OECD/CERI ICT AND THE QUALITY OF LEARNING PROGRAMME

A Case Study of ICT and Organisational Change at
Rugkobbelskolen – Denmark

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1. Presentation of Rugkobbelskolen

Rugkobbelskolen is one out of five municipal primary and lower secondary schools situated in a provincial town. The school has about 450 students in two tracks from kindergarten class to grade 10 with an almost even gender distribution. Above principal and deputy head the staff consists of two secretaries, 37 teachers, two kindergarten class teachers and one assistant. The teachers are organized in teams attached to each class, which offers the possibility of planning coherent teaching programmes, while the teaching itself mainly is organized according to a preset week plan with fixed lessons of the various subjects. The school offers two 'project courses' per year with participation of the entire school plus a series of minor 'everyday projects' and interdisciplinary courses planned by the team teachers.

At present Rugkobbelskolen has at its disposal 65 personal computers with world wide web access, 26 without www access and 50 home-based computers. Of the personal computers with www acess 25 are so-called 'thin clients', meaning outdated makes connected with one server, thus being rather slow in operation. Rugkobbelskolen has two computer rooms with 15 personal computers in each and one group room with six 'thin clients'. Four stationary computers and two lap top are used for administrative purposes and the rest are placed in the classrooms. This means that 5,2 students share one ordinary computer, and 6,8 students share one computer with www access.

As a new arrangement a 'mediateque' has been established, forming part of the present Pedagogical Service Centre. The mediateque functions both as a working base with 10 computers available and as a supplier of various electronical equipment to be borrowed. The educational service centre is being developed as a forum offering teachers and students technical assistance and educational inspiration. Above the mediateque also the school library forms part of the centre.

2. The past

Computer technology was first introduced at Rugkobbelskolen in the early 1980es, when a "Comet" computer was purchased to be used for administrative purposes. However, this computer often proved itself more time-consuming than expedient. From the janitor's office came other – more positive – comments. He applied for, and was granted, a computer. Today he is able to control the school's heating system via his WAP telephone, and thanks to his interest in ICT he has obtained more flexibility in his job functions.

At the beginning of the 1990es the role of ICT at Rugkobbelskolen was still a modest one. A few dedicated persons among the teachers were personally interested in ICT and tried to apply it in their teaching practice, but there was no co-ordinated efforts or integration in the school practice as such. However, electronic data processing (EDB) had been offered the students of the higher grade levels as one of several non-compulsory subjects.

The increasing focus on ICT in society and school implied that in 1996 the issue was placed on the agenda of the Pedagogical Council. The local school authorities had decided that before the end of 1998 the school would have to establish a local network and be linked with the Sector Web. Following a long process with internal dialogue and negotiations the school staff agreed in 1997 to make ICT a field of effort, and the school applied to the Ministry of Education for authorization to participate in the 'Poseidon Project', established in co-operation with a consulting firm, which was in charge of the practical part of the project.

At Rugkobbelskolen the ICT co-ordinator was appointed project leader, and subsequently a steering committee was established consisting of the project leader and the school leadership to which the overall responsibility was assigned, and a supportive group comprising teachers involved in the planning of the programme. In order to ensure the backing-up and involvement of the school leadership the 'Poseidon Project' comprised the obligation of the principal to be a member of both the steering committee and the supportive group.

The project consisted of three phases:

XDuring the Status Phase a status report on the school's actual frames and conditions for an integratation of ICT was prepared.

XDuring the Vision Phase the entire school – including the students – was involved in phrasing visions and set up objectives for the implementation of ICT.

X During the Action Phase the objectives were operationalized and incorporated in a concrete plan of action.[i] (Appendix C)

As far as Rugkobbelskolen is concerned The Poseidon Project concretely resulted in the preparation of an ICT school curriculum. The plan describes, what ICT activities the students of each grade level must go through in order to obtain the recommended skills. Above being a systematized plan to guide the teachers in the planning of their teaching it has also served the purpose of ensuring that the students' ICT skills were not only determined by what teachers they might have, as it was the responsibility of the team teachers to co-ordinate the integration/teaching of ICT.

In 1999 Rugkobbelskolen was selected for participation in the 'IT-springet' (the leap into ICT), which meant, among other things, that the entire school staff was granted home-based computer facilities for educational purposes and was in turn obliged to entering ICT in-service training consisting of a series of courses, training for a Computer Driving License or a Pedagogical ICT Driving License.

This innovation set into motion a series of initiatives which later became important elements of the ICT strategy of Rugkobbelskolen and, at the same time, have had far-reaching consequences for other fields of the school.

3. The Present

[i] In this part of the project it was the task of the steering committee and the supportive group to establish a balance between visions and reality. Today the phase model which was a central instrument of development in the process is profitably used by the staff in other fields of effort.

3.1 ICT in organization innovation

As pointed out by several of the persons interviewed a special feature of the innovative development Rugkobbelskolen has gone through is that the school has proceeded from 'an institutional culture into an organizational culture'. Described with the words of the school principal this means moving from an unconscious, unwritten level into one of visibly discussing and conveying to writing, including a conscious attitude to the school's basis of values. Where an institutional culture is ruled by regulatives, an organizational culture is in motion as an entity. In the school's organizational culture also lies – according to the principal – that the school has become self-learning. "*... it is an organization that consciously reflects on its own behaviour. It is reflecting together on the things we do, and finding out what way to go.*" (Principal).

School culture and school innovation

According to several staff members the process of implementation has led to a more level organizational structure: "*We are developing from an organization of a very regulated and hierarchic structure into one consisting of teams which to a high degree are self-adjusting – within certain common frames, of course, this is very important. But also teams reflecting on what we are really doing, discussing it between us and setting up new goals.*" (ICT co-ordinator). This development is considered generally positive, although not quite free of costs, as it implies more frequent meetings, and the teachers must find the time for this collective reflection and discussion, which may prove stressing in an already busy school life.

Moving from institutional to organizational culture the implementation of ICT has had an important function. The process, starting with the Poseidon Project brought about a new awareness, which means that today discussions on objectives and means lie implicit in the co-operation of the individual teacher teams. "*... the school has not (had) a tradition for getting together and talk objectives and action plans and that sort of thing ... And at any rate this is what I see as something people are interested in ... really talking*

about what we want with this." (Teacher).

About the role of ICT in the school's process of innovation the principal says: "*ICT promotes the possibility of thinking differently, acting differently, teaching differently, thus giving the children a different ballast. So, it is nothing but a piece of hardware, which we can use properly as a catalyst.*" (Principal).

The demand that everybody had to participate in the 'Poseidon Project' offered a common frame of reference and according to several teachers it resulted, at the same time, in a higher degree of openness among the teachers. Where earlier the teachers closed the door of the classroom and considered teaching a personal matter, today there is an extensive exchange of experiences and a reciprocal inspiration. The school innovation is described as a transition from an 'I-culture' into a 'we-culture', where everybody is acknowledging a responsibility for the quality of the teaching.

If the focus is set upon whether ICT can make the organization's work processes more effective a somewhat confused picture appears. As regards administration, experience tells that to some extent ICT may contribute to rationalizing the work processes in a way that offers time and energy for new actions. For instance, the secretary finds that ICT has offered wider possibilities of meeting with the surrounding world's demands for quality and service. Subsequently, however, she considers it a problem that in the everyday life in school there is rarely time left to make oneself acquainted with new software ect. and keep track of innovations in the field.

Several teachers find that the most important aspect of the process has been the personal development, that took place along with the school innovation. For instance, some of the teachers felt unsure with ICT, but using their home-based personal computers made them more familiar with the media and, at the same time, gave them more self confidence through the experiences of success the learning process implied. Although ICT can facilitate certain work processes no teachers find, however, that it is capable of rationalizing the teaching, on the contrary, it demands more time for planning and for instructing the students.

Communication

As a means of information and communication ICT today has become a central function in the organization: "*Distribution of information and inter-communication has been very much facilitated – and the use of e-mail and exchange of documents now form a matter-of-fact part of the co-operation within at teacher team and of the leadership's co-operation with the teachers.*" (Evaluation of the 'Poseidon Project').

Thus, ICT has created a quick and easy access to extended communication between the teachers. Particularly, the school's intranet has opened for the exchange of experiences. This takes place, for instance, in the teachers' closed web conference, where various issues are discussed. Above that a browser has been installed giving access to general documents containing information on various projects. Apart from being an alternative to the school's notice board the intranet serves as a centre for the booking of courses and classroom facilities. In the leadership strategy the intranet is deliberately used so that all current information from the administration is placed here, which means that the teachers have to use the intranet in order to obtain information on school matters, thus, maintaining some of their ICT skills.

Staff development

Before the staff of Rugkobbelskolen were involved in the 'Poseidon Project' a few desultory courses were arranged by the ICT co-ordinator. With Poseidon the ICT training of the teachers became organized; everyone attended the course 'School-ICT' comprising 50 lessons, and above that individual training days were held, where each teacher was granted 10 lessons with an ICT co-ordinator. 'School-ICT' which was based on team-training combined practical instruction with a theoretical-pedagogical superstructure introducing among other things The Learning Organization. Furthermore, the courses were designed to conclude in the acquisition of a Computer Driving License. Moreover, the teachers have attended various internal and external courses, which, however, took place on their own initiative and were based on personal relevance.

The Pedaogical Service Centre also offers a series of training facilities and study groups for the individual teacher to attend, for instance picture editing. The courses are arranged according to requirement and are often coupled with the 'resource-teacher' arrangement, where a teacher may 'order' and use the

competence of the ICT co-ordinator, for instance in the planning and implementation of an ICT project or the construction of a homepage. This arrangement leads to confidence among the teachers, enabling them to find guidance in more complicated technical processes, and at the same time the arrangement works as an in-service training which gradually increases their ICT competence.

Rugkobbelskolen has introduced as a non-formalized training activity a teacher-to-teacher arrangement implying that the teachers between themselves arrange internal courses, typically whenever they have acquired new ICT skills. According to all the interviewed persons this arrangement is a great success attracting many teachers – even those who initially were reluctant towards ICT are communicating their experiences and skills.

Obstacles

According to the interviews the differences in interests initially appearing among the staff were, primarily, related to the staff members' attitudes to whether ICT was or ought to become the school's most important field of effort. Several teachers found that the implementation of IKT formed a natural part of a major innovation in society. Others, however, were more critical, finding that the implementation would take place at the cost of other fields of equal importance to the students' personal development, for instance the practical and creative subjects.[ii]

At the voting for or against participation in the 'Poseidon Project' a majority voted for and 6-8 blank. The voting meant that all teachers were to participate in the implementation of ICT. Two teachers chose to give notice on the grounds that they did not want to use the time necessary for learning how to master the technique.

As regards structural obstacles, the leadership found that sometimes the school culture in itself would check the innovation. In some respects the underlying values and self-interpretation expressed itself as a "we-use-to..." tendency – certain ways of doing things – which first had to be overcome.

[ii]   Among other things Rugkobbelskolen has had a long tradition for theatre and music; however, this field has been whittled down.

3.2 ICT in teaching

According to the basic values of Rugkobbelskolen the school's principal task is to support the students' aspirations to becoming 'viable' persons, which also comprises that they should learn how to master the cultural techniques considered necessary to get on in society. Traditionally, the cultural techniques have been defined as reading, writing and mathematics, but the diffusion of ICT in society has implied that nowadays also ICT skills are considered belonging to the group of essential cultural techniques. In this way the acquisition of ICT skills should contribute to offering the students more varied possibilities of acting in their future life.

The school's general objectives for ICT are that the students should become familiar with the www; they should be capable of critically screening and assessing the information available on the world wide web, and they should learn how to master the most widely used software (word-processing, spreadsheets, e-mail etc.).[iii] The same objectives are valid for the teachers, but above that the latter should become able to incorporate ICT in their educational practice and to form part of the teacher-to-teacher arrangement. Above that ICT should be used to strengthen the contact with the surrounding society, especially the students' parents.[iv]

In extension of these objectives has been established a set of ethical guidelines to be followed by the students. However, the rule-of-thumb is that one should not do anything 'one's grandmother was not allowed to see'. In case of abuse the students are deprived of their access to the computers, which, according to the students themselves, has appeared an effective sanction. The teacher attitude is that in order to promote responsibility it is necessary to work with the student's norms, and that the teacher should appear as a trustworthy model rather than issuing bans, since most often prohibitions will, unintendedly, give rise to

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[iii]   Objectives and sub-objectives are found in Appendix C: 'Visions and objectives for the ICT innovation'.

[iv]   The teachers have a more concretized school curriculum describing precisely what skills should be obtained and when. Thus, it is expected that in grade 2 the students will have an initial knowledge of how to use a computer. Before the end of grade 6 the students should master the common instruments, have a certain knowledge of picture editing and homepages. The school curriculum also comprises suggestions for courses and programmes which might be of relevance to the individual teacher.

increased curiosity. At the same time, the ICT co-ordinator finds that the students are so capable that they will always be able to find short cuts in relation to ICT, which is another reason for refraining from taking up a fight in this field.

The school's use of ICT in its teaching is in harmony with the guidelines set by the Ministry of Education stating that ICT is an instrument to be integrated in all subjects. As mentioned earlier it is up to the individual teacher teams in what ways and to what extent the integration takes place , so, within the general rules of the school and the Ministry of Education a certain freedom of method still exists. The overall impression of practice at Rugkobbelskolen is that all teachers are integrating ICT in at least one of the subjects they teach, to an extent they find appropriate in relation to the contents of the teaching. Thus, the absolutely precise extent cannot be identified. As many of the teachers explained, a class might spend months without instruction that specifically comprises ICT. On the other hand there would be a long period, where the relevance of ICT was obvious and, consequently, was applied in many lessons.

Advantages of ICT in teaching

The teachers' attitudes to the integration of ICT in teaching has changed radically during the innovative process. Initially a certain reluctance towards ICT was ruling as it was considered an unknown and uncontrollable factor. Today the attitudes to the media are far more positive. Many are aware of the fact that in certain respects ICT may be a great advantage in teaching, while in other fields the application of technology will not be very expedient.

ICT has contributed to granting the teachers more possiblities as regards the contents of teaching: "*There are new possibilities of action. Now the students no longer need to write an essay on how they spent their holidays. In fact they can construct a homepage, where they can communicate directly with others – typically the parents.*" (ICT co-ordinator). Moreover, the integration of ICT may also add several dimensions to a subject: "*... simply by working differently ... interdisciplinary, and focussing – not necessarily on subject matters but on seeking information and on being able to read a text in many different ways.*" (ICT co-ordinator).

Furthermore, the ICT-coordinator finds that ICT demands a way of working that becomes part of

conveying to the students a greater responsibility for their own level of academic standards. Being unable to guide to the same extent the process the students follow when sitting by themselves at the computer the teacher must reflect more on this aspect in his or her planning of the teaching. "*It is incredibly important that when you start incorporating ICT, you should, in fact, have some learning processes, where the responsibility is delegated to the individual student.*" (ICT co-ordinator). Thus, relating to motivating the students ICT is also of great importance to the teachers. Many teachers describe how it is easier to promote involvement and concentration with the students by integrating ICT in their teaching. Among other things it is a great deal easier to achieve an esthetically more satisfactory product, which to many students is motivating in itself.

Among the students ICT knowledge and competence is assessed as a positive quality, and a teacher told, how one student in many respects placed a little outside the social circle improved his social status among his peers through his extensive knowledge of ICT. The teacher deliberately used this by appointing the student 'assistant teacher', when the class was working with ICT.

Disadvantages of ICT in teaching

Many teachers emphasized that ICT is only an instrument, and that one should be careful not to glorify the technological development. In a school the most important still is the social dimension and the encounter of people.

Furthermore, a few examples indicate that the demand for integration of ICT into all subjects can be very stressing for a teacher. The attitude is that in some subjects it does not seem obvious that ICT should be included and that it demands much too much time compared with the benefit. One teacher explains that she has made a personal decision not to choose ICT in a subject where she does not find it relevant, knowing perfectly well that this is not in accordance with the school's objectives.

Outdated computers and technical problems are facts that may impede the teaching. One teacher explains, how her class had used many hours at the computers to produce a 'speaking book', when the system broke down and all their efforts were wasted. Many of the technical problems cannot be solved by the teachers, and it takes much time to require assistance or find out, all of a sudden, what the students should do instead.

Also the outdated computers is a major source of frustration among the students who quickly lose their patience, which also contributes to making it difficult to get along with the teaching.

The technological development in society is also frequently considered a problem seen in relation to in-service training. The development runs fast, and knowledge is rapidly outdated. Therefore, it demands a lot to keep up to date. One teacher commented that ICT is "*a field developing so rapidly that by definition we are four to five years behind.*"

Many teachers stress the fact that it is important to remain critical towards ICT and as far as the students are concerned to work up a critical sense toward the media. The tendency is that the students ascribe a high degree of trustworthiness to the world wide web as a source of information, for which reason to a large extent the teachers consider it their responsibility to teach the students to discern among the material available. Moreover, it may prove far more time consuming to seek information on the world wide web than looking up things in a book, but often the students will choose the web as their primary source of information.

Furthermore, several teachers point to the fact that ICT may prove a time consuming factor both in the teachers' own acquisition of the necessary ICT skills and in their teaching practice. How ICT is used in a stressed everyday life is sometimes a question of priorities, as there are many other essential tasks which also need attention. Also time is an important factor in relation to the school's two computer rooms, which have to be booked a long time in advance, as they are in great demand. Therefore, it is often a problem to plan a coherent educational course, and it is difficult to spontaneously include ICT in the teaching, if an obvious opportunity suddenly occurs.

One of the disadvantages of ICT pointed out by everybody is that large sums of money have to be spent on maintenance and renewal of equipment. Often the equipment does not work and moreover it is rapidly outdated, which means that large annual financial provisions are necessary to maintain an up-to-date level.

The ICT co-ordinator, acting today as both educational consultant and technical assistant, finds that larger resources should be set aside for technical support. As it is, much time is taken from guidance and spent on maintenance because the same person has to take care of both functions. Technical difficulties are

considered one of the greatest obstacles in the teaching, one that gives rise to the largest frustration among students and teachers.

Academic rigour and equity

Whether ICT will contribute to improving the students' academic level (generally or individually) is assessed differently among the teachers of the school. Thus, the assessment depends on the individual teacher's view upon learning and on his or her specific application of ICT in the subjects. However, it is generally pointed out that technology does not lead, directly or in itself, to improved academic standards. On the other hand, the application of ICT may contribute to increasing the students' motivation, thus, indirectly influencing the level of academic standards in a positive way. However, nothing unambiguously indicates that the academic level of the entire school is rising. In some subjects, for instance reading, it is assumed that it may give the subject an extra dimension (layout, criticism of the sources etc.) thus, raising the total level. However, as one teacher expresses it: "*Some you can raise, others you can't.*"

Generally, the teachers do not believe that ICT can contribute to levelling differences between competent and less competent students. However, many teachers find that the demand for differentiation of teaching is more easily met, when ICT forms part of the teaching. The students work independently at their own pace, and it is possible to set the level according to the individual student's prerequisites: "*I think they benefit equally from ICT – according to their individual prerequisites, of course. But, fundamentally, I believe it is the activity – the self-activity arising, when you sit at the computer ... the fact that you are in fact responsible for writing or finding something that makes you derive a benefit. They all rise from their starting level.*" (ICT co-ordinator).

There is a faint tendency towards pointing out boys as the more dedicated as far as ICT is concerned, but at the same time it is stated that this difference is approaching cancellation. If any gender difference should be mentioned, it would have to be the different way in which boys and girls use ICT. For instance, many girls seem to be more interested in the communicative aspects of ICT.

One teacher explains how she found ICT particularly applicable on the lower class levels, where writing

skills are not yet well developed, but where the children are very good at 'thinking in pictures' and visualizing. With her firstgraders she has made a 'speaking book', in which sound, picture and text were united, thus arousing enthusiasm and concentration in the students. The Speaking Book now forms part of the school's homepage.

The fact that not all students have access to a computer at home will often contribute to causing problems in the application of ICT. The principal describes the conflict arising when the school as part of its basic values endeavours to establish equal opportunities for all its students, and, at the same time, attempts to integrate ICT in the teaching to form part of the students' everyday life, thus granting students with a computer at home an advantage. Students without a computer at home are dependant on the computers available at school and the school's opening hours. Therefore, it is important to the principal that she and the teachers are aware of the fact that students without computer access at home are not, automatically, left behind. An example of the consequences of these reflections is a teacher who has refrained from the possibility of offering the students to do their homework on the computer, finding that this would have the effect that "... *some students would be sorted out ... who almost feel it as a punishment not to have a computer, so they have to write everything by hand.*".

However, the school has established an ICT-café to meet with these students' needs.

3.3 The diffusion pattern of the innovation

One of the facts characterizing the innovation of Rugkobbelskolen is that the school has been in a privileged position through participation in the 'Poseidon Project' and the 'Leap into ICT', which has been the fulcrum of the innovation. Among other things these projects have meant that resources of funds and time were set aside for the innovation of leadership strategies, which has been decisive for the way the implementation of ICT took place.

The point of origin was a wish for innovation in the school before it entered the projects – at that time mainly on the leadership level and, consequently, not as a wish widely spread among the teachers. The leadership took various initiatives to uniting the staff as regards entering actively into an innovative process around the integration of ICT, and after about a year of dialogue, information and negotation it appeared

through a vote that the major part of the staff now found it appropriate to make ICT a field of effort.

Gradually, the staff members were more involved in the innovation, both through the visionary work on the design of an ICT strategy and through the compulsory Pedagogical ICT Driving License. Several of the persons interviewed emphasize the fact that once they got the home-based computer, the development gained momentum. For instance, one of the teachers who was initially very critical towards the technology tells: "*The moment you get this instrument you have to make yourself acquainted with how it works.*" Today the teachers are contributing to continuing the innovative work through their daily practice, and also the great support to the teacher-to-teacher arrangement can be interpreted as an expression of the teachers having 'taken possession'.

The ICT co-ordinator has had decisive role in the innovation. All the persons interviewed agreed that without the ICT co-ordinator's involvement the process would have looked differently: "*... You must be really devoted, beause nothing comes from just shooting off some interest in general. Someone has to take the lead, to make it happen, and this is what he has done. So, well – without him we had not joined up.*" (Teacher). In this case it has proved important to have one central person to whom the teachers could turn for encouragement and guidance. In this way he has played a special role in the implementation and still does as far as maintenance and sustenance are concerned, acting – apart from ICT co-ordinator – also as resource teacher, technician and responsible for the school's intranet and homepage. Furthermore he plans training courses for teachers and act as the school authorities' consultant on ICT. His personal opinion is that the relationship with the teachers rests upon trust, for which reason it is a very important quality in a project leader that he is capable of displaying empathy and taking the teachers seriously during the process.

The role of leadership

Even though the implementaton of ICT was launched by the leadership, the ICT co-ordinator acting as prime mover, it seems that today everyone is involved in executing and sustaining the implementation, even those, who, initially, were the most critical, now taking part in and responsibility for the integration. In this connection the leadership emphasizes that a precondition for characterizing the process as a success is that the will and interest towards carrying the projects through were generated from the bottom-up. "*... if it were entirely a top-down process, it would be dead.*" (Principal). The leadership may have an initiating function; however, according to the ICT co-ordinator, if the teachers are not prepared, the project will fall, which has happened earlier at Rugkobbelskolen. Several teachers find that the leadership has backed up on the process to a high extent: "*In fact we may wish whatever we want and close to everything is granted as long as it concerns ICT. And it is incredibly great that this is the way it is.*" (Teacher).

It has been decisive to Rugkobbelskolen that leadership has developed along with the other staff members. In order to establish a fruitful leadership strategy it was necessary to obtain more insight into the subject related and pedagogical aspects of ICT. At the same time it put a pressure upon the leadership that all staff members had a home-based computer, since this implied that on all levels it was obvious that the new possibilities were to be used for communication and distribution of information.

Co-operation with a consulting firm has proved of decisive importance on the leadership level, as the school profited from trying other methods for school innovation than those traditionally applied. During the process a stringent form of project work was developed which today is used as an organizational instrument in other connections and related to other fields of effort.

Sustainability and scalability

The ICT co-ordinator of Rugkobbelskolen is also employed as the ICT consultant of the local school authorities, and it is his task to try to 'transfer' the innovation to other municipal schools. Among other things, the job consists of arranging in-service-training, carry through strategy processes and co-ordinate the ICT innovation in the other schools. In this connection he emphasizes that the decisive task of the consultant is to motivate the principal to take the responsibility for the implementation and start a process aiming at producing objectives and plans for action and at establishing a joint ownership for the staff. In this way the ICT co-ordinator is working as a consultant for the other schools on the same strategic basis and using a phase model similar to the one that has proved effective at Rugkobbelskolen.

The financial possibilities granted Rugkobbelskolen via its participation in the projects mentioned above made it possible to realize the objectives far quicker than expected, as time and energy should not be used beforehand on finding sponsors and funds to cover unforeseen expenses. This is also seen as an essential condition but not necessarily as a prerequisite. Thus, the principal as well as the ICT co-ordinator consider it possible to carry through a similar innovation at other schools without the same financial support: *...we have been enourmously lucky that we also got half a million for hardware.* That was an essential condition for our success. I still believe that we had had the innovation, but not with the same speed." (ICT co-ordinator). Both point out that the most important prerequisite for a successful implementation is that as a point of origin the school sets aside resources for project leadership. In this way is secured that the course is structured and that joint and realistic objectives are developed along with extensions in the hardware field.

Apart from time for project leadership, Rugkobbelskolen set aside 2200 hours for in-service training of the teachers, which equivalates 1,5 full-time employed teachers. However, the ICT co-ordinator of the school has no doubts as to what would be strategically best to do about the training of the teachers: "... *we also tell the principals and politicians that the very cheapest solution, if you want to establish good in-service-training, would be granting each teacher 10.000 D.kr., so that they can have a home-based computer. That would be the very best thing to do.*" (ICT co-ordinator).

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

XVia participation in the individual ICT projects the staff of Rugkobbelskolen has been engaged in the phrasing of general visions and objectives for the implementation of ICT. This has started a joint process of reflection, which has strengthened and goal-directed the co-operation within the organization in several fields.

XThe school leadership has supported and in the same way as the employees participated in the ICT upgrading. Thus is also on the leadership level developed instruments/methods which can be actively applied in the establishment of innovation within other areas of the organization.

XThrough the ICT-related projects the in-service training of teachers became organized (a.o. via the Pedagogical ICT Driving License and the home-based computer), and this form of upgrading one's qualifications has meant that Competences and ownership in the innovative process has diffused through the entire staff.

XThe school has accomplished to benefit from the staff members' Competences by establishing various supportive arrangements – for instance the teacher-to-teacher and resource teacher programmes – where the staff members goal-directedly learn from each other and exchange knowledge, which has also led to a more open and reflective culture among the teachers. Establishing world wide web and intranet as fora for the accumulation of experience and for discussion has contributed to this development.

Material supporting the rival hypothesis

XOn the teaching level the integration of ICT has made it possible to meet to a higher degree with the demands of the Ministry of Education for a more up-to-date teaching as regards, for instance, co-operation and communication.

XThe teachers express the point of view that ICT may be an instrument for coping better with certain pedagogical problems. For instance, a deliberate use of the technology will often lead to better conditions for the differentiation of teaching.

A Rugkobbelskolen it is possible to find argumentation for ICT as a catalyst for a major part of the innovation that has taken place on the organizational level. However, it is important in this connection to notice a few decisive elements of this catalystic function: The school has worked deliberately with a more general organizational innovation, and it has been an objective in the implementation of ICT to *make* technology the catalyst of this process. Thus, technology has acted as a catalyst at Rugkobbelskolen being initially thought into an organizational context, and by virtue of a series of conditions of a successful organizational innovation already established. Thus, part of the picture is that the school set aside resources for a goal-directed strategy and the establishing of practicable objectives in connection with the ICT projects.

On the teaching level it seems, however, that at the time of the study ICT more had the shape of a resource which the teachers may integrate with advantage, which, however, was not yet considered a catalyst changing the traditional ways of teaching very much.

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 Rugkobbelskolen the diffusion pattern is characterized by the fact that the three levels traditionally forming the mainstay of innovations in school all have been clearly involved in the implementation of ICT.

The prime mover has been the school ICT co-ordinator, whose dedication and support little by little has encouraged everybody to become involved and develop their competences. The ICT co-ordinator has been very capable of 'reading' the needs of the other staff members and subsequently adapting the effort in relation to each individual.

Furthermore, the school has been good at establishing a network having made use of the fact that various staff members possessed competences that advantageously could be communicated to others. To that end among other things the teacher-to-teacher arrangement has formed an important part of establishing the open culture that has given the diffusion a push forward. In this way the school has succeeded in making ICT a joint project, where in a relatively short time the entire staff has become involved in the integration into both teaching and organization.

Moreover, ensuring that ICT was diffused among the members of the organization has been a deliberate leadership strategy, for which reason the leadership has actively entered the negotiations on conditions, the teachers could close their ranks about. Therefore, most of the teachers were ready to accept the suggestion when it was put to the vote, whether ICT should become a field of effort, where everybody was obliged to participate.

A prerequisite for the relatively quick diffusion at this school has been its participation in ICT-related innovative projects. Among other things, the projects contributed to the diffusion becoming systematized all the teachers having completed a course of in-service-training. It is especially emphasized that the establishing of home-based computers for all employees was an essential prerequisite for the upgrading of qualifications and, thus, for the diffusion.

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

XInitially, a certain resistance existed among some of the teachers against making ICT a field of effort, which was connected with their feeling insecure towards the new media, the fact that they did not realize its relevance or preferred other issues to be given a high priority. Probably, several teachers would have chosen not to integrate ICT, if it had not been decided through a majority vote that everybody had to participate in the process of implementation.

XThe school has adopted an educational plan setting guidelines for what competences of ICT the students should acquire throughout their schooling. Thus, it is considered the teachers' responsibility to communicate their competences to the students, and the school curriculum is an attempt to ensure that at length all students acquire ICT competences on a certain level although the teachers'methodological freedom, which is a tradition of the Danish school system, is maintained.

XThe school has established supportive arrangements making it easier for the teachers to meet with the school curriculum in case they do not feel quite up to integrating ICT into their teaching.

XWhen the teachers were given home-based computers and started an ICT in-service-training the development accelerated – subsequently, the teachers have acquired a more homogeneous basis for their work, which also contributes to ensuring that to a higher degree the students are more homogeneously taught.

Material supporting the rival hypothesis

XThe teachers are depending on the availability of computer rooms which have to be booked beforehand, which some of the teachers consider a limitation of the possibilities of integrating ICT in their teaching.

XOutdated computers and technical problems are often seen as an obstacle to carrying through the teaching, and at the same time this has a demotivating effect on both teachers and students.

At Rugkobbelskolen the conclusion must be a 'both-and' as regards the two rival hypotheses. Today all teachers take an active part in the implementation process, but there are many indications that the teachers might have chosen not to integrate ICT en route, if they did not feel prepared for or did not realize the relevance of the intended implementation. The critical attitude which existed initially was diminished as the teachers' competences and their knowledge of ICT were increased, and today the teachers are aware of a

series of advantages at using ICT in their teaching. Not until the teachers can actually see the relevance and take responsibility for the integration is ICT integrated into the teaching.

The infrastructure of the school, as it looks today, sets some natural limits for how often the teachers have the opportunity to use ICT. Many classes share the two computer rooms, so there is not a free access to the computers. However, this is not seen as a general problem compared with the problems of meeting with the school curriculum's objectives, being something the teachers can deal with when planning their teaching.

If the teachers' home-based computers are considered part of the infrastructure it is obvious that their possibility of becoming familiar with the media, prepare their teaching and maintain their competences is important to the outcome of the implementation. So the teachers' own conclusion is that the innovation really started to gain momentum, when they were granted a home-based computer where they could 'practice'.

Thus, it may be concluded on the one hand that the infrastructure actually decides the access to ICT, and, consequently, the extent to which ICT can be integrated into the teaching. On the other hand it is obvious that the teachers' competences, their familiarity with technology etc. are decisive for whether they consider ICT a relevant and practicable possibility in teaching. Moreover, the importance the teachers attach to the establishing of home-based computer facilities indicate a close connection between infrastructure and competence development.

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

XRugkobbelskolen finds that ICT in teaching may imply motivation, and the teachers find that ICT is a good instrument for differentiation of teaching. According to the teachers this means that based on his or her individual prerequisites each student can benefit from ICT, if the technology is applied with proper consideration.

Material supporting the rival hypothesis

XApparently there is no material which in this case supports the rival hypothesis that the highly performing students to a marked degree raise their level through the application of ICT.

At Rugkobbelskolen much attention is paid to ensuring that students without access to ICT at home are not, on those grounds, in danger of falling behind as regards ICT competences. It is attempted to anticipate such cases by offering possibilities of access to ICT at school beyond school hours. On the whole, however, the teachers find that the students with home computers are not necessarily more capable in a learning situation than those without. They point out that often the students' experience with home computers are related to games, which does not automatically mean that they also master the ICT skills taught at school.

All things considered, the experiences of Rugkobbelskolen do not indicate that the highly performing students benefit more from ICT than the less highly performing – the students rise from the level where they find themselves.

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

XThat the school has adopted a school curriculum for the ICT field is a consequence of its awareness of the fact that what a teacher expects from the students will often have a decisive influence on their actual level of academic standards.

XThat, moreover, the school curriculum, contains references to relevant software can be seen as an expression of the necessity to secure a certain quality of the teaching material.

Material supporting the rival hypothesis

XThe teachers pay attention to the fact that they carry a responsibility as regards making the students capable of a critical assessment and screening of the information accessible on the world wide web, as some students tend to ascribing such information a high degree of trustworthiness. It is incorporated in the objectives of the school curriculum that the students should acquire a critical attitude.

XIt may be time consuming to browse on the world wide web, and some students tend to prefer seeking information on the web to seeking it for instance in books, which in some cases would be more appropriate. Therefore, the teachers consider it a major task to make the students capable of assessing when ICT is a relevant instrument for solving a given problem, and when it is not.

As Rugkobbelskolen mainly uses the world wide web and the Office programmes in the teaching it does not look like poor quality in general is something the teachers have to cope with in everyday school life. On the contrary, much is indicating that the teachers are paying attention to the fact that ICT-teaching must be of a high standard, for which reason they sort out much of the material they find inadequate. At the same time it is a widespread attitude that ICT is a media with certain potentials, however technology should not be glorified. Consequently, the teachers are very attentive to teaching the students how to take up a critical attitude to the media's possibilities and limitations, as otherwise they might find it difficult to use it appropriately and benefit from it. Thus, it is the predominant conviction of the school that poor quality teaching material has a negative influence on the level of academic standards, and an awareness that to a certain degree the teachers must control and secure the quality of materials.

Since Rugkobbelskolen in practice is securing the quality of teaching materials for ICT the supplementary

documentation from the school must be considered supportive of the hypothesis that the students' level of academic standards level depends on the expectations expressed by school and teachers. Nothing indicates that generally the expectations are lower in the ICT field than in other fields of teaching.

5 The future

To Rugkobbelskolen it has been a profitable but also hard process making ICT a field of effort. The teachers have had to go through in-service-training on a large scale, and many resources have been applied in the field. Today many of the objectives of the ICT efforts have been obtained, and even though many still want more education for themselves, a certain fatigue is also traceable. As the ICT co-ordinator expresses it in an evaluation report it is "*... understandable that a certain saturation occurs along with a need to occupy oneself with other aspects of life than precisely ICT. Many teachers want to let the innovation flatten for a while, so that they can have some time to digest all the new things – and not least get time for incorporating it in their teaching.*".

The ICT innovation of the school has implied that a focus has been set on different fields which now need to be looked more closely into. For instance, a need has appeared to change the physical frames so that teaching can be carried out in other ways than the traditional classroom teaching. And, as the ICT co-ordinator also points out: "*We ought to put more weight on the practical-creative aspect and be even more conscious of how we use it as a counterweight to our sitting motionless at the computer. That will make a great supplement.*" (ICT co-ordinator).

Rugkobbelskolen has already started working actively in a new field, namely that of developing 'internationality'. Here the idea is to establish international contacts via ENIS or other relevant networks. It is the principal's intention to take the initiative to carrying on the experiences derived from the ICT implementation process. Thus, a supportive group, a 'day of visions' etc. are being established. Thus, the innovation set into motion at Rugkobbelskolen via the 'Poseidon Project' does not stop, but is actively carried on tentatively in relation to other fields of effort.

Appendix A

In Denmark the team behind 'Case studies – organisational change' comprised project leader Arne Carlsen, project researcher Lotte Broe, project assistants Lea Holst Spenceley and Ulla Milner Drewsen – all employees of The Danish University of Education. The study has been 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 five observation sessions of 45 minutes each and a total of 16 interviews.

The informants were: school principal (2 hrs. in 2 sessions), ICT co-ordinator (3 hrs. in 2 sessions), 7 teachers (1 hour), 3 groups of students, in total abt. 15 (30 min.) 2 parents (30 min.). All the interviews were tape recorded and transcribed.

41 questionnaires of 41 were answered. The first 15 minutes of a staff meeting (teachers) were used for answering the questionnaire.

The additional material/appendixes from the school consists of 21 items comprising a.o. school curriculum, plans for action, objectives and evaluations of projects and courses.

Appendix B

((Please insert Appendix B – Rugkobbelskolen))

Appendix C

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Notes