

OECD/CERI ICT AND THE QUALITY OF LEARNING PROGRAMME

A Case Study of ICT and Organisational Change at
Nordsjællands Grundskole og Gymnasium (NGG) – Denmark

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1 Presentation of Nordsjællands Grundskole og Gymnasium (NGG)

NGG (Primary, Lower and Upper Secondary School of North Sealand) is a private school comprising primary, lower and upper secondary school, and is situated in the outskirts of a small provincial town North of Copenhagen. It was founded by the present headmaster wishing, among other things, to create a school where the students might start in kindergarten class and finish their schooling with the ‘studentereksamen’ (upper secondary school leaving examination). The idea was to establish continuity in education and sustain the acquired acquaintance with the students throughout upper secondary school. Above its capacity of primary and lower secondary school and upper secondary school NGG also houses a pre-kindergarten class taking care of the younger students, and an international department with a special international curriculum.

The school has four classes on each of the grade levels and a student population of abt. 1.100 aged 4-20 years with a rather equal gender distribution. Above a registration fee and the monthly school fees paid by the parents, the school’s income derives from state subsidies (85%) donations and funds. The school is situated in a neighbourhood, where the average income per family belongs to the highest in the country.

The school staff comprises abt. 130 persons including six administrative employees. The headmaster is the formal principal of the entire school, whereas the daily leadership is taken care of by the principals of each department (inspectors) of which two are allocated to the primary and lower secondary school department. Three teachers are in charge of the daily ICT functions, one being responsible for primary and lower secondary school and one for upper secondary school, whereas the third is appointed webmaster and taking care of the establishing and updating of the school’s homepage. The ICT co-ordinator for primary and lower secondary school is in charge of arranging staff training courses, technical assistance and, at the same time, works as a kind of ICT support teacher who may assist the teachers during lessons. Furthermore, recently a so-called ‘computer janitor’ has been appointed whose only task is to maintain the technical installations of the school.

NGG is profiling itself by being more academically oriented than the public schools, particularly putting weight on the science subjects. The teaching is traditionally divided into subjects and lessons and planned one school year ahead. Thus, it is left to the individual teacher to decide whether time should be set aside for particular subjects weeks or cross curricular courses.ⁱ

In 1992 NGG decided to establish special 'computer classes' which implied that one class per year from grade 7 to grade 10 had computers integrated into the teaching. The students of these classes must bring their personal portable computer, bought or rented through the school, and connectable in specially equipped classrooms and in all rooms for special subjects. A minor additional school fee is charged for students in computer classes, to cover part of the extra equipment etc.ⁱⁱ

The school demands that all the computer class students instal Microsoft's Office packageⁱⁱⁱ in their personal computers, as the programmes contained in the package are considered standard and are used as the primary instrument in teaching. Initially all students must carry through an intensive typing course, during which they are also introduced to the programmes of the Office package, thus, acquiring a common basis for their future work with ICT. Moreover, many teachers choose to take their students on a school camp tour in order to provide them with a series of basic skills.

All computer class students are currently tested in ICT skills and finally obtain a diploma to be added to their official leaving examination certificates. The students who do not attend a computer class are offered edb-courses from grade 7 but apart from that have no compulsory ICT instruction.

ⁱ An extended procedure of evaluation forms part of NGG's efforts to maintain a high academic standard. From grade 3 marks are given three times a year based on a scale from 00 to 13. Also yearly reading, spelling and mathematics tests are carried through from grade levels 1 to 6 which form the basis for an assessment of the need for special support to certain students. School 5 has no proper remedial class arrangement, however, in some cases extra support is offered. Also the school's procedure of admission comprises an initial interview where it is assessed whether within its existing frames the school is able to meet with the children's educational needs.

ⁱⁱ This amount far from covers the actual expenditure, thus being more of a symbolic amount contributing to making students and parents reflect on the expediency for the individual student of joining a computer class.

ⁱⁱⁱ The package can be purchased through the NGG as a side-license.

The school has two computer rooms with a total of 28 computers with web access. Furthermore, the students have the possibility of connecting their own portable computers with the world wide web via outlets installed in the computer rooms. NGG also has 75 computers without web access, stationary as well as portable, at the students' disposal. Not counting the computer classes primary and lower secondary school comprises more than 600 students, which implies a student/computer ratio of 22,5 students per computer with www access and 6,1 students per computer, when counting those with web access as well as those without.

2 The past

Although NGG is trying to keep up many of the traditional virtues, it is trying, at the same time, to keep abreast with the development of society. That private schools are not subject to directives from the Ministry of Education to the same extent as municipal schools implies that they are more free to organize their teaching according to their own set of values. On this very background NGG established, among other things, a 'vocational line' in the 1980es, an international department in 1997 and in 1992 was able to offer its students to attend a computer class.

The wish for having computer classes established came from different parts. At the school itself several enthusiastic teachers realized that to a wide extent computers would be the media of the future, and several parents had also started urging the school to offer the students possibilities of increasing their ICT competences. The leadership supported the idea, realizing that ICT would have an increasing extension in society and could be expected to become of decisive importance to the students' future occupational chances. Moreover, the school realized that the efforts might be valuable for the school's image, as, at that time, ICT was not yet in the focus of primary and lower secondary schools in general.

NGG entered into co-operation with Macintosh, Denmark, who contributed with computers, large screens etc., and the school received much attention from the outside, being the first school to offer computer classes. After pressure from the parents it was decided to change to personal computers with Windows, so that for some time the school used both operational systems. In practice this was inexpedient in relation to teaching, and today the students are encouraged to buy personal computers with Windows only.

During the initial period other unforeseen difficulties occurred: Among other things, the school had not taken into account that physical limitations were connected with the fact that the portable computers depended on plug outlets for the recharge of batteries. If the students should be mobile, plug outlets had to be installed around the school, but the outlets were often damaged, and this meant interruption of the

teaching. Furthermore, financial problems occurred, as the resources available did not allow computers for all students. Consequently, much time was spent on inviting tenders which looked reasonable, so that students who might wish to rent the equipment from the school were offered this possibility.

Initially many teachers were very interested in teaching the computer classes, and they were given in-service training at the then existing Royal Danish School of Educational Studies or internal staff training courses^{iv}. Right from the start the teachers would volunteer for teaching the computer classes, and although there were no specific demands to the extent of ICT use in these classes it was implied that teaching a computer class meant using ICT as much as possible.

Today, nine years later, the situation is different. There is still a need for computer classes, however, it is under discussion in which shape they should be continued, as the basis of the computer classes has changed.

^{iv} The ICT co-ordinator estimates that about half the teaching staff (from both primary and lower secondary school and upper secondary school) have attended the training courses.

3. The present

3.1 ICT in organization innovation

What characterizes the ICT implementation at NGG is that, primarily, the technology was considered an instrument which might contribute to innovating the form of teaching and establishing new learning processes. Thus, it was not subject to the same extent of consideration, whether ICT might be of value in an innovation of the organization, and, consequently, the innovative processes on this level were not very radical.

School culture and school innovation

NGG appears as a somewhat complex phenomenon, as, roughly sketched, it is marked by innovative efforts and a wish to keep abreast with time, and, at the same time, is emphasizing the traditional educational ideals. For instance, it is considered the most essential task of the school to contribute to developing the students' working morale and good manners, and 'the old civic virtues' are an essential aspect of the school's basic values. A tradition which has been preserved is the morning assembly gathering teachers and students three times a week.

The school's general objective is that the students derive the highest possible benefit from subject matters, which, among other things, is the reason why the traditional division into subjects is preserved: "*In this school we have emphasized the statement that we want all students to obtain a basic knowledge in the subjects within all subject areas.*" (Headmaster). Both teachers and parents find that the academic standard is high, particularly owing to the traditional way of teaching.

Parents as well as students leave the impression that generally NGG is characterized by a dedicated teaching staff and leadership – as one parent explained about choosing this school: "*It meant a lot that we sensed that this was a solicitous place also offering challenges.*" Especially the headmaster is pointed out as a very

charismatic person, and the students feel that they can approach him directly with school related or personal problems.

Like several teachers and parents the headmaster assesses that ICT held great possibilities as regards an innovation of teaching, but on the administrative level he was more sceptical and not to the same extent inclined to let go of familiar processes of work: *“He was one of those very hard to convince that we should have computers in the administration ... but today he is thrashing the keyboard and could not do without it.”* (Inspector).

It is hard to find real evidence to the fact that ICT has influenced the school culture basically or led to changes in the processes of decision, organizing and communication. However, several teachers find that the school has become a more interesting place to work after ICT has been implemented, and quite many students have chosen NGG for the very same reason. Moreover, ICT is taking up a central position in the administration, where, according to a secretary, it has made many work procedures considerably more effective. However, initially not all staff members were equally enthusiastic, and, stably, it has been difficult – especially to the elderly staff members in administration – to ‘leave’ the work to the computers. A similar problem is present today, where the administration is facing a renewal of the familiar DOS-based programmes. That ICT makes many administrative tasks easier is not seen as an unambiguous advantage, as – paradox as it is – it may contribute to increasing stress; the feeling that the tasks are no longer very time consuming makes the staff take on a much larger number of tasks than before.

Communication

As a media of communication ICT is not yet used very systematically. An estimate of one inspector is that about half the teachers have e-mail addresses, and few examples exist of exchange of assignments and information between teachers and students taking place via ICT. The school is attached to the Sektornet, giving both administration, teachers and students access to the web, for which reason the webmaster considers it the school's 'life line' to the surrounding world. However, he finds that the school has been too slowly profiting from the possibilities within internal communication contained in ICT. A future project will be the establishing of a conference system via ICT, and it is hoped that this will strengthen communication for students as well as teachers "*...so that we build a kind of extra dimension on top of our classroom.*" (Webmaster).

NGG's homepage is mainly used for general information on the school, and according to the administration, quite many students and teachers have found their way to NGG from that source. Few teachers use the homepage on their own initiative for gathering information on homework, assignments etc. The headmaster finds that using ICT is often very demanding as regards time and other resources, and that to the teachers it will often be a question of priority, whether the media is used. One argument often stated by the staff members as a reason for a reluctant attitude to using ICT for communication is that they do not want to replace the human contact factor, and that a direct approach looks more personal.

Staff development

The education of the staff which has taken place via external as well as internal training courses does not immediately look formalized, and nothing indicates that the effort has been co-ordinated or planned with an eye to making all teachers familiar with the technology. According to the headmaster the school has emphasized that the teachers should not be forced into a development for which they were not ready and of which they did not realize the relevance. *“Not all teachers find that ICT is a good idea. Some do not like computers, and I don’t think you can make everybody like them.”* (ICT co-ordinator). This attitude is also found among other staff members who point out that in order to be able to use ICT in a relevant way in the teaching of computer classes it is necessary to master the technology on a certain level. *“... the teacher, who more or less unwillingly had to become acquainted with it, and perhaps was just able to use a word processing programme, ... what would he or she do in a class, where the students are absolutely superior – it couldn’t be used for anything – apart from making a fool of the teacher.”* (Teacher). Basically, the majority of the staff supported the establishing of computer classes, but since some of them did not give priority to using the time and resources required for applying ICT on an appropriate level, some of them backed out. According to the interviewed persons there is a very clear picture of the group of teachers who participated actively in the ICT integration: *“It was the group of teachers who realized the possibility of developing themselves and their subject by means of the computer – that is, the progressive teachers of the younger category, who wanted to learn something new. So, it was not the older teachers. It was obviously the younger ones who ‘jumped that waggon’.”* (Inspector).

Another effort attempted in order to motivate the teachers to using ICT is an arrangement where the ICT co-ordinator joins the teacher during lessons and demonstrates certain possibilities of applying ICT, thus acting as support teacher to the teachers who may feel a little lost. According to the ICT co-ordinator this happens four or five times a month. The school has also made it possible for the teachers to borrow a portable computer to take home (the computer class teachers have one permanently), and quite many have accepted the offer and have been motivated in this way.

Finally, it is intended to arrange internal school courses for those teachers who have not yet participated and, consequently, lack ICT skills. The leadership has realized that something has to be done to motivate the

teachers, who are a little slow, and this will be implemented in connection with making it possible for the students to acquire the Computer Driving License.

3.2 ICT in teaching

It was estimated at NGG that an intensive computer use is not expedient until grade 7. The younger students are not yet sufficiently trained in the basic skills such as reading, mathematics etc., which are necessary to be able to use ICT to any greater extent. Moreover, the ICT co-ordinator points out that the younger students do not feel the same responsibility towards the equipment as the older ones. Thus, no demands have been set up for ICT skills in the lowest grades, and it is left to the individual teacher to decide whether and how ICT should be integrated.^v

The idea of what functions ICT should have in teaching has changed in the course of time: *“Wherever we used it much, I found that this was the future, whereas now we are more inclined to think that it is an instrument, that has come to be naturally used, just like when the students bring a pocket-size calculator, or whatever aid they have got.”* Today the teacher attitude is that ICT should mainly be used where it seems relevant, and several teachers point out that ICT is not expediently integrated into all subjects, which is one of the reasons why many students do not bring their portable computers every day. Thus, there are other demands on ICT, namely that it should support the teaching or add something extra, exemplified by the ICT co-ordinator’s statement that today the teachers work on the basis of a quality before quantity principle. Also the students have generally changed their attitude to ICT. Where formerly it was connected with a certain high status to attend a computer class and possess a portable computer, today it is not considered something out of the ordinary.

All the interviewed persons agree that the most important function of ICT is to be an instrument in the

^v This does not mean, however, that the younger students have never tried to use a computer. If a teacher finds it relevant in his or her teaching, ICT will be integrated on these grade levels as well. In the pre-kindergarten class, for instance, it happened that four- or five-year-old children appeared in the computer rooms to play with a drawing-programme. According to the kindergarten teacher this was to make the children familiar with the computer mouse and introducing them to the meaning of icons. On the same occasion we watched another pedagogical initiative by a teacher who had arranged for two ICT-skilled students from grade 8 to join the children in a supportive capacity. Apparently this was a success for children and students, the latter using their spare time on this matter.

teaching of the computer classes. The demand is that the students should become able to master for instance word processing, spreadsheets and presentation programmes and the control system of Windows. Few classes have made attempts at homepages, and projects where for instance students communicate with other classes are not yet frequent on the primary and lower secondary school level.^{vi}

The web is used to a modest extent in the computer classes. The students should learn to use the more basic search and communication possibilities, however, this has not become an integral part of the teaching. On the other hand, they mainly use the web in the ordinary classes, where the teaching takes place in one of the school's two computer rooms, and the programmes which might be of use in the daily work are not integrated to any higher degree. Several of the interviewed persons find that the task of the teachers is, to a wide extent, to establish a consciousness in the students as to what the media is, and how it is used expediently, thus working on the basis of the objective that the students should learn how to take up a critical attitude to technology.

Advantages at ICT in teaching

One of the advantages at ICT, pointed out by teachers and students as something very important, is that it is much easier for the students to produce good-looking results, as far as assignments are concerned. This is important especially to students, who find it difficult to write something nice-looking by hand. Using ICT makes it possible to make a neat product which is a considerable factor of motivation to some students.

At the same time, it is pointed out that ICT offers the students extensive possibilities of concentrating on the contents of the assignment, as there is no need to spend time on draft and fair copy, as was earlier the case. This and the fact that it is easier to make corrections in assignments also make the media effective in process-oriented writing, where the students must deliver and correct their assignments in several relays.

Several teachers find that ICT may make teaching more exciting to all parties involved, since it may give access to a variety of teaching possibilities, for instance new ways of communicating and seeking information. Moreover, it increases the possibilities of differentiation of teaching, as ICT makes it easier to

^{vi} This was successfully carried through in upper secondary school, where the students of high level English have a long tradition for co-operation with students in Toronto. The students read the same texts and communicate via e-mail. Also a homepage has been established as part of the communication.

offer the students challenges in accordance with their prerequisites. At the same time it gives room for the teachers to use more time on the students, who may need a little extra support, as the computer will guide the rest of the students along in the various programmes.

The web may be used to advantage in teaching, as it gives access to a wider supply of information thus contributing to raise the students' level of information, if it is 'properly' used. Also the web gives the students access to the latest research results, which, according to a teacher, grants a better understanding of authentic matters.

Furthermore, according to one teacher ICT has appeared to be of decisive social importance, as sometimes the students take up positions different from their usual ones, as students who are very competent in traditional school subjects seek those, who are less competent in those subjects, but, on the other hand, master ICT. It has also been noticed that computer games may be of social value, as they bring the students together independent of positions, thus, making new social relations possible. One teacher describes, how the students of a computer class are often prepared to help each other, which, generally, is not the case in an ordinary class.

Disadvantages at ICT in teaching

Thus, ICT contains a series of advantages, but at the same time, practical problems rapidly occur, which may make it difficult to carry through the teaching. Several teachers point out that it is an often unnoticed problem that in some ways computers may cause increased turbulence among students. Just setting up the computers at the start of a lesson may be a noisy affair, which takes up much time. Above that it may prove difficult to control what the students do during lessons, whether they are playing games, as the operation of two keys will enable them to change the programme. Thus, the fact that the school cannot make demands as to what programmes above the Office package may be available on the computers may cause problems, as the students rapidly find shortcuts to using ICT for other than subject related matters during lessons. Other teachers find that this is a common problem, not only occurring in the computer classes, as also students who find it difficult to concentrate in ordinary classes find something else to do.

There is a general space problem at NGG, but this fact causes special problems in the computer classes.

In the small classrooms the students are placed in rows facing the teacher, which does not leave much room for the teacher to walk around, and, at the same time, the students have their attention diverted by sitting too close to the other students' screens. Thus, the placing of students and computers is considered an important factor in the question of disturbance in the classroom.

Technical difficulties during lessons are considered the most disturbing factor in relation to carrying through the teaching of a computer class dependent on 25 portable computers. Often the teachers are compelled to consider whether they should stop the programme planned, as owing to technical difficulties certain students may be cut off from participating. It will soon give rise to frustration and block off the teaching if some of the computers are out of order, or if there is a queue at the printers, which are the most frequently occurring problems in the computer classes. Another fact which is not easy for the teachers to guard themselves against is that often the students will use 'technical difficulties' as an excuse for failing to deliver their assignments. *"They have been given about five hundred extra excuses for not doing their work, and you have to take up an attitude to that."*

Wanton destruction is considered a relatively large problem at NGG and has implied, among other things, the necessity of disconnecting the network outlets established in the computer classes. The outlets were ruined by misuse on the part of other students, who also used the classrooms and could not keep their hands off the equipment. At the time of the study it was being considered whether the network should be re-established, but no immediate solution seems available to the problem of students, who ruin the equipment by accident.

Also the time factor may be a problem in several ways. As far as time is concerned ICT may offer large advantages in individual student work, however, at the same time it demands that the individual teacher will often use much time for preparation of the teaching, if ICT is included. Another aspect of time is that the technological development runs so fast that sometimes it is difficult to go deeply into all its possibilities. *"... there are so many things the computers can be used for, which 90 percent of the users do not know; they have got nowhere near the limits of the computers ... we miss all the subtleties, the computers are capable of, even now."* As software etc. is frequently updated or renewed the tendency is that it is often substituted before it has been fully utilized.

Teacher competences

That NGG has no general strategy for the implementation of ICT and in-service training of the staff has implied, according to some of the teachers, that there are great differences in teacher competences, and not all the computer class teachers have the prerequisites for integrating ICT into teaching. As the teachers are not allocated on their ICT competence but according to their professional know-how the result is that on several occasions it has proved impossible to apply the computers in many of those cases where the teachers do not master the technology.

Several interviewed persons report how they find that a development has taken place as regards their involvement in relation to using ICT in their teaching. Much indicates that not nearly as many teachers as earlier are prepared for an intensive use of ICT. Thus, a parent who had had two children in different computer classes had noticed how the teachers' involvement decreased in the course of time, and in this connection she found that it was of great importance to the children's performances what teachers they had. She wondered why the school had not tried a better co-ordination of the teacher resources.

Also several students regret that the computer class teachers tend to lack the necessary computer competences. *"They might take care that our teachers also got some kind of education, so that they were always able to teach us something new."* The importance attached to teacher competences also depends on how ICT is applied in teaching. If ICT is used only as an instrument for note-taking the students generally do not find it problematic that they are more competent than the teachers, and in these cases the students find it more important that the teachers are competent in their subject. Another perspective on this matter is that many students are already to some extent familiar with ICT, and that, consequently, the technology loses its motivating effect in the long run, if it is used only as an instrument for note-taking. This is also mentioned as an explanation of the fact that the students do not find the computer classes as attractive, as was the case before.

The leadership realizes the problem of varying teacher competences. *"If, for instance, we have a reading teacher, who does not care for computers at all, this will, of course, rub off on the children."* One teacher

finds that this may imply that some students will go through their entire schooling without acquiring ICT competences to any particular degree. In a way the school is trying to cope with this problem by offering ICT as a non-compulsory subject from grade 7. Another solution, used by some of the teachers, is to encourage the students to deliver their assignments on a computer disc, even though the teacher does not actively integrate ICT during lessons.

Not preparing all teachers for coping with the technological development may have far-reaching consequences for the teaching situation. *“Today a school which does not know how to educate its staff to keep abreast with that development will be in trouble in five or six years’ time. Then the students themselves will have a knowledge and some possibilities, the teachers will not understand, and that will turn the normal teaching situation upside down, which I believe it could not bear in the long run.”* (Webmaster).

Academic rigour and equity

There is no agreement among the interviewed persons as to whether ICT may have influence on the academic standards or not. Some teachers do not find that a parallel can be drawn between ICT and student performance, whereas others take up the attitude that ICT may well influence the students’ learning, as it makes the process more interesting. Basically, however, the attitude is that the students’ performance fundamentally depends on the students’ attitudes to ICT and to learning as a whole – the greater involvement, the greater performance.

Thus, as regards subject matters there is no evidence that the computer classes in general reach a higher academic standard than the ordinary classes. However, it is evident that the students of the computer classes have the greater knowledge of ICT. One of the most remarkable differences is that often the computer class students are far more skilled in producing a spectacular layout for an assignment. Furthermore, some teachers find that skilled ICT users also have the possibility of becoming better writers, as they get a lot more work done than other students.

The academic standards of the computer classes also depend on the ICT competences the students have to start with. Some students have ‘imbibed ICT from infancy’ while others have only a superficial knowledge and will have to practice a lot. The different prerequisites of the students may render it very difficult to plan

and carry through a standardized teaching; however, in many cases the differences will be levelled in the course of time.

At NGG several teachers have noticed that students with a rather low academic standard in the subjects tend to apply for the computer classes. This is explained by the fact that these students often believe that ICT is a shortcut to learning; they reckon they will improve their performance, because ICT makes it easier, which leads to major disappointment for many of them, as this is not always the case. Some teachers have experienced that in some cases students are urged by their parents to choosing the computer classes without their being particularly interested – as described somewhat ironically by the headmaster: *“Well, someone’s son has not done a good day’s work in the first six years of his schooling ... now is the chance! He must choose the computer class and become the luminary of this world; for now he will just press the ‘deliver’ button, and then the machine will do all the assignments.”*

According to the teachers nothing indicates that the poorly performing students benefit especially from ICT – some believe that the opposite is the case, as their resources and attention will be more concentrated on the use of ICT in itself than towards the subject contents. Some teachers even find that these students do not learn as much as they would have without ICT, which, precisely, is due to the fact that their concentration is spent on the media, for which reason their difficulties may increase in the computer classes. Some teachers point out that the highly performing students become even more competent, and that ICT is a good instrument for those who are already performing well in the subjects. However, the positive experiences ICT may give rise to, may imply that the teacher will get in contact with some of those students otherwise unapproachable and may inspire students who are tired of school.

On the whole, the teachers find that the computer classes are often rather unhomogeneous and displaying great differences among the students. Some teachers find much diversity in the prerequisites of students from one year to another, for which reason no immediate generalization of the academic standard of the computer classes is possible compared with other classes.

3.3 The diffusion pattern of the innovation

An attempt to sketch the innovation of which the integration formed part at NGG brings out a somewhat blurred picture. Thus, from the start of the computer classes in 1992 till today no points of rotation or milestones can be immediately identified, which have been of decisive importance to why the implementation of ICT looks like it does today. The school has not been involved in any externally established project^{vii} aiming at integrating ICT, and the innovation may seem to be marked by a certain ad hoc method. It is possible to identify certain persons, who have been set on integrating ICT – among others the ICT co-ordinator, the leadership and a few teachers, but any decided diffusion of ICT cannot be said to have taken place at NGG throughout the years. Rather the innovation still tends to be concentrated around the same persons, who considered ICT relevant right from the start.

This may indicate that NGG has had too great expectations on the computer classes as regards their capacity to carry through by themselves. Thus, one of the consequences of the fact that the school emphasizes the individual teacher's freedom in his or her choice of teaching methods and right to teach, what he or she finds relevant – within frames set by the leadership – appears in the computer classes, where to a steadily decreasing degree ICT is integrated in the teaching. One teacher finds that the decreasing interest and the change of attitude among the teachers are due to the fact that a collective pedagogical innovative setting around the computer classes was never established, nor a general support among all the teachers was accomplished.

^{vii} Officially NGG participates in ENIS, however this cannot be said to have had any influence on the integration of ICT in teaching.

The role of leadership

At NGG the headmaster is a key person and his influence is discernible throughout the school. The school is a product of his visions, and the organic structure implies that he carries the general responsibility and competence of decision. Thus, the leadership has an essential influence on, how the school and the teaching are organized. Important questions – pedagogical as well as financial – are decided here and subsequently passed on to others for implementation. Apparently most matters must pass the headmaster's desk, and if the teachers present a good idea for a teaching programme etc. it is always discussed with the headmaster who estimates whether it is sufficiently realistic and expedient for carrying through. In co-operation with the ICT co-ordinators the leadership also makes the decisions of purchase of hardware and software. Most teachers find that the leadership is open to innovation, and they also feel encouraged to integrating ICT in their teaching.

Sustainability and scalability

In many ways the ICT innovation at NGG has turned out differently from what was expected, and actually, the school finds itself in a situation where it is discussed how ICT should be integrated into teaching in the most expedient way. It is not so much a question of its justification; all the interviewed persons believe that ICT will be an important factor in the students' future occupational situation, for which reason ICT skills have to be mediated to the students. Rather it is the quality of the present organization, its volume and form which is critically scrutinized, as apparently, the basis of the computer classes has changed.

It appears as an essential part of the teachers' opinions on their school that NGG must be considered an innovative one, among other things, because it established computer classes, before it had become usual to use ICT in teaching at all. At the beginning of the 1990es one imagined that in the course of time ICT would, to some extent, replace the teacher and permit a qualitatively different kind of teaching, where the teacher should concentrate more on developing educational software. The idea was that everywhere around the school networks should be available to the students for connecting their portable computers. Teaching would consist in “... *the teacher sitting at his desk distributing assignments to the students via the network, and students returning their solutions the same way, and so on.*” (Inspector). Also it was taken for granted

that ICT would have a positive influence on the academic standards. *“At the beginning it was quite obvious that a lot of people, also parents and students, believed that, once you had a computer the world would be saved, meaning that one’s performance in the subjects would rise from average to super, super, super.”* (Teacher).

All the interviewed persons find that today they have got a more realistic view upon the role of ICT in teaching. ICT did not replace the teacher, nor the book, as the software was never developed that would compensate for human interaction and reflection. Moreover, a series of pedagogical challenges appeared, which had not been foreseen in the preparatory phase. For instance how a teacher should tackle a technical problem in a teaching situation which was based on fully operational computers with all students. The functions of ICT have been discussed currently, and today the computers are considered an instrument integrated in teaching the same way as other kinds of aid. Thus, a certain flexibility in application has developed, where it is no longer intended that the teaching should be based on ICT, but that technology should be integrated, wherever it is relevant.

What really happened during the period from the start of the computer classes and up till now is not quite easily seen through, as the innovation NGG has not been subject to current analysis. However, some point out that the fact that the school never had a real strategy and operationable objectives for the implementation of ICT has implied that the innovation took a rather haphazard course. Furthermore, it is emphasized that the lack of a plan for in-service training of the staff has implied that the teachers have very different ICT competences, and that, for the same reason, the pedagogical innovation takes place in small innovative settings here and there in the organization.

One teacher finds that the societal development has entirely caught up with the computer classes of NGG, as the students possess the most basic ICT skills beforehand, and according to the teacher, the teaching in its present form has had its day. He criticizes the school for not attempting an innovation of the contents of the computer class teaching, and for being insufficiently progressive pedagogically.

The decreasing teacher engagement is seen as an increasing problem at NGG, which is particularly expressed by students and parents, whose demands on the volume of ICT use in the computer classes are not

met with. It has been discussed whether a solution of the failing engagement might be a special team of teachers to be in charge of the computer classes only. However, the headmaster has emphasized that the classes should not always be taught by the same teachers, and, according to the ICT co-ordinator, the risk that students base their choice of a computer class on their attitude to individual teachers should not be taken.

Today many of the teachers would prefer that the future integration of ICT will take place in the computer rooms available at the school. They find that here they will be granted the possibility of concentrating on projects where the relevance of ICT is obvious, and where daily technical problems could be avoided.

In the upper secondary school section of NGG the history is different from that of the primary and lower secondary school section. Here computer classes were started, but as a consequence of an apparently insufficient teacher competence to teach these classes they were closed down. One teacher explains that one of the reasons for upper secondary school not to offer computer classes is, among other things, that it has not been capable of making a structure into which ICT could be integrated; there were no well-defined objectives for the implementation. This he considers a necessity in the future. *“I think it is very important to have a group of teachers who feel confident about computers; who ... have some ideas of how it may be used in a subject – and that is simply a condition for going on.”* (Webmaster).^{viii} Today the students of the upper secondary school may choose to bring a portable computer, but the teaching as such is not based on ICT.

In the primary and lower secondary school section of NGG it is discussed at present whether like in the upper secondary school section, it should be made optional for the students to bring their portable computers; however, this solution will also have some consequences which are not considered expedient by everybody. For instance, the ICT co-ordinator points out, if not everybody has a portable computer ICT will be even more reduced into an instrument for note-taking, and the teacher will be unable to give the class tasks involving ICT. Nor will the students be taught in a way that gives them a thorough knowledge of the

^{viii} However, also some practical problems arose in connection with the continuation of offering computer class teaching in upper secondary school. For instance, it cannot be expected that an entire class will choose the same stream, for which reason a sufficiently high number of students per class cannot be brought about.

capacities of different software programmes, as is the case in the computer classes today. Furthermore, the ICT co-ordinator does not find that the necessary teacher competence is present at NGG to secure all students ICT skills. Closing down the computer classes will make the students' ICT instruction even more sporadic and far less extensive than is the case today. Nor does the headmaster or the inspector of primary and lower secondary school seem to agree with those of the teaching staff who want to close down the computer classes and instead base the ICT integration on the computer rooms. *“On the contrary, we would like all classes to become computer classes of some kind or other.”* (Inspector).

The discussion seems to be marked by the fact that the parties involved have not had a common basis upon which advantages and disadvantages might be considered. On the teacher level, apparently, the discussion is whether computer classes are relevant at all, whereas on the leadership level the discussion does not concern the existence of computer classes but rather a change in their shape and contents. However, the shape integration has assumed hitherto does not immediately seem reliable – a clarification of objectives and means is needed.

Retrospectively, several of the staff members of NGG realize that when planning new educational efforts it is essential to set up a general strategy. This strategy must comprise both the practical and the pedagogical dimension. It is also important that, to some degree or other, everybody realizes the relevance of carrying through the project; however, it is crucial that some will take up the responsibility and guide the innovation into the direction desired. Finally, a current discussion and maybe wording of new sub-objectives is necessary as one cannot be sure that the innovation will proceed as expected – as experience has shown.

As a consequence of the school's unrealistic expectations to the computer classes many point out that in order to make ICT a strong point in the teaching it is important to take up a critical attitude to the media. The guiding principle of the ICT implementation in the individual class must be a qualitative evaluation of when ICT will represent a support to the pedagogical objectives of the teaching.

Another important condition for realization of the project is a merely material matter. The financial resources for purchase and maintenance of equipment must be available. The headmaster of NGG emphasizes the importance of having a person who can handle the technical problems, thus preventing

longdrawn interruptions of the teaching. Among other things, the allocation of resources depend on the support of the leadership to a project of this size. A positive attitude on the part of the leadership and a willingness to spend time and financial resources must be present in order to sustain the project. However, in this connection it is important to realize that the resources generally available in a school are far from sufficient to keep abreast with the technological development – it will always lag behind as far as equipment is concerned. This problem appears, among other things, when new programmes cannot be used on outdated computers. Therefore, in a computer class it must be demanded that the students use special programmes – and not necessarily the newest ones.

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

XAt NGG experience shows that the implementation of ICT must be linked with a current discussion and development if it should lead to educational or organizational innovation. This realization has implied that today the school is re-considering the concept and the objectives in order to see how the technology can be adapted to new conditions, and how more teachers can be involved in the innovation of the computer classes.

Material supporting the rival hypothesis

XOriginally, the intention was that the implementation of ICT should lead to a radical restructuring of the form of teaching of the school, and the computer classes appeared as a visionary idea of how the school might meet with the demands of future, where ICT was expected to play an important role. But although ICT is used daily in the computer classes, the integration of ICT has not lived up to the original expectations, and it is functioning more as an (important) resource within the traditional forms of teaching.

XThe general opinion is that ICT has a series of potentials, when it comes to motivation and differentiation of teaching, and it is true that in the computer classes the students generally acquire much more ICT competence than is the case in the ordinary classes. Thus, the school has applied ICT as a pedagogical resource, but the technology cannot be said to have worked as a catalyst for a more radical innovation of teaching or organization.

Even though NGG is using its experiences with ICT implementation as a basis for discussion and maybe a rephrasing of the intentions with the computer classes it cannot be said that up till now the implementation has been a catalyst for innovation. However, the school's expectations as regards technology have been directed primarily towards the pedagogical aspect, where, however, no real catalytic function can be pointed out either. Thus, it must be concluded that at NGG ICT has functioned as a resource in teaching.

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

The computer classes of NGG have existed for about 10 years, and the assessment is that it is practically the same teachers who, at that time, involved themselves in the implementation who carry the innovation today. These teachers can be said to form a group of entrepreneurs, but an actual network around the ICT implementation has not come about. Thus, in spite of the intense attention on the computer classes, initially, the school has not succeeded in establishing an innovative setting around the computer classes or having the in-service training organized in a way that has gradually involved more of the staff members. To a certain degree this is due to the fact that throughout the process participation has been voluntary, and a number of teachers who, among other things, have not recognized the relevance of ICT, have used this possibility of not choosing to integrate ICT in their teaching.

Another matter impeding the diffusion is the fact that sufficient assistance for the solution of currently occurring technical and pedagogical problems has not been available. These difficulties have contributed to a slow decrease of the teachers' engagement, and in spite of a great effort as regards arrangement of training courses and technical assistance the ICT co-ordinator has not been able to solve this task alone. Even though, generally, the teachers find that the leadership supports ICT related initiatives, in-service training etc., apparently there is no clear leadership strategy in this field, which might have supported the ICT co-

ordinator's efforts and the general ICT innovation of the school.

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 experience of the upper secondary school section of NGG where the computer classes were closed down was that the necessary teacher competences were not present – the teachers did not feel prepared for integrating ICT on a large scale. Therefore, it is considered a condition for ICT implementation that the teachers realize the possibilities of ICT and understand how to use them.

XThe students find that the teachers' ICT competences are an essential condition, if the computers should be used for anything but an instrument for note-taking.

XThe computer class teachers are not allocated according to their ICT competences but rather according to other professional qualifications. The consequence has been that the use of ICT in the computer classes has been rather variable, as some of the teachers chose not to use ICT in their teaching at all, due to lack of competence. One argument for this decision is that if a teacher does not master ICT on a certain level, he or she will look silly, the students being the more competent.

Material supporting the rival hypothesis

XAt NGG the ICT teaching in ordinary classes is dependant on the access to the two computer rooms of the school, which is decisive for, how often the students use ICT. This restriction does not exist in the computer classes, for which reason the degree of application is much higher in those classes.

XTechnical difficulties are considered a severe problem in the computer classes. The teaching is based on

the computers' being operational, and if some of the portable computers are out of order the students in question are cut off from participating actively, and, moreover, part of the teaching time is spent on trying to solve the technical problems.

XThe computer classes are, physically, bound to certain classrooms, where power and net outlets have been installed. The net outlets have often been exposed to wanton destruction, which has restricted or hindered the teachers in integrating www and carrying through the teaching planned for these classes.

XIt is necessary to put demands on the software of the students' portable computers, as it is a source of many conversional problems if students and teachers work in different programmes.

It appears that the teachers' engagement and actual competences are of great importance to the integration of ICT into teaching at NGG. When the teachers do not possess the necessary competences, they often choose not to integrate ICT into their teaching – also in the computer classes – and innovation seems to come to a halt. The students find that teacher competences are decisive for the quality of ICT teaching and, consequently, also for further development and engagement in the use of ICT in teaching.

Throughout the implementation the school's attitude has been that the teachers should not be forced into development/upgrading of qualifications. The school has tried currently to stimulate also the more reluctant teachers to acquiring ICT competences, but there is still a group of teachers having very little knowledge of the media. Thus, today much variation exists as regards teacher competences, and as, at the same time, the teachers have a high degree of freedom in their choice of teaching methods, it may imply that the students end up by leaving school with very different ICT competences.

Today the leadership admits that a special effort must be made to motivate the teachers, as regards the integration of ICT; furthermore, it is discussed whether the principle of voluntariness, which up till now has prevailed, is expedient. It is found important that the teachers' ICT competences are upgraded in order to avoid that, in future, the gap between teacher and student knowledge becomes too wide making a sustainable development impossible.

Even though the majority of the material from NGG supports the hypothesis on the importance of teacher competences as regards a successful implementation of ICT, it appears that also the infrastructure is a very important part of the process. The teachers find it stressing that so many technical problems occur, and even

the teachers with ICT competence feel an incipient dislike for letting ICT form a great part of the teaching. The school tries to counter this problem by appointing a so called 'computer janitor' whose only task is to solve technical problems.

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

XIt is a general experience among the teachers of NGG that the students' benefit from the teaching depends on their engagement and attitude to learning.

XOne of the advantages at ICT, which is emphasized, is that the technology may establish more room for differentiation of teaching, which is a general quality to the benefit of all students, offering the possibility of introducing them to challenges on the basis of their own prerequisites.

XApparently, another advantage is that the use of ICT in teaching may leave the teacher time for giving extra support to those students, who do not perform very well in the subjects. The other students can be left to independently solving ICT-related tasks, and in this way the differences between student groups may be levelled.

Material supporting the rival hypothesis

XAt NGG a tendency is discernible to consider ICT a good instrument for those students, who perform well in the subjects, and that often these students achieve even higher academic standards.

However, not all the well-performing students are masters of ICT, and there are also examples of positioning among the students taking place by well-performing students seeking help with students who are less well-performing in the subjects but competent ICT users. Thus, there are tendencies at NGG supporting both hypotheses.

However, there is also a third tendency, which points towards a connection between the ICT

implementation in the shape of special computer classes and decreasing academic standards as regards the not so well performing students. Thus, the computer classes have shown examples of considerable differences between the student level from one year to another – some years even saw the least well-performing students applying for the computer classes, expecting that ICT would upgrade their academic standard. In this connection there is a risk that some of these students will learn even less, as they direct their entire concentration towards the technical aspects of ICT and not towards the subject contents. Consequently, in some cases it has proved difficult to maintain the academic standards in the computer classes expected by NGG, for which reason it is being discussed, whether the computer classes in their present shape is an expedient arrangement.

Even though it is difficult to draw unambiguous conclusions from the material from NGG something speaks for the point that ICT *may* lead to an increase of the difference in academic standards between well performing and less well performing students, if the teachers do not consciously and actively use those qualities of ICT that will pull into the opposite direction (e.g. differentiation of teaching, student co-operation etc.).

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

XIf the computer is only used as an instrument of note-taking which at present is the tendency in the computer classes, the quality of software is not decisive.

Material supporting the rival hypothesis

XThe experience of NGG shows that sometimes it will demand much time and cause disturbance during lessons, when the students work with ICT, as they easily let themselves be disturbed by other functions than those decided by the teacher. Apart from causing disturbance during lessons the teachers in general have no negative experience with the use of www.

It is difficult to draw conclusions to hypothesis 5 on the basis of the actual experiences from NGG, as the school precisely aims at sorting out software that does not live up to the school's demands on quality – and it is attempted through the pedagogical efforts to prevent an inexpedient use of the technology. However, both points of view are implicitly confirmed through the necessity of these precautions. As a consequence of this it seems obvious that on the part of the teachers it is not a question of lowering demands or expectations on the quality of teaching or the efforts of students, just because ICT forms part of the teaching.

5 The future

The technological development in society runs fast, and at NGG certain circumstances indicate that the school is reconsidering the principle of voluntariness formerly maintained, as regards the teachers' upgrading of their qualifications in the ICT field. For instance, several initiatives are slowly being established in order to upgrade the teachers' ICT qualifications. The headmaster mentions that it has been considered to have someone from the outside arrange training courses for the group of teachers who has not tried to gain insight into ICT on their own initiative.

The inspector for the primary and lower secondary school sector expects that in future it will be demanded that all teachers upgrade their ICT skills, consequently, also the teachers of NGG. *“It is our intention in the long run that all teachers should have an ICT Driving License – a Pedagogical ICT Driving License.”* (Inspector). The ICT co-ordinator's hopes for the future of NGG are that all students bring a portable computer, when they start in school, so that there will be a possibility of working currently and intensively with ICT. She finds that also the teachers will benefit from increased access to computers. The same attitude is taken up by the inspector for primary and lower secondary school, who believes that in the near future there will be more computers at the school in general, and also that the teachers will use the possibilities of communication offered by ICT, both mutually and in relation to the parents. *“I believe, really, that the school will not be in charge of this development ... it will come from the outside.”* (Inspector).

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 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 four observation sessions of abt. 45 minutes and a total of 17 interviews.

The informants were: headmaster (abt. 1½ hour), inspector for primary and lower secondary school (1 hour), ICT co-ordinator (2 interviews of 1 hour), webmaster (1 hour), 6 teachers (1 hour), 3 groups of students, abt. 12 students in total (30 min.), 2 parents (30 min.). One teacher interview was not tape recorded, otherwise all interviews were recorded and transcribed.

Of 120 questionnaires 29 were returned. The school decided to let the teachers answer the questionnaires on a voluntary basis.

The additional material consisted of 20 pamphlets, articles and notes. Much was general background information on the school; however, the material also comprised internal notes from meetings concerning the computer classes.

Appendix B

((Please insert Appendix B – Nordsjællands Grundskole og Gymnasium))

Notes