has been handled on the basis of intentions to meet with the demands of the Act on the folkeskole and, at the same time, to develop staff and students to be prepared for the future. Therefore, one of the ambitions of the school is to keep up-to-date with the development in society in a wide sense in order to make the school's teaching reflect the society of which it forms part.

School culture and school innovation

Kærby Skole is a small school described by the parents as a secure setting for their children till they change school after grade 7. The staff supplements this description feeling that they form part of a good, socially well-functioning and open organization where mostly new initiatives are met with a positive attitude.

Most of the descriptions of the implementation process indicate that the innovation has been a positive experience for the majority of the school staff. This is particularly ascribed to the former ICT co-ordinator's ability to initiate and engage so that all teachers were involved in the process starting from their individual prerequisites. The training courses arranged by the ICT co-ordinator were considered profitable, an experience which today the school wants to utilize in a tradition for internal courses contributing to the innovation within other fields.ⁱⁱⁱ

ⁱⁱⁱ Among other things, the teachers have established a group – inspired by the success of the ICT co-ordinator – to offer guidance to the practical and creative dimension of the school.

Communication

Today the staff of Kærby Skole looks upon ICT as an indispensable instrument for communication and for making more effective essential work processes in everyday school life. Among other things, ICT is used as an instrument for diffusing information in the organization: After all teachers were given access to home-based computers it was decided that all information should be diffused via ICT-based means. At the same time, the teachers committed themselves to opening their e-mail every day, which decision is mostly considered positive as the teachers find it easier to orient themselves in and keep abreast with what is going on in the school now that information is gathered centrally and distributed to all staff members.^{iv}

With the internal conferences, some of which are closed to outsiders, was established a formalized forum for exchange of experiences, and everybody is encouraged to place descriptions of experiences and successful teaching on the web, so that others – also outside school – may be inspired. Thus, the system works as a kind of ‘collective memory’ and is considered a resource of notices, guides etc. relevant to the school. At the same time, it is mentioned that the fact that it has become easier to distribute messages throughout the organization has raised the level of information. Earlier, matters that were not given a high priority for oral communication are now distributed via the internal conference and mail systems.

The conference system of Kærby Skole forms part of the larger municipal ‘First-class system’ established by the local school authorities in order to stimulate communication among the schools and at the schools. The system applies not only to the teachers of the individual schools but also students, parents, principals, the school municipal director and others have been connected, thus ensuring a better flow of communication among the various persons and instances involved. The system has given access to a new form of dialogue where it is possible to follow actual and former lines of discussion in the conferences, and also to get counsel and guidance, and this wide pedagogical debate permits the procurement of several perspectives on the same problem.^v

In some ways ICT has also proved time-saving: As the teachers participate in various teams with

^{iv} In this connection the teachers committed themselves to meet with the school curriculum.

^v For instance has been established a conference for the ICT co-ordinators of the municipal schools to further mutual guidance in the technical field. Also the school principals have a conference for the exchange of experience and discussions.

different colleagues it will often be difficult in a busy school day to find the time for a proper discussion; however, via the home-based computer and the electronic mail system ICT has established a room for exchange, making communication independent of time and place. This is particularly expedient, as the teachers often work at different times and need not be present at the school to be updated on what is going on. This has contributed to making communication more fluent and has saved the teachers time otherwise spent on meetings, thus producing a calmer atmosphere in school life.

In spite of the above mentioned advantages at using ICT several teachers find that generally ICT cannot be considered a time-saving factor, as the time saved is spent at home at the computer. The teachers receive much information, which may be an advantage, however, it may also be just too much; maybe it will be necessary to set up regulations for what is communicated, as everybody is obliged to read the collective messages.

Staff development

As previously mentioned the in-service-training of the staff has been arranged partly by the local school authorities, partly by the school itself. Among other things the authorities have tried to support the schools by letting the municipal data department arrange courses for all staff members, which also has implied that the ICT co-ordinators assemble at least six times a year to discuss relevant and actual issues.

One experience derived from the municipal courses was that they had no particular effect. It appeared that many teachers found it difficult to adapt what they had learned at the courses to another context, for which reason obstacles frequently occurred, which the teachers had no competence to overcome, implying that the integration was brought to a halt. Also the teachers personally found that the courses did not encourage the development: “... *I came from a training course now and then ... on my way home I had to ‘rebuild’ myself to feel convinced that after all I was not that stupid.*” (Teacher).

In this connection it became evident that competences are more effectively developed in the frames where they are to be used. “... *it should be ‘just-in-time-learning’ right where you have the opportunity to use ICT in a reading or mathematics lesson or in theme teaching; it must take place right there, and*

therefore the assistance in coping with the technical hurdles and maybe also the inspiration to using ICT should be delivered at the right time." (Municipal consultant). Therefore, it is important to innovation that the school has a resource person at the teachers's disposal where it is relevant, someone who is also acquainted with the teachers' different needs.

The former ICT co-ordinator of Kærby Skole has been successful in uncovering the individual teachers' prerequisites and make them the starting point of his training courses, which have been considered very important by the school staff. The courses have been arranged according to occurring needs, and although participation was optional the attendance was large. *"He has some pedagogical talents which he could use uninhibitedly on the teachers, and anything went down with them."* (Present ICT co-ordinator) The former ICT co-ordinator knew how to get everybody involved, to establish the right settings, and afterwards he was there for the teachers, when they had questions. It is important to the comprehension of his successful work to know that he never pressed on but proceeded slowly enabling newly learned competences to settle before new ideas and courses were introduced.

The new ICT co-ordinator is not alien to arranging teacher training courses either, and she offers her support via her connection with the Pedagogical Service Centre, which generally is in charge of the pedagogical counselling of teachers. The ICT co-ordinator is available a few hours weekly for what might have occurred, and above that she may join the teacher in a lesson to start an ICT procedure in co-operation with the teacher. She explains that in this connection it is important to think procedurally along with the teacher, in order that the support works as a supplement and to enable the teacher subsequently to go on with the teaching on his own.

As it has appeared the ICT related projects in which Kærby Skole has participated have contributed to supporting the staff development and the general ICT integration. Especially the participation in the 'IT-springet', which implied that the entire staff was trained in ICT and provided with home-based computers, has meant that ICT has diffused throughout the organization. Today ICT is considered part of everyday life, and practically all the teachers use ICT in their teaching and in the planning of the teaching.

In connection with the Pedagogical ICT Driving License the teachers co-operated in the teams they are

attached to during the school day, which has contributed to demystificate technology and, at the same time, has given them a mutual basis for their work. Above resulting in actual ICT sequences to be used by the teachers in their teaching the training also set the stage for further upgrading of the quality of the team work, precisely by offering possibilities of discussing the pedagogical aspects of integrating ICT in teaching.^{vi}

The teachers consider it important that the process not only involves the development of ICT skills: *“I don’t think ICT is worth anything in itself. I believe it is worth anything only as part of something else. As part of a professional development, as part of the pedagogical innovation.”* (Teacher).

Obstacles

The experiences of Kærby Skole as regards the integration of ICT are mostly positive, and apparently many dedicated and willing persons altogether have put much time and energy into the ICT implementation, into educating themselves and applying the potentials of the media as they immediately see them. In connection with the question of obstacles it was mentioned that some of the teachers have been worried that ICT would become too dominating in everyday life, and that there was not sufficient time for becoming acquainted with the functions of the media. Besides, the ICT co-ordinator explains that as a teacher one has to get used to the idea of discussing one’s teaching with others and to be open to advice. However, mostly positive statements have been registered among the staff members and nobody find that there has been any decided resistance against ICT integration at the school.

Obstacles in the shape of technical problems have not been marked at Kærby Skole either. On the whole, the ICT co-ordinator has been able to handle the technical problems that occurred, and, besides, assistance could be required at the municipal data department.^{vii}

Misuse of the equipment occurs very rarely, which is explained, among other things, through the fact that the teachers of Kærby Skole have succeeded in communicating a reasonable responsibility to the students;

^{vi} The local school authorities are convinced of the qualities of the Pedagogical ICT Driving License and have chosen to give those teachers having acquired the license a qualification bonus in addition to their regular salary as a financial incentive.

^{vii} Many technical problems are solved via the first-class system in co-operation with colleagues from other schools, thus avoiding to wait for someone to appear physically at the school.

moreover, sanctions in the shape of being excluded from the use of computers during a period have been instituted. Another reason why relatively few technical problems occur is said to be that the students use the equipment frequently and, consequently, take a larger responsibility. *“In fact, I think it is because we use it as much as we do. The students themselves find it irritating, when it is out of order.”* (ICT co-ordinator).

3.2 ICT in teaching

Much indicates that Kærby Skole has reached far in its integration efforts, also in teaching. A school curriculum has been set up which the teachers have committed themselves to implement in practice, which contributes to ensuring that the students acquire certain competences, and that to some extent or other ICT is integrated into all subjects.^{viii} Today all classes are using ICT, and teachers as well as students estimate that most classes use ICT every week as part of the instruction.^{ix} An indicator of the extent to which ICT has been integrated at Kærby Skole is that a great many of the students actually find ‘all that ICT’ somewhat tiresome.

The fact that all teachers have obtained the Pedagogical ICT Driving License and attended a series of internal courses has implied that generally the teachers find that they have the competence to integrate ICT in their teaching. To most of the teachers ICT has become a natural part of teaching, and few still seem to find it difficult to integrate. That differences still exist is explained by the fact that the teachers’ personal interest in the media decides how much energy is spent on maintaining the competences acquired via the Pedagogical ICT Driving License, and, consequently, how much it is integrated in the individual teacher’s teaching.

^{viii} By now the school curriculum has been in force for two years and has to be revised and adjusted – it should be decided whether the required skills are attached to the relevant grade levels, whether supplements should be added etc. One example of changes is that homepages should be on the agenda much earlier than the present grade 6, as many younger students have also benefited from this kind of production.

^{ix} Exactly how much the classes use ICT may vary, as for instance the ‘contact classes’ have more computers at disposal in their own classrooms and, consequently, use them every day, whereas other classes use computers in one to two lessons a week on the average, as they are dependant on access to the computer room. Above that it is in the nature of things that the Pioneer class uses ICT more than the ordinary classes.

At Kærby Skole ICT is considered an instrument to be used in teaching as one possibility among others. In this connection it is emphasized by teachers and one parent that ICT holds no value in itself, however, it has several potentials depending on the subject matter and the way technology is used. The school has chosen to give a high priority to teaching the students those functions contained in Microsoft's Office programme and world wide web. This is exemplified by a series of teaching sequences where classes have communicated with other classes via e-mail – nationally and internationally – and also by a relatively large production of homepages which has taken place even on the younger grade levels. To some extent educational programmes have been given a low priority, as they are considered too expensive and of varying quality. The students quickly lose interest if the contents of the programmes does not offer challenges, and a parent explains that the material is not automatically interesting because it is wrapped up in electronics.

ICT is also considered a good instrument for changing the traditional forms of teaching, and, in fact, traditional classroom teaching is not seen as often as before. To a higher degree the attention has been attracted to forms of teaching, where the students are in focus and offered various activities during the same lesson. ICT may contribute to supporting these new forms of teaching, and, thus, to establishing the basis for “... *teaching the students to become independent, curious, reflective and, interrogative persons, and this is the kind of people needed in the future.*” (Principal).

Advantages at ICT in teaching

At Kærby Skole it is obvious that ICT is considered a media capable of adding something positive to teaching. As emphasized by the teachers, largely nothing but advantages and possibilities can be derived from ICT, provided the teaching is expediently planned.

Firstly, it is emphasized as an advantage that word processing programmes may render a writing process quicker and easier to plan for the students. Moreover, the students write more extensively, when they do not have to think of handwriting and neatness.

Furthermore, using ICT generally makes it possible to produce something very presentable, which is considered an essential advantage contributing to motivate the students and make them satisfied with the completed product. The same is true of presenting something via a homepage. The students are aware of the

fact that the homepage is seen by others, and the teachers find that the students work very concentratedly when homepages are established. Also when communicating with other students via the www they are very eager and wanting to deliver a product of good quality. The teachers find that the communicative means of the web will contribute to the teaching with an authenticity that makes learning more relevant and interesting to the students.

Seen in a different perspective ICT may be of assistance to meeting with the demands for differentiation of teaching, and for that matter contribute to establishing a more varied teaching. The teachers also find that the use of ICT has social potentials – based on a proper organization a co-operation between the students can be arranged, and the experience is that in those situations they are good at learning from each other; also some students may benefit from seeing themselves as capable of communicating knowledge to their peers.

When the students are able to open their e-mail at home, it means that the teachers when correcting exercises at home can forward them to the students, thus giving them a faster response on their work. This also saves time, as the students can read the teachers' comments at home, so that lessons at school are not used for this purpose. The teachers are also able to send new assignments to the students at home, which gives more order at the beginning of lessons as the students know beforehand what they have to do.

In the Pioneer class where everybody has a computer at home it has been possible to experiment a little more with the media, and certain advantages have appeared due to the special situation of the class. Among other things, the co-operation with parents has been extended on several levels. On one level there is a more fluent and open dialogue among the parents via their mutual conference, and on another level there is a more extensive dialogue between teachers and parents. It is considered easier to communicate via the web, and information otherwise not given enough priority to justify a telephone call will now be conveyed, which has implied that the teachers are experiencing an improved contact with the parents.

It has been carried through as an experiment in the Pioneer class to make the teaching independent of time and place by dismissing the students to go home and work in order to obtain in this way a more continuous instruction, independent of the clock. However, this possibility has not been used to any wide extent, as it is the experience that at home the students will often find it difficult to manage the time they

must set aside for a given assignment.

Disadvantages at ICT in teaching

The disadvantages mentioned by the teachers of Kærby Skole do not refer to ICT as a technological instrument; rather they are connected with how the teacher is organizing the teaching comprising ICT. For instance, it may be necessary to exercise a certain degree of control as it may be very time-consuming for the students to use ICT. They get easily lost in details and are fascinated by the many possibilities of the various programmes. Furthermore, it may also be necessary to keep an eye on whether all the students benefit from the teaching as intended, since when working in couples they tend to letting the most able use the keyboard, while the other one retires.

The school is also aware of the fact that ICT should not prevail to an extent where the students are not taught to use other methods than those related to ICT – for instance it may seem an impediment to use handwriting, when accustomed to word processing, and a certain worry is traceable that ICT will take up so much of the students' lives that they become less active and too focussed on ICT as an instrument.

From the teacher's point of view it is now and then seen as a disadvantage that computer rooms must be booked – it may impede the spontaneity that you have to plan the integration of ICT a long time in advance.

Academic rigour and equity

At Kærby Skole no unambiguous picture is emerging of what significance ICT has, as far as academic standards are concerned. In a wide perspective it does not seem that the general level is raised, rather that the students are given a new dimension to their academic standard. Some are pointing out that to a certain degree the ICT skills are learned at the expense of other skills; for instance, the students may become more able to seek information, but, on the other hand, they do not read as many textbooks as previously. However, this is not necessarily something negative; it may as well be seen as forming part of a positive and up-to-date development: *“I do not doubt that we shall have more competent children ... they may not have a very extensive basic knowledge, but they have been given possibilities of finding out for themselves, where they can find the information they need. They have learned how to learn, and I think this is very important and in preference to the old way of learning.”* (Principal).

Another aspect which is emphasized is that ICT may influence the academic standards in a positive way, the students' level of concentration being raised in those connections where, for instance, they are aware that their work is accessible from the outside, for which reason they take more trouble.

There is much variation in the extent to which the students actually master ICT – many of the students are beforehand quite able in playing computer games or chatting, but according to the teachers very few have more than a superficial knowledge of the instrumental programmes when they start school. In this connection is pointed out that boys are mostly keen on games and girls mostly on chatting, but apart from that no particular differences in competences are seen. Nothing indicates that the use of ICT may contribute to levelling differences between academically competent and not so competent students. *“Most often the academically competent students are also the better when it comes to manage on the computer.”* (ICT co-ordinator). However, some teachers find that ICT may give the less competent a necessary lift, but not to any degree that can level differences.

ICT has proved an expedient means of teaching in the contact classes (autistic children) due to its ability to visualize and concretize an abstract assignment, and also it is a more systematic and logic tool, which is expedient in relation to children demanding a higher level of predictability and definite bounds. *“It feels*

fairly safe to sit and work with this thing instead of confronting a person, which may be a little more unpredictable.” (Teacher). Furthermore, it is being attempted to establish co-operation between the contact classes and an external class. Since these children have difficulties in establishing social relations, but are often good at writing, the teachers hope that co-operation with a paired class where communication is going on via e-mail will imply that the students are given the possibility of becoming part of a network, thus having access to positive experiences. It is also assumed that the social dimension can be set in focus through computer games, and in the contact classes the games are used in a goal-directed attempt to bringing the students together through a common activity.

3.3 The diffusion pattern of the innovation

What characterizes the innovation at Kærby Skole is that the ICT implementation has taken place in a lengthy process – it has never been pushed, and the staff has been granted the possibility of keeping up and slowly getting used to the media. The innovation was started on a small scale with the former ICT co-ordinator as the pioneer, but today practically the entire staff is involved in sustaining the ICT innovation.

The ICT co-ordinator has taken care that his knowledge was diffused via the internal training courses, and the projects in which the school participated also contributed to diffusing the ICT competences and the interest in the media. Apparently, the teaching staff has been able to inspire each other and keep up with the new teaching possibilities the others were experimenting with. Also the leadership has supported the ICT implementation through a positive attitude which has been an important precondition for the fact that the teachers have had favourable conditions for their work. The ‘IT-springet’ implied that all the teachers acquired ICT competences, and the fact that, at the same time, they committed themselves to comply with the plans of action, it was also ensured that by now all the students are introduced to ICT in teaching to some extent or other.

The role of leadership

The principal of Kærby Skole is not immediately visible in the diffusion process, however according to the staff, he has played a very active part, having acknowledged the various initiatives and, at the same time, taken care that the relevant resources were available for the implementation. When about six years ago he took over as a principal he was put in charge of an institution with great potentials for innovation, as, at that time, among other things, the school was facing an extension owing to a larger intake of students and, consequently, an extension of the staff, and at the same time he found a certain readiness among the original staff. Therefore, basically, good conditions were present for initiating the innovation, which, according to the principal, was of importance to the success of the process.^x

As a principal he has a well-defined objective aiming at establishing a place of work where the employees learn from each other, thus diffusing the competence throughout the organization. Moreover, he considers it important to establish good conditions for the teachers' work, this being the most important precondition for the good learning conditions of the students. He regards himself as a leader oriented towards innovation, who rarely says no to new ideas, but, on the contrary, supports the progressive forces of the school.

Sustainability and scalability

By now ICT has been integrated on the organizational as well as the teaching level to an extent where it is used every day, and the innovation has reached a position where it must be considered sustainable without any greater effort. ICT competences have diffused throughout the staff, so that it no longer rests with a few persons to make things work – there is a mutual co-ownership and, consequently, good reason to assume that the innovation will go on in the future.

Above a culture implying that the teachers seek mutual counsel and guidance Kærby Skole has well-organized supportive arrangements at several levels. At the school internally there is the pedagogical and technical guidance system organized under the Pedagogical Service Centre. Having two ICT co-ordinators is

^x However, one teacher wants more computers available to the teachers at school which would be more expedient as regards making effective the unoccupied time, teachers will always have during the school day.

given a high priority, and it is considered important that the persons in question are able to contribute to the innovation technically and pedagogically. Externally there is the municipal support on which the school may draw for the solution of various problems. At the same time, the municipal arrangement has meant that the individual schools are spared resources, as the centre has the competence to maintain and use the schools' hardware capacity to the effect that the computers may be used for a longer period, and the equipment should not be renewed very often – “... *in this way we are self-sustained and we definitely save millions of kroner which, otherwise, would have disappeared into more or less qualified electronics companies.*” (Municipal consultant).

In relation to the communication lines of the school it is presupposed that everybody continues to commit themselves to using the system and remember to pick up the new information conveyed here. At the same time, the teachers themselves must keep the various conferences going, as long as they are considered relevant by contributing to the discussions suggested. In this connection the home-based computer is considered an indispensable guaranty of the teachers' ability to keep themselves up-to-date as regards knowledge and competences.

According to the principal it was the more experienced teachers who seemed especially prepared to adopting new initiatives, also they have been in front as regards the ICT innovation at the school.

Many factors and actors have contributed to making the ICT implementation a success at Kærby Skole. A central figure was the former ICT co-ordinator who, many years ago, laid the foundation stone of the innovation the school has carried through. During the last couple of years the new ICT co-ordinator also seems to have had an important pedagogical position in the integration of ICT, and both have been supported by a leadership granting them room and resources for trying to integrate ICT into the school's activities. Furthermore, the school has been involved in various projects which became important factors as regards furthering the commitment of both teachers and students. Another profitable instance was the municipal data department which actively supported the school technically and pedagogically.

The ICT co-ordinator emphasizes that one of the reasons for the successful implementation process at the school was that the innovation was not forced upon it from the outside. An innovation like the one Kærby

Skole has been through takes time and has to be willed by those who have to sustain the innovation, if it shall have the possibility of taking root. This means, among other things, that the teachers should be given time to getting used to the media and discover that in some connections it may be an advantage to use ICT.

At the municipal data department it has also been the experience that nothing is obtained by dictating the schools a certain innovation rate or model, as the schools have different preconditions and different stages of readiness. An innovation cannot be pressed on, if the basis of innovation is not present. Therefore, it is crucial to start from where the school finds itself and start on a level, where everybody can join in.

It is also an experience with the local authorities that the external courses are not always having the same effect as the more informal, internal training courses, the schools may have. In this connection it is important that there is a competent person who can inspire and support the teachers at the right time. *“Quite often it is a question of planting the idea and supply some tiny bit of security, support and resources to start it rolling.”* (Municipal consultant). Therefore, the school’s ICT co-ordinator is considered an absolutely decisive person in connection with the integration of ICT, as is the case at Kærby Skole.

The municipal data department has often witnessed that the technically very competent ICT co-ordinators unwillingly ended up by scaring their colleagues away, because they did not possess the necessary understanding of their colleagues’ prerequisites as far as ICT was concerned. Therefore, the data department points out that what is necessary for a rapid continuation of the general ICT innovation is the establishing of an instructors’ education pedagogically oriented towards adult education, enabling making ICT co-ordinators more able to take care of and inspire the teachers. The strong point of able ICT co-ordinators is that they are capable of decoding what consultative, professional and ICT related needs the schools have, so that the local school authorities may arrange for more precise educational facilities for the teachers, adapted to the actual needs.

It has played an important role in the innovation at Kærby Skole that there has been a general readiness to set the innovation in motion by means of resources – also as regards equipment and in-service training of the individual teachers. The school does not doubt that the best thing to do in order to promote the teachers ICT competences is placing a computer in the teachers’ home along with the offer to participate in training

courses. When a teacher can experiment and learn at home he or she is not only acquiring competences but also sustaining them, so that ICT becomes an integrated part of everyday life, say several teachers and the ICT co-ordinator. Furthermore, it is considered important that everybody has been obliged to using ICT to some extent or other so that the innovation is sustained by as many of the staff members as possible.

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

XOn the organizational level the school's participation in the ICT projects has implied, among other things, that all teachers have attended in-service training, which has contributed to a relatively high general level of integration in the organization. Furthermore, has been established a culture where via internal educational arrangements the teachers exchange experiences and communicate competences mutually. The methods are being developed so that the positive experiences from the ICT field can be applied in other fields of effort.

XThe school has used technology for the construction of a complex communication system by means of which today all communication is diffused, the teachers having committed themselves to using the system in their daily work. Among other things, the system has raised the level of information in the organization and has established a good basis for mutual reflection and accumulation of experience.

XAbove the internal possibilities of communication the school forms part of a wider municipal network, which through the years e.g. via comprehensive conferences has formed the basis of an extensive pedagogical debate across school boundaries.

XOn the teaching level some classes have experimented with educational practices actively using ICT to establish new forms of teaching and make the teaching independent of time and place.

Material supporting the rival hypothesis

XAlthough ICT forms part of the efforts to meet with the Ministry of Education's demands for a more up-to-date teaching, and even if the school, for instance, has acquired much experience in communication with other schools, ICT is mainly used in everyday school life as a resource in the existing teaching practice.

At Kærby Skole ICT has been a field of effort through many years, and the school has currently participated in innovative projects with ICT as the central point, which has contributed to an extensive innovation on the organizational as well as the educational level.

A conscious effort from both the leadership, the staff and the local school authorities have established good conditions for an organizational innovation on the large scale, and as time went by, the effort to integrate ICT resulted in the establishing of a progressive innovative environment. Thus, the material from Kærby Skole must be considered supportive of the hypothesis that technology – granted the right conditions – may act as a catalyst of an innovative development of the school.

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

At Kærby Skole the diffusion of ICT has taken place through a long process during which the staff has been allowed much time for getting accustomed to the media. Today practically all teachers use ICT on the organizational level, and the school's computer room is in great demand, technology often being used in teaching as well.

Especially the former ICT co-ordinator, being an entrepreneur, has been the leading figure in the innovation with commitment and pedagogical flair. Among other things, he has arranged internal training courses, while the leadership has rendered its support by making the necessary resources available and joining actively in the implementation process.

Generally, it seems that the teachers have backed up well, and it is emphasized as an important part of the

establishing of networks that all teachers have committed themselves to participate actively in the innovation – for instance via the communicative system, which is checked for new information every day. The teachers also have had the opportunity to require good help from the supportive arrangements established by the school, which today are taken care of by the ICT co-ordinator, who is ready with technical and pedagogical assistance. The internal arrangements are evaluated as being of great significance to the diffusion of technology, as unsecure teachers have a chance to get assistance enabling them to get started on an integration of ICT in the right setting. With the teaching related ICT projects the interest of the teachers was further intensified, and the installation of home-based computers in connection with one of the projects combined with the teachers' joint attendance of a mutual education really expedited the diffusion.

Finally, it must be pointed out that also the municipal support, which has brought about resources in the shape of technical and pedagogical guidance, has been of decisive importance to the diffusion of ICT at Kærby Skole.

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 technological infrastructure and student ICT competence rather than staff competence determine ICT implementation outcomes.

Material supporting hypothesis 3

XThe 'IT-springet' meant that all teachers were offered a home-based computer and in-service training, thus, obtaining relatively quickly a high degree of familiarity with the media. The school considers this leap into ICT decisive for the fact that the ICT integration accelerated.

XExperience shows that the ICT integration is in danger of coming to a halt if the teachers do not – in some way or other – overcome some of the pedagogical and technical obstacles that may occur in their teaching. Therefore, it is decisively important that teachers who find it difficult to include ICT are given the opportunity of guidance by the ICT co-ordinator, who also from time to time may join actively in the teaching.

XThe teachers have agreed upon a school curriculum for the students' ICT skills and committed themselves to meet with this curriculum hoping that it will imply that the students leave school with fairly equal skills which have not been randomly decided by the individual teachers' preferences.

XThe 'Pioneer Project' which implied experimenting with basing all teaching on ICT had been difficult to carry through, if the teachers had not had the necessary ICT competences.

Material supporting the rival hypothesis

XGenerally, teachers and students depend on access to a computer room, which does not further spontaneity in the use of ICT. On the other hand, the technological infrastructure is not seen as a real obstacle for the integration of ICT into teaching, as the teachers are incalculating this fact in their planning. The Pioneer class has not been subject to this problem, as the class has free access to computers both at school and at home, which makes it possible to experiment with teaching courses independent of time and place.

At Kærby Skole it is obvious that most teachers feel prepared to using ICT in their teaching, and also that the degree of use is high. For many years the school has had ICT as a point of rotation, it has participated in a series of innovative ICT projects, and the entire staff has gone through in-service training; this has contributed to making ICT an everyday phenomenon forming a natural part of the teaching. At the same time, municipal and local supportive arrangements have been established, which, technically and pedagogically, have helped the teachers facilitate the integration process. Thus, it is the experience of the local school authorities that it does not pay to focus solely on investments in hardware, as it is at least as important to clarify how the teachers are made able to operate and apply the opportunities offered by ICT.

Of course, it is important to the degree of application and what pedagogical possibilities can be applied in teaching, how free access the teachers have to ICT in school itself. However, the material from Kærby Skole indicates that the development of teacher competences – being familiar with the technology and feeling secure about its pedagogical application – is a critical factor in the implementation process. If the teachers are unable to operate the computers, they do not use them; consequently, the implementation of ICT must be considered an allround process where the focus is set both on hardware, staff training and provision of the resources for carrying through the objectives.

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 general picture of the school shows that to some extent or other everybody is given the opportunity of benefitting from the advantages present for instance in the word processing programme as related e.g. to presenting a nicer looking product and making the writing process more easily prepared.

XIt is also emphasized that ICT can be used for differentiation of teaching and to establish variations in the teaching, which means that the teachers are able to meet with the students' demand in a more expedient way.

Material supporting the rival hypothesis

XSome teachers find that the academically more competent students tend to profit the most from ICT.

XIt may be a problem that the less competent students withdraw and leave the keyboard to the more competent, when co-operating at the computer.

It is hard to say something unambiguous about what students benefit the most from working with ICT. Although some teachers are of the opinion that the more competent students derive the highest benefit, others mention that ICT may contribute to lifting the less competent, so that, generally, they profit more from it. Most teachers find that ICT may contribute to an innovation of the teaching practices, so that the students can be stimulated in different ways. As regards the 'contact classes' (autistic students) ICT represents a fine opportunity of visualizing and concretizing abstract assignments. At the same time, the technology possesses communicative potentials implying that ICT is experienced as an interesting instrument of development in the work with these socially fragile students.

According to the school's assessment about 90 percent of the students have a computer at home, for which reason it may be difficult to figure out, whether the use of ICT at school influences or is influenced by

differences in this connection. However, the teachers emphasize that even though the students have computers at home, it rarely means that they have anything but a superficial knowledge of the instrumental programmes, on the other hand they are very able at playing computer games. Consequently, having a computer at home does not mean that they automatically have any advantages in an educational connection. However, the school is trying to establish extended possibilities of using ICT both for those who have no computer at home and for those who find it difficult to use: The school arranges ICT café twice a week, where students may get assistance for various assignments.

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

XKærby Skole has chosen to give a high priority to the programmes of the Office package, as educational software is often expensive and of varying quality. In this connection quality is a criterion for applying the programmes at all.

XVia the 'school curriculum' the teachers are expected to teach the students specific skills, so it is up to the teachers to assess the quality of the programmes as related to meeting with these demands.

Material supporting the rival hypothesis

XIt is a common experience that students may easily get lost in ICT and become fascinated by certain operations; this demands a certain control on the part of the teachers.

XIt may prove time consuming to seek information on the www, and the students should learn where other instruments are more expediently applied.

XIt is a widespread assumption that it is important that the students develop versatility, and that,

consequently, the use of ICT does not prevail, of which fact the teachers are very much aware.

Much indicates that, generally, the teachers of Kærby Skole are attentive to how the students benefit from using ICT at school, and, consequently, make demands on both the programmes in use and on the students' way of using ICT in order to accomplish expedient methods of work. Thus, it is impossible to say anything in general about the influence of bad quality software on the learning level, as much has been sorted out before it reaches the students; however, according to the teachers, quality is of great importance to the success of the teaching. The students will soon lose interest and choose not to use software programmes, if they are not challenged by their contents – also the students are conscious of quality and do not consider anything relevant just because it is wrapped in electronics.

Furthermore, experience from Kærby Skole shows that sometimes the students may be fascinated by less expedient functions of various ICT materials, which may imply that their concentration is taken away from the subject-related contents of the teaching. Since the teachers are aware of avoiding this 'danger' of ICT, it is not in practice considered important to the learning level. Moreover, the school has set up guidelines for an ethical and responsible use of the www, which are repeated to the students every school year, and violation of the rules leads to sanctions, which, according to the students, has a preventive effect.

The general impression seems to be that there are no convincing signs of the truth of hypothesis 5, as regards the quality of ICT material, whereas the assertion that the learning level depends on the teachers'/the school's expectations is confirmed by the material from Kærby Skole. Nothing indicates that these expectations are lower, when ICT is integrated in the teaching.

5 The future

After many years of intense efforts to integrate ICT Kærby Skole has now reached a point where most of the staff has been sated and need to turn their eyes towards something else. What seems the most obvious field to tackle is the practical and creative area, where a group of dedicated teachers are planning to use the experience from the ICT co-ordinators' successful inspiration of the teaching staff, trying to set the focus on this more creative area of teaching in the same way.

In relation to ICT it is now a question of the teachers sustaining their ICT competences, as the very basis of integrating ICT in the teaching has been established. In this connection the future ICT co-ordinator in concert with the present will probably have great influence.

At Kærby Skole ICT is considered an important instrument to the school of the future, where to an increasing degree learning will be organized according to subjects and to the students' prerequisites, rather than to age, as is the case today. Such innovation is considered practicable with ICT and electronic logbooks as an instrument.

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 six observation sessions of 60 minutes and a total of 14 interviews.

The informants were: school principal (1,5 hours), ICT co-ordinator (2 hours in 2 sessions), 5 teachers (1 hour each), municipal consultant (1,5 hours), 3 groups of students, in total abt. 9 students (30 min. each), and 2 parents (30 min. each). All interviews were tape recorded and transcribed.

Out of 38 questionnaires 29 were answered. The school principal granted the necessary time during a weekly teachers' meeting.

The additional material consisted of 6 appendixes comprising among other things an ICT 'school curriculum', objectives and plan of action for the ICT innovation of the school and reflections on how ICT education can be established for an entire school.

Appendix B

((Please insert Appendix B – Kærby Skole))

Notes