

OECD/CERI ICT PROGRAMME

ICT and the Quality of Learning

A Pilot Study of ICT and School Improvement at Freiherr-vom-Stein-Schule,
Hessisch Lichtenau, Germany



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Introduction

The following pilot study for the OECD qualitative research ICT and the Quality of Learning was carried out August 27 – 31, 2000 at Freiherr-vom-Stein-Schule in Hessisch Lichtenau.

The research focuses upon a major whole school innovation and the part that Information- and Communicationstechnologies (ICT) has played in that innovation. In the pilot study school, the major innovation was the involvement in the community and the installation and use of an ICT room with completely free access for all students.

The data collection was carried out by means of interviews with key personnel, observation of lessons and analysis of survey for teachers and school documents.

Overview

The Freiherr-vom-Stein-Schule is a state school in the provincial town of Hessisch Lichtenau in the Federal State of Hesse in Central Germany. The area is mainly very rural and the inhabitants lower middle class. The pupils parents are mainly engaged in the technical sector as skilled workers. The largest employers in the surroundings are the clinic and the Bundeswehr (the German Federal Armed Forces).

The comprehensive school has a senior grammar school level and teaches children from the age of approximately 11 to 18 years. The other school branches, - Realschule (secondary modern school for children from approximately 11 to 16 years of age), Hauptschule (general secondary school for children from approximately 11 to 15 years of age) and Gymnasium (secondary grammar school for children from the ages of 11 to 18) are all under one roof, divided into classes according to age up to the age of 16, the upper school is located in its own building on the premises. There are currently 50 classes in the school and approximately 1200 pupils. This number includes 15-20 are physically handicapped and 130 children from families of ethnic German immigrants from Russia. There is, at present, a staff of 105 teachers between the ages of 40 and 50. For the first time in many years, the school has been allocated 11 new teachers to replace those leaving for reasons of illness or retirement.

Hessisch Lichtenau is one of the centres in Hesse involved with resettled ethnic German immigrants, who, according to their passports are of German nationality but as they represent the third or fourth generation and were brought up in Russia, they often do not speak any German. This represents many problems for the school particularly in sociological and inter-personal matters. In the Freiherr-vom-Stein-Schule, children from resettled families attend additional German classes for six months after their arrival in Germany in separate remedial groups for 6 to 10 children. The classes are supported during this time by the Hessian Ministry for Social Affairs.

Practically since its founding in 1946, the school has taken in physically handicapped children since 1953. These pupils participated and participate in normal school lessons. This had to do with the fact that, at that time, there was a boarding school for physically handicapped pupils in the immediate vicinity. Mixing with the physically handicapped in school is still characteristic for the school and its image. The school has been equipped to meet the needs of the physically handicapped. In the meantime, the number of physically handicapped children has declined drastically, as today physically handicapped children are able to attend a normal school practically anywhere in Germany. Therefore, the boarding school has now closed down and in the meantime physically handicapped children from throughout the region attend the school.

As a state school, it receives an annual budget of DM 110,000.00 for administration from the educational authorities. The school spends approximately DM5,600.00 per year on information and communication technology.

Normal lessons are from 8.00 am to 1.00 pm, longer in the upper school. In the afternoon, there are study groups for the pupils on a voluntary basis; for example Sun-Wind, cycling, guitar, choir, light athletics, computer, data communication for the middle and upper school and the school magazine. The headmaster of the Freiherr-vom-Stein-Schule joined the school six years ago.

2.1 The German Educational System

The educational system in Germany can be divided into general and vocational educational facilities. Vocational educational facilities feature places of learning both in schools as well as in-company training and is known as the Dual System .

The general educational school system in Germany comprises three sectors. A general primary level which usually lasts for four years (Grundschule = primary school) and which all pupils must attend. This is followed by a secondary level comprising three types of secondary schools. The Hauptschule and the Realschule covering the lower secondary sector and the Gymnasium (grammar school) which covers the lower and the upper secondary sector. The three school types mostly commence with Form 5. (In a few Federal States in Germany there is an orientation level, e.g. in Lower Saxony, Hesse and North-Rhine Westphalia, which extends over Form 5 and 6 and is followed by the secondary school).

Compulsory schooling in Germany lasts for 12 to 13 years, the grammar school having the longest attendance of 13 years counting from Form 1. The final school-leaving certificate at a grammar school is called Abitur and is a qualification for university entrance. Hauptschule attendance comprises 9 years after which a vocational

apprenticeship can begin combined with attendance at a vocational school. Attendance at a Realschule is for 10 years, ending with the Mittlere Reife (a General Certificate of Secondary Education) which qualifies the pupil for vocational training and an apprenticeship or a transfer to a grammar school.. Finally, there is a higher and advanced further education sector which includes universities, vocational training within the Dual System and further education. These are deemed as institutions for vocational initial training and are differentiated from general schools.

Mention must be made of the fact that most pupils at the Hauptschule come from families at the lower end of the social scale. Lessons are at an easier level at this type of school so that the academic performance of pupils there is lower and cannot be compared with the level of pupils at Realschule or grammar school.

The past

3.1 Information and Communication Technologies (ICT)

About fifteen years ago, the Freiherr-vom-Stein-Schule bought its first C-64 computer and the first members of the teaching staff began to take instruction in computer operation. There was just one room, and it was very sparsely equipped.

Twelve years ago, the first computers with two disk drives were acquired and a new teacher was recruited to take over the technical responsibility for the computer sector. In the school he is known as the Technical Specialist and under his expertise, ICT has been extended (cf. infrastructure). In the beginning, the Technical Specialist led just one computer study group for pupils; later computer science was added. About three to four years ago, the Technical Specialist, assisted by the pupils in the study group, began to network the computers in one room and to design the school's homepage.

The Headmaster and the Technical Specialist began to work out a school programme three to four years ago heralding not only the innovations and the handling of new media, but also educational innovations. The whole of the teaching staff got together around a table to form a think-tank in order to work out what areas of school were to be further developed. This resulted in four to five main points of focus. One of these was how computers, data communication and internet were to be integrated in school to enable all pupils to be introduced to the PC, internet and new media step by step. Ideas for implementing the main points were then worked out.

The Headmaster emphasized, however, that this programme would be updated in the future. At present, the authorities have not produced a curriculum concerning ICT. Schools in Hesse have merely been given a general outline that information and communication technology is to be integrated into schools and teaching. How this is to be implemented has not been stipulated and the schools are left to themselves as to how such integration is to be carried out. The Technical Specialist, however, sees this in a positive way:

There is no information in the sense that they (politicians/ the government) help or deter us. I don't know whether it would be desirable to have more of it (information). How far in principle ought we to leave the issue open so that all schools can develop in their own way?

Three to four years ago, the Freiherr-vom-Stein-Schule applied to Schulen ans Netz on the initiation of the Technical Specialist and the Headmaster. Schulen ans Netz (schools into the network) is a programme jointly promoted by the Federal Ministry for Education and Research and the German Telekom AG throughout Germany. Schools can submit an application which is then checked and judged and if it is found to be worthy of promotion, the school is given financial and material support for introducing information and communications technologies. The Freiherr-vom-Stein-Schule submitted projects for three areas which they wanted and still want to carry out with the support of information and communication technologies. Firstly, projects of an ecological nature where ICT would help to evaluate data, gain information and compare results. Secondly, artistic projects to be designed for the internet and thirdly, the new school magazine. The projects were found to be worthy of support and in 1997, the Freiherr-vom-Stein-Schule became a model project school for Schulen ans Netz. *Schulen ans Netz meant access to financial resources to the amount of DM 40-50,000. Without this money, we could not have implemented the projects. (the Headmaster)*

Generally speaking, the Technical Specialist and the Headmaster see the Schulen ans Netz promotion as the driving force in the implementation of innovative projects using the new media in the Freiherr-vom-Stein-Schule.

With the Schulen ans Netz aid, the Freiherr-vom-Stein-Schule was able to purchase very modern computers, plus a very well equipped Windows-NT-Server (for approximately DM 8,500), a digital camera (to the value of about DM1,000) and a free account with the online providers T-online, AOL and WinShuttle. Through the Schulen ans Netz promotion, the Freiherr-vom-Stein-Schule also became a Microsoft partner school. This cooperation provides the school with practically all the software it requires for teaching purposes, networking and the data communication study group free of charge. The DFÜ AG (the data communication study group) is a voluntary working group, led by the Technical Specialist in which pupils are intensively trained in the use of internet, work for the homepage and service and maintenance on the computer. There is a DFÜ AG for Middle School (forms 7 to 10) and Upper School (forms 11-12) and children can participate on a voluntary basis in the afternoons. The Middle School group is occupied with working over the homepage while the Upper School group functions as a computer hotline and is responsible for all technical repairs, maintenance work and school networking. The teachers regards his competence and responsibilities as being on the same level as his pupils, even placing himself deliberately behind them.

Between 1996/97, the school first accessed the internet, shortly before being awarded the Schulen ans Netz promotion. The Technical Specialist and pupils from the study group equipped a computer room and networked the whole school thus providing every pupil with access to the internet at the end of 1997 and the beginning of 1998. In the first years, the cost of pupils using the internet was paid for out of the school budget costs which the Headmaster had to answer for and make acceptable to the staff. However, for approximately one year, the internet connection has been free of charge, being financially supported by the state. The pupils can use the computer room from 8.00 am until 4.00 pm when it is not being used for teaching. They simply have to inform a teacher that they wish to use the computer or the internet and fetch the key for the room from a teacher. The fact that the pupils are permitted to use the internet and the computer reflects the basic attitude of the Technical Specialist and the headmaster:

I would just like to say something about the whole philosophy of the matter. In my opinion, it is of utmost importance that a school makes equipment, which has cost a great deal of money, available to the pupils as often as possible. In our school that means that whenever the computer room is not being used for lessons, it has to be available for the pupils. In addition, the pupils were told from the very beginning that it isn't the teachers who prepare the computers and pupils simply use them, but rather those pupils with the know-how who set up the computers for their fellow-pupils to use. And I am convinced that this philosophy has decidedly contributed to the fact that we have a very low record of damage to software and hardware, and matter such as the pilfering of mice etc.

As soon as the internet connection was available, each pupil was able to have an email account for an in-school domain. However, administrating the emails meant a lot of work so the pupils were asked to open their email addresses with providers who offer email accounts free of charge. The pupils make good use of this and took positively to the idea as it meant they could use these accounts not only in school but also at home.

Since the beginning of this school term, the school has introduced a fee of DM10.00 for using the computer, a measure which was greeted positively by both pupils and parents as the money will go towards the costs of repairing the computer.

One of the major problems facing a school when introducing ICT and educational innovations is always the question of financing projects and materials, e.g. new computers. The Headmaster and the Technical Specialist have gone to great efforts to raise money from sponsors.

3.2 Educational Innovations

Many innovative changes carried through in projects are becoming visible in the Freiherr-vom-Stein-Schule both in the ICT sector as well as in the educational sector. The focus is on three main topics. Firstly, the inclusion of the environment. A second major point is the innovative handling of art at school and finally, efforts towards a responsible attitude to ecology. The following projects stand out among a number carried out at the school in cooperation with the local bodies. For three years now, pupils at the Freiherr-vom-Stein-Schule have been playing a simulation game called Polis once a year for five days with soldiers from the Federal German army in Hessisch Lichtenau as part of the their social studies lessons. The game involves the simulation of UNO problems and the solving of conflicts. Two years ago, pupils designed the window decoration of an optician's shop. The school carries out regular training in the drawing up of job applications in cooperation with health insurance companies

and banks. Six months ago, the town approached the Freiherr-vom-Stein-Schule and asked the school to cooperate in re-vitalising the town centre. The latest project in which the pupils work together with local authorities was to maintain part of the German Märchenweg (Fairy Tale Route). A neighbouring community approached two art teachers at the school through a former pupil and asked for their advice on how to make the route more attractive. The work began in this year. Plans have been put forward for pupils from the art classes to set up sculptures along the walking trail. This project and the project to revitalise the town centre will be recorded with the digital camera. The Headmaster regards these projects in which the school works together with outside partners and institutions as one way of promoting innovations in the school. *We are trying to reach the outside with our projects. Where there is contact with the world outside of school, where the outside world is brought into school, innovations can develop. Impulses are formed. Issues are questioned.* (the Headmaster)

The main responsibility for these projects with the world outside of school lies with the Headmaster. Two art teachers, in particular, bear the responsibility for the next innovative focal point a new way of looking at art in school. The two art teachers have developed new forms of artistic work for the pupils during the past few years, for example, the projects Art and the Church or Art and Nature . Together with the church and a forester, the pupils installed their work in the church and in the woods. The results have been documented on the school s homepage. It is characteristic for the art teachers that they have not adhered strictly to the guidelines concerning course contents but are developing individual forms, backed by the Headmaster.

A further educational project at present at the Freiherr-vom-Stein-Schule is the Czech Project . The project was initiated four years ago when a headmaster from the Czech Republic contacted the Headmaster of the Freiherr-vom-Stein-Schule with the wish to cooperate with a German school which had experience with physically handicapped pupils. This resulted in the idea for an art project dealing with Art and Nature . Practical work and the joint creation of artistic work is intended to break down the language barriers between German and Czech pupils more easily.

The Czech project is part of a project group of pupils under the leadership of the art teachers. Pupils from both groups each spend alternately a week in the Czech Republic and in Hessisch Lichtenau. Pupils from both schools go to the woods and their work which is created amidst nature has been documented in admirable art catalogues. Both schools applied to the EU with their projects and were financially supported by them for one year. Later, the Freiherr-vom-Stein-Schule applied to the Bosch Foundation which finances projects from all over Germany intended to improve exchanges between Germany and the east European countries. The Freiherr-vom-Stein-Schule is currently receiving about DM15,000 to 18,000 from the Bosch Foundation for their Czech Project. According to the Headmaster and the art teachers, this financial aid is of major importance for successful work on the Czech Project. One and a half years ago, the Freiherr-vom-Stein-Schule was one of 14 winners in Germany with their project.

Direct confrontation with life in the Czech Republic poorer and so different from Germany enable the pupils to develop an opinion more easily than any amount of oral reporting.

Another important innovative field at school deals with ecology. The whole school has been separating waste for recycling since 1997/98. The project resulted from the ideas of a group of about 20 teachers who thought about what could be done in the school with alternative forms of energy. This resulted in the forming of a study group Sun-Wind, which investigates thoroughly the issue of energy. Teachers and pupils have erected a windwheel on the roof of the school and installed a photo-voltaic unit and solar panels, supplying energy for the chemistry laboratory. In addition, a water treatment plant on the roof also supplies two classrooms with water. The pupils in this study group were extremely enthusiastic when explaining their work, going into classrooms and talking about energy conservation and new forms of generating energy. In the meantime, this environmentally-friendly attitude at the school has become a matter of course. In 1998/99, the Freiherr-vom-Stein-Schule was the Environment School in Europe.

Another point worth mentioning is that the children in Form 7 and 8 in all school types participate each year in a Self-sufficiency Training Course. They go to Belgium, a country whose language they do not speak and must find their way around alone that means buying food, cooking, sleeping etc.

In the meantime, the local Volkshochschule (evening school) also holds classes in the computer room in the evenings. This is free of charge, as the Freiherr-vom-Stein-Schule has free access to the internet.

The present

4.1 Organisation of Evidence

4.1.1 Diffusion patterns

The Technical Specialist in particular and his pupils from the DFÜ workgroup and three, four other teachers are responsible for introducing ICT to the Freiherr-vom-Stein-Schule. Within the last three to four years, the DFÜ work group led by the Technical Specialist have proven to be the driving force behind introducing and maintaining the new media. This study group has become an important component of the school, not only for the pupils in the group but also for other pupils who can ask them for help.

The Technical Specialist and his work group are, in particular, responsible for computer maintenance and the internet. In the past three to four years, two pupils from this study group have been official school administrators with the same rights as the Technical Specialist, knowing all passwords and in possession of keys. The Technical Specialist also says that the two administrators are much better versed in the subject matter than he himself and that he does nothing without one of the administrators or another pupil from the group so as to stop himself from doing even more work.

There is a huge degree of acceptance something which was initially not expected The use of computers and CD-Rom in school was, at first, strongly criticised. Many dismissed the whole idea at first, saying it was not the school's business. When I think about the past three/four years and how certain things are no longer put to discussion now and all this has become part of everyday school life, thanks to a small group of highly committed pupils and teachers. (the Headmaster)

The Technical Specialist is a teacher at the Freiherr-vom-Stein-Schule. He teaches mathematics, social science and computer science. Although he has never studied computer science, he has a good working knowledge of computers, their maintenance and the handling of programmes. Parents questioned about him said he was enterprising and committed. The fact that he does not only teach scientific subjects appears to be important for the teaching staff to accept his ideas and the person himself. Anyway, it is not the maths teachers who present an innovation potential at the Freiherr-vom-Stein-Schule but a teacher of English who was mainly responsible for introducing software into her lesson. She began early on to try this and the internet out in her lessons. The Headmaster describes a control group of both male and female colleagues spread among the different school types who are regarded as innovative forces.

Those teachers who set this innovation in motion are described by the Headmaster as being inquisitive and open. This group supports innovation, takes up social developments and tries to integrate them into their lessons. A driving and motivating force in implementing new media and educational innovations is that those who are responsible, enjoy doing it. Intrinsic motivation would appear to be characteristic for those responsible for and supporters of innovations and is critical for the time and commitment they invest in their projects.

The other group of teachers who tend to disapprove in particular of implementing new media are described as apprehensive. Their apprehension is mainly due to the fact that these teachers are insufficiently familiar with computers and internet and are afraid of failing in front of their pupils who are often much better informed than they themselves.

In the meantime, there are a great many pupils who have Pentium at home. Some even have Pentium III. What does a colleague do who has hardly any idea of the matter and wants to do something with his pupils? He's afraid! (the Technical Specialist)

But there are also ideological reasons for rejecting computers. Those teachers categorically reject not only computers but also TV and are described as persons who do not know why they should make any changes to their lessons and teaching as they see themselves as successful.

Some teachers mentioned that this negative attitude towards computers and the internet could be a question of age. One art teacher who bears the main responsibility for the Czech project frankly admits that for three to four years he simply refused to touch *that thing* because he was not used to working with a computer.

The integration of teachers at the school in innovative educational measures and the handling of new media has been commented on in various ways. As observers, we were given the impression that a number of teachers have

been integrated into the innovation process albeit no more than 30% of the staff. According to the Headmaster, this number, however, is steadily growing.

As a rule, it can be said that educational innovations and innovations in handling the new media can only be achieved by the personal commitment of those responsible. *Without the initiative of colleagues, nothing would be happening here. (Technical Specialist)*

All the teachers engaged in the innovations and implementation of the new media agree that the process as it is would not have been possible without the strong support of the Headmaster.

The greatest problem concerning the implementation of innovations and ICT is that those responsible must invest a lot of time. All of those involved – the Technical Specialist, the art teachers, the Headmaster and two or three other committed teachers – all mentioned the enormous amount of time spent on their commitments. In some cases, this was found to be extremely stressful. The Technical Specialist remarked that his motivation in recent times had declined because, in his opinion, he found the relationship between the effort invested and what came out of it less and less positive for himself.

Finally, the problem of maintaining and introducing ICT and educational innovations arises when pupils from the DFÜ work group, who are heavily involved with introducing new media, maintenance, homepage updating and educational innovative projects – such as the Sun-Wind study group – leave school after finishing their formal school time. That means efforts must be made to motivate more pupils to participate and to learn these new skills. It also means that important resources are only available at the school for a limited time.

4.1.2 Staff development and involvement

It is characteristic for the school that a form of in-school training takes place regarding computer and internet operation. In the last three to four years, the Headmaster has organised in-school training in small groups. Three to four teachers who are highly familiar with ICT have organised introductory courses for three to six teachers who are interested in ICT but have no experience. This led to a slow but steady increase in the number of teachers in the Freiherr-vom-Stein-Schule being trained and increasing their knowledge. The Headmaster described this type of personnel development as *not a typical further teacher training but more as an out-of-school, informal increasing of knowledge*. He regards *the process as a sort of alphabetisation*. It would appear to be important that those teachers who are carrying out the training know the other teachers personally.

It is important that they have someone to do it, someone who other people recognize and trust, someone who can explain things to them and that they don't have to go out of school elsewhere for this training. It is like a basis for trust and acceptance which has achieved so much. It is an innovation concept for the staff. (the Headmaster)

A general characteristic for all teachers at the Freiherr-vom-Stein-Schule in the ICT sector is that they are practically self-taught. Only a few teachers requested further training as this involves, as a rule, investing more time, something they are reluctant to do.

At school, many things run via an informal back-up system. Pupils from the DFÜ work group, the Technical Specialist and three to four other teachers who are well informed are available as contact persons if teachers or pupils have problems; for example with maintenance or they need support with application programmes.

The questionnaire for teachers concerning the utilisation of ICT shows how teachers from the Freiherr-vom-Stein-Schule judge their ICT skills. It must be said however that only 16 teachers filled in this questionnaire of which 31.5% said their computer skills were good, 50% as fairly good and only 18.5% as bad. 75% of teachers who filled in the questionnaire used their home computer several times a week for preparing lessons.

In answer to the question *How important is each of the following computer-related skills for your teaching?* 81.25% of teachers said that writing a text using a text processing programme was very important for their teaching, 18.75% of teachers found this skill to be important and this skill was shown to be the most important of all. The following were judged to be of no importance – writing a programme (60%) and creation of a website (56.25%). 46.65% of the teachers said presentation of information was important for their lessons even though only 43.75% were familiar with presenting information in this way, 31.25% were vaguely familiar and 25% were not familiar at all with the matter.

Probationary teachers and teachers new to the school are said to *take the handling of new media for granted*. These are seen as chance for innovation and can represent a new source for the further maintenance of

innovations.

4.1.3 Role of leadership

All of the teachers and responsible persons interviewed confirmed without exception the support given by the Headmaster. The Headmaster is described as the *driving force* who supports the projects financially and verbally. He gives great encouragement to teachers who are prepared to become involved in innovations, tries to create time for them and goes to enormous trouble to find sponsors and money.

I believe that, as the person responsible for this sector, I can only act as I do because I have the full support of the Headmaster, considerably more than from the rest of the staff. I know he is behind me, creating time for me and playing some money my way. (the Technical Specialist)

The Headmaster endeavours to create an atmosphere and culture at the Freiherr-vom-Stein-Schule which will be supportive to any innovations.

For example, the Headmaster supports and encourages the art teachers to experiment beyond the prescribed syllabus or gives the Technical Specialist extra hours, which he must make plausible to the rest of the teaching staff. This means that the Headmaster allocates the Technical Specialist two of the two DFÜ work groups. These run for two hours but the Headmaster gives the Technical Specialist two times three hours for this work group so that at least two hours of the time the Technical Specialist puts into computer maintenance and introduction are recompensed. Or the Headmaster allows the Technical Specialist and a female colleague two hours in which they do not teach but spend on training six to seven teachers in the afternoons.

The Headmaster sees his position as one of a moderator taking up thoughts, ideas and impulses from a group of pupils and teachers. He endeavours to find focus points and to mobilise the available strengths and compensate weaknesses. It is important for him to create a feeling of solidarity to facilitate cooperation and to take away the threshold fears of apprehensive teachers so they might venture into the innovation process. His personal commitment in this respect is extremely strong, and without it, the development at the school would not have run as it did.

4.1.4 ICT Innovation Connections

The use of new media such as computers, internet, CD-Rom or digital cameras has increased in the school. There are even some teachers who initially were sceptical of new media in teaching have now begun to integrate it into their lessons where they deem it to be sensible.

In answer to the question of how high the percentage was at school of those working with PC and new media, one teacher replied, *I believe a maximum of 50 to 50, perhaps even 40% of which 60% certainly have a computer at home (teacher).* The Technical Specialist judged the situation differently: *When I really think about it, my colleagues are not competent to operate a computer. I think 70% of the staff are not able to work with a computer . (the Technical Specialist)*

One of the pupils had the following to say about the use of new media in lessons:

It depends really a lot on the teacher. There are teachers who take conventional lessons. They come in, you get a sheet of paper, you work through it, talk about it, and later on, at some time or other, you have to write a test about it. Then there are others who show a film or who tell us we have an hour s time, we can do what we want. But we have to work on a set task. Here s the computer room, go in, look for something or other in the internet - , that s it. It s quite normal, but that doesn t mean, it happens every week. (pupil)

It is noticeable at the Freiherr-vom-Stein-Schule that particularly maths and physics teachers use CD-Rom in their lessons or work with programmes for e.g. visualising three-dimensional particles, simulating radioactive reactions and trials, for calculating a series of measurements, using the computer to collect data or calculating mathematical problems. Although these teachers were not particularly active regarding the use of the media at school, they seem, however, to use them. One female colleague began to integrate the computer very early on in her lessons by offering courses such as German and the Computer . However, the PC is being used as a tool more than an innovative teaching material. Nevertheless, a positive mention should be made that at other schools in Germany even less use is made of PC, software and internet compared with the Freiherr-vom-Stein-Schule and the questions arises whether this teaching with new media in itself is not already innovative.

Innovative use of the new media at the Freiherr-vom-Stein-Schule can quite definitely be observed. There are teaching units or projects; for example, a teacher has read a book with her class about a typical adolescent problem. A young person has run away from home. In the book there is a scene in which the parents report the missing person. The teacher has looked in the internet together with her pupils under the subject of Missing persons. And the children discovered that there are really many parents who place a missing persons report about their child in the internet. *That was a case of reality within literary fiction. In the end, the result has a completely different quality. The new media are not always innovative from the very beginning, they are only a part of the whole.* (the Headmaster)

During the last school year, pupils worked together in a course in computer science which overlapped with an art course in a competition organised by Siemens. The pupils in the computer science course produced a CD-Rom of the work done by pupils in the art course, among others, the work on the Czech project and placed it in the internet. The handling of internet and the digital camera also would appear to be very innovative at the Freiherr-vom-Stein-Schule as is the way all of the pupils may surf the internet without limitations or borrow the digital camera to document situations or things. This free and trusting attitude is very innovative in general, also regarding the new media.

All these different educational innovations and projects with ICT simultaneously give rise to questions concerning the organisation of school and lessons. The Headmaster is convinced that the new media will change everyday teaching and *the traditional teacher-pupil relationship, the duration of lessons and the limits of subjects*. There are examples of changes in the duration of lessons in medial and educational sectors. For example, to write an internet novel in a German lesson could not be integrated into a normal school day, but would have to be extended to a project week as the work could not be finished within the duration of a normal school lesson. The same applies particularly to the arts lessons, which already incorporate a lot of hands-on work. In the Freiherr-vom-Stein-Schule, the lesson is held, if necessary as a block, i.e. not a 45-minute session but compact lessons over two days, a weekend or, e.g. as with the Czech project, a whole week. This means one subject can be dealt with in a consistent way which in turn leads to a new quality of teaching.

4.2 Outcomes

4.2.1 Infrastructure

The school has three rooms equipped with PC s which the pupils may use:

- The DFÜ room can be seen as the control centre for the school s computer system. There are two Win-NT-servers and five other computers serving administration purposes. The Technical Specialist works from here with his team of pupils from the two DFÜ work groups who have access to the room at all times. The computers in the administration sector are also managed from here.
- In the Oberstufenraum (room for upper school classes) which is situated in the Upper School building are nine Pentium PC s (3x P_I 133 and 6x P_II 266) which are connected to the Windows NT network and configured as NT Clients. All PC internet and email can be used via the connection to two Win-NT servers in the DFÜ room. In this room lessons in computer science are held for pupils from the Upper School or lessons in which the computer is used. When the rooms are not in use for these purposes. All pupils may use the room between 8.00 am and 4.00 pm. These nine computers available to the pupils for lessons so that in a divided class, there is always one to two children at one computer. Occasionally, pupils bring their own laptops from home to the computer science lessons. Taking the total number of pupils in the school to be 1200 there is one computer per 58 pupils.
- In the so-called junior school room is situated in the building for junior school pupils there are older computer models which are mainly used to teach the elementary computing. In addition, small figures can be formed from foam polystyrene with the help of an x-y-table whereby the pupils use a programme for automatic computer-aided manufacturing. The room is equipped with four older computer models (386) and five newer model (3 x 486 and 2 x Pentium I_133).

On the whole, those interviewed described the computer equipment as not so good but, in comparison to other schools, above-average. In both the staff room and the common room there is a computer for the teachers use or to surf the internet and in addition the biology room and the art room each contain a computer.

The question of who is responsible for maintenance has not been clarified and for some teachers is combined with a fear of contact with the computer. The problem exists because, in Germany, there is no planned post for the technical maintenance of computers and the additional work is taken over by knowledgeable and interested teachers. This results in above-average work for them and thus technical maintenance is mostly unsatisfactory and means additional stress for those who take on the work. One teacher speaks plainly about the difficulties of implementing ICT into her lessons:

The main problem is that we have no-one who really masters it and everything takes so long to do. And it always involves extra work And it all takes up so much time. It s frustrating when you want to do something and the computer doesn t work.

It must not be forgotten that the introduction and maintenance of innovation processes in the computer sector of the school depends solely on the competence and the willingness of individual pupils to commit themselves to the task. It also depends on the personality of the teacher leading the work group, knowing how to motivate it and bringing a considerable amount of personal commitment to the work.

As the school is a Microsoft partner school, it is equipped with all the usual text and data processing software. Furthermore, the school has a few simple graphic programmes in art, programmes for creating websites and special CD-Rom for art and mathematics.

4.2.2 Effectiveness

4.2.2.1 Motivating learning in lessons with the help of ICT

Some of the teachers at the Freiherr-vom-Stein-Schule use the computer in normal lessons, apart from the computer science lessons. The teachers have had both positive and negative experience regarding the effect on motivating the pupils. Some of them are convinced that using computers in lessons leads to immediate motivation among the pupils, others have experienced that pupils are not necessarily better motivated. Although games and chatrooms make a welcome change to everyday school lessons, they do not increase the pupils willingness to learn. *That has been my experience, it is not the solution when we say the children like working now. Those who do not want to work, do not work on the computer either. That in effect is the most important fact.*

There are enormous differences among the pupils. Some love to work with the computer, others dislike them just like some adults do.

In principle, it is other pupils who perhaps work now and then, but then you lose others. That means when I have a class of 30 then the percentage of those who do not want to work in class is the same as those who do not want to work with the PC. It is not always the same pupils. It is not true that they would rather work on the PC. (teacher of English)

When attending lessons as observers, the pupils were quite disciplined. Most of them worked together with a partner on the task they had been set. On the other hand, in spite of our presence in the class (four observers) some pupils did not devote their time on the set task but surfed around in the internet.

All the pupils we questioned about learning motivation gave very positive answers whereby all of them were computer enthusiasts any how. On the one hand, they found they were less reluctant to do their homework, e.g. writing a report when they could do it on a PC because it was easier for them to change things around or delete items. On the other hand, they particularly liked being active themselves in lessons by working on a PC than simply *having to sit on a chair for 45 minutes and listening to someone talking* . In their opinion, learning in this way was more attractive. It is of major importance to them that they can try things out for themselves on the PC and contribute more to the lesson and that the atmosphere in the lessons are, on the whole, much more relaxed. One schoolgirl from the Junior School remarked: *It s up to you when the teacher says: Try this, see how you can manage this or this, or how can you do this instead of being told: Do it like this . We can learn by doing it ourselves .*

Particularly in the case of creative work on the so-called X-Y-Table where the pupils can cut out their own initials in foam polystyrene using a computer we found a very concentrated and busy group of pupils. The fact that each pupil had a computer of his/ her own to use was certainly a very favourable factor. Furthermore, no other functions were available on the PC (e.g. internet) as the computers were older models.

The pupils welcome being active themselves in lessons, but apply this to other forms of teaching too. The same

pupils said that it is fun to hold discussions or to act out literature in the German lesson or a court hearing in Social Science lessons.

4.2.2.2 Learning effects

The pupils say that learning forms like these, in comparison to traditional chalk and talk methods have a positive and increased learning effect: *We can remember information much better when it is explained or illustrated in this way.* (pupil) One schoolgirl from the Junior School told us that although she could hardly remember anything of lessons in the past two weeks, one project day was still clear in her mind. After reading the book *The Wave* the pupils had acted out the story a whole day long.

The Headmaster points out one aspect of the positive learning effect when using the computer the pupils usually work in pairs at the computer which means partner work is being trained and it is more natural that they are willing to help each other.

The benefits of using ICT and internet for the pupil, natural integration into the contents of a lesson, basic PC training for the whole of the Junior School and the offer of various optional courses in computer science is uncontested by all teachers. It is preparing the children for the future. It is necessary for whatever work the pupils will do later and it is something the school must provide them with. For the members of the DFÜ work group, the effect goes beyond the basic training and two of the group members told us that in their leisure time, they create websites and short programmes for a company. The Technical Specialist told us with pride and joy that some of his former pupils now work in the computer sector.

4.2.2.3 Learning motivation through contact with the outside world

All the participants welcomed educational innovations or projects in connection with ICT which allowed contact to the public.

On the whole, the Headmaster rated the successes of the school's own homepage and other innovative work with the new media as positive for the whole school and its image because through this *although the school is situated in a provincial area, (...) the school has developed the feeling that it can achieve something and that it can carry on with further work with its qualifications. There is no reason for it to hide behind its achievements.*

One very impressive example within the art lessons is the Czech Project. The pupils presented the results in Berlin at a competition held by the Bosch Foundation. Most of the schools presented their work on the wall via a beamer. The pupils from the *Freiher-vom-Stein-Schule* gave a life performance in counterpoint, acting and dancing in disguise in front of their pictures. The art teachers remarked that the performance was cheered by the audience (about 200 participants) and received great acclaim. The art teacher attributed the success to the combination of a medial presentation combined with a sensorial live experience. The group's project was rewarded with a prize being among the first 10 out of 100. The Headmaster emphasizes with this experience particularly the effect of positive feedback regarding motivation of teachers and pupils. The art teacher confirmed this.

3.2.1.1 Teaching motivation

On the whole, it can be said that teachers who initiate educational and technical innovations to a high degree, also gain personal advantages from them. The Headmaster describes: *Those who work on innovations are highly satisfied, they feel what they are doing is right, they feel that they are making progress for themselves. That is the sort of satisfaction which helps to forget the stress.*

Finding pleasure in work and being a part of innovations also motivate teachers to commit themselves to a much higher degree than normal and to invest their time. One of the art teachers remarked on the immense amount of additional work and increased stress which the manifold projects in their sector involves *many teachers are reluctant to do it, that is simply a matter of fact. We are only doing this because we enjoy doing it* and both of them are convinced *that is what contributes to the quality of a lesson and that in turn, is reflected in the pupils motivation.*

4.2.2.4 Parent involvement

Until now, the Freiherr-vom-Stein-Schule has been unsuccessful in involving parents in the school's activities. According to the parents questioned, most of them are reluctant to commit themselves. They expect the school to provide certain services but are more or less unwilling to make personal or financial contributions themselves.

4.2.2.5 Advantages and benefits of the innovations

As the Freiherr-vom-Stein-Schule is situated in a rural setting, the provision of internet is of enormous benefit for teachers and pupils. Neither the school nor the town has a library and the nearest, which is some distance away, can only be reached by bus. The internet allows easy access to information and all the teachers have noticed a change in the pupils' willingness to undertake researching of information.

The pupils have become more independent and confident in obtaining information or working on reports or work sheets. The pupils themselves welcome the increased choice of information sources in internet and the possibility of quick and easy access. Furthermore, the management of acquired data is simplified, as it is stored in the computer and need only be printed out or reviewed. Monotonous, handwritten work or calculations can be neglected in favour of comprehension work. The appearance of material created in this form is much more pleasant to look at both for the pupil and the teacher. There is a further advantage in mathematics as the software presents mathematical facts in a much more comprehensible way. Thus, pupils can compensate for their deficits themselves by using practice programmes and new learning channels are opened up in which different types of learners can be approached visually.

Furthermore, both teachers and pupils praise the up-to-date information available on internet and not having to depend on out-of-date text books. One teacher emphasised a further advantage of being able to make use of programmes of varying degrees of difficulty, adapting them to the pupils' abilities and performance.

4.2.2.6 Problems and disadvantages of the innovations

Space and time

One disadvantage of ICT is that additional space must be found and equipped as computer rooms and these take up space which is then lacking elsewhere. Another re-occurring problem is that certain skills are necessary to operate a computer which means a lot of time is invested without showing any results. One pupil remarked, *you need a lot of time and you must be able to operate everything, otherwise you get nothing out of it.*

Class size is always a problem and in particular when using ICT in a lesson. The issue here is whether the school must change its way of thinking in the long term. The computer rooms are not designed for the traditional class number of 25-33 pupils as in many cases, there are not a sufficient number of computers installed. A sensible learning effect cannot be achieved if there are more than one to two pupils to one computer. So far, the problem was solved by timing the lessons to the beginning or end of the school day and dividing the classes. This procedure is also followed when the computers are needed during normal lessons. These conditions deter many of the teachers to such a degree that they prefer to go back to the old traditional teaching forms. According to the Headmaster, the new media brings its own intrinsic dynamics into play and this requires new structures for learning: *The form of new media requires smaller groups and for teachers to take on the role of an advisor, to act as a moderator (...). We are looking for ways to do this, but when we look at the factors of space and time these are hostile to innovation.*

Communication

Both teachers and pupils equally recognize that computers and internet present the danger of a lesser level of communication among pupils. Our own observations showed that group discussion did not take place in the lesson but, following a directive introduction by the teacher, each pupil worked alone or with a partner on the task set. One teacher was afraid of group processes being endangered when for example, one pupil leaves the class in order to quickly research for something or other in the internet in the adjoining room.

The changed role of the teacher

We can differentiate between two lines of changed roles: on the one hand, a levelling out of traditional differences in role relationships in the DFÜ work group and on the other hand, a change in the importance of roles as pupils become increasingly PC-competent. In the DFÜ work groups, the old teacher-pupil limits have disappeared, a fact much welcomed by the Technical Specialist. Other teachers are intimidated by the loss of authority in these changed roles because as soon as a teacher includes ICT into the lesson, there will always be one pupil in the class

who is more knowledgeable than the teacher. One pupil in the upper School confirmed that teachers can sometimes learn more from their pupils than vice versa and that pupils are now turning to other pupils for help instead of to the teacher. In relationship, pupil parity is therefore larger and former hierarchy levels the teacher is the person who knows more and thereby legitimates his/ her power is decreasing. One teacher described the fears of her colleagues:

It s a simple fact that many of them are just afraid and they say I don t want anything to do with it . They are afraid of the teacher s new role: I am no longer the person in control. There are certainly some, who just don t like the situation.

If, in some cases, the pupil is more knowledgeable in technical sectors than the teacher, then it becomes even more the teacher s role to teach the pupils to handle the media critically:

I believe, that there is still a need for a continued teacher-pupil role, even in Junior School, regarding the critical reflection of such material. In the technical sector, the pupils are often more competent, as they contribute to the lesson. This changes the role of the teacher either the teacher is made to feel insecure or he/she sees this contribution as a positive addition to his lesson. Each teacher reacts in a different way. The basic system will not change because the pupils have to learn how to handle these things critically.

The ability to reflect

One problem among pupils is that they find it difficult to select and differentiate the flood of information they find in the internet, to reflect on the contents in a critical way and to evaluate the information. In the internet, extreme forms of political opinions are to be found seemingly on an equal level with scientific information. One example was found by the art work group working on the subject of Guernica . The pupils often do not know how to react and feel the demands made on them are too high. It then becomes the prime task of the educationalist, not only to impart facts but also to show the pupils how to handle them. The pupils tend to believe and approve of everything they find in the internet and it is of major importance that they learn to handle these sources critically.

Handling the internet in a sensible way also depends on the teacher and must not be a substitute for a well thought-out and well-considered lesson as one teacher put it:

A second fact is that until you can use the internet, there must be a process a learning process of how to use the internet sensibly! I would say, sceptically, that 80% of colleagues who use the internet do so because they have not prepared their lessons. That sounds harsh, but I notice more and more that these colleagues work according to the motto: go into the classroom today, give them a key word to research and they have all got something to do . They like doing it, it s something different from the ordinary run-of-the-mill lessons (...) and you can sit back and let them get on with it!. So, the search and the unplanned begin and sometimes this makes me really angry because the pupils get a wrong impression of the internet. Those colleagues who use it to whitewash their own laziness, well, I feel very sceptical about them, and I am not hesitant to make the appropriate comments.

Adoption of prefabricated material

Conflicts arise between individual creation and prefabricated computer material, particularly in the subject art. While pupils prefer the quick and simple solutions provided in the computer, the art teachers propagate the targeted planning of a project, and using the computer as an instrument to achieve this *when we want to design something, we want to design it as it should be and not as the computer would have it* . They can envisage the pupils depending too much on prefabricated programmes and not on their own, original ideas.

Recourse to prefabricated material, without individual efforts, is a problem in each subject. One teacher of English explained that pupils are beginning not to take so much care with their work i.e. they copy something out of the internet and they depend on it being there, but as they sometimes do not even make the effort of reading the information through from beginning to end, the subject matter is not automatically absorbed.

Misuse

This is a problem of a form of misuse connected with ICT: Teachers correcting homework, reports or the yearly tests in the Upper School increasingly cannot judge what the pupil has done himself and what has been simply copied from the internet. When interviewed, one schoolgirl commented smiling on the advantage of the computer:

It s easy to show off with ready-made texts out of the internet . Additionally, there is the danger that pupils are not learning in-depth. An effective method of control is to orally test written homework. However, not all teachers are aware of the possibilities offered by internet and others feel powerless. One teacher commented:

We set them a yearly test and the teacher needs more time to mark it than the pupil does to write it. And that is, of

course, a very questionable issue. And I think, we ought to make the teachers more aware of this. Many teachers simply need a bit more training in order to learn what is possible today. Some pupils, I repeat, some pupils, are much more advanced.

Little computer misuse has been established at the Freiherr-vom-Stein-Schule. Although the computers are used by pupils all through the day without any supervision, there has been little damage to hardware or software. The competent teachers are convinced the reason for this is because the pupils are trusted and they know that everything has been prepared by fellow-pupils and they would only put themselves at a disadvantage if something disappeared or was damaged. With the exception of a few pages by right extremists, which the pupils cannot access, no internet pages are blocked for the pupils.

Only a random control is made of the use of other pages as the Technical Specialist can see in the computer which pages have been called up. Should he find an undesirable page he goes to the other classroom and makes it quite clear that this is not wanted. These random checks are usually deterrent enough in their effect. Since this year, the pupils must be in possession of a PC card in order to access a PC room. This card formally states that the pupil is not allowed access to certain pages in the internet. The computer room can be viewed from the outside through a window and as the computers stand in a row along a wall, the screens are all visible. A teacher sometimes comes along to check. The computer also has a built-in CD-guard card which protects the instrument from access in which the user can do everything and after switching off returns to the original condition. However, one teacher remarked:

As a rule, the pupils are interested in indifferent chat pages and suchlike, if that can be seen as misuse. But I think you can't see that as problem. But I really believe that the pupils are not our opponents and we all try to join forces. I think the reason is that basically they can use everything. Nothing is prohibited. That means, when they switch on the computer, they basically have a free hand.

4.2.3 Academic rigour

Generally speaking, the influence of ICT on the pupils' academic performance cannot be clearly defined. The innovations have not yet been implemented throughout the whole school, but only in certain sectors/ work groups, optional subjects, basic training in Junior School or projects, particularly in the Upper School of the grammar school.

No definite evaluation has yet been made of the use and effect of new media in subjects, although the Headmaster would very much welcome such information.

The Headmaster assumes a definite improvement among weaker pupils in certain areas, who could train on computers objectively and independently with e.g. learning programmes in grammar and orthography in German or a foreign language, or for mathematics. Programmes like these are already available to pupils on some of the computers or the pupils are recommended to purchase them to use at home. One mathematics teacher thinks that using computers in lessons would enable more sophisticated tasks to be worked out as marginal activities would increasingly drop out.

More time, personal and financial investments must be activated to embody the innovations throughout the school lessons and in the syllabus. It would appear up to now, that the innovations have provided an additional quality to school life in the form of further dimensions, i.e. presentation and explanation of facts, new types of learning and experience through external contacts.

One advantage in performance is noticeable in the pupils from ethnic German immigrant families from Russia in working on PCs. One teacher reported that their weak knowledge of German caused many problems in other subjects but the computer provided an opportunity to perform as well as other pupils as the language barrier here did not present so many problems. The computer also provides new opportunities for the physically handicapped children in the school.

4.2.4 Equity

A special feature of the Freiherr-vom-Stein-Schule is that the pupils can use the computer rooms daily when they are open from 8.00 am to 4.00 pm on their own and completely independently, a fact which pupils mentioned positively when interviewed. In other neighbouring schools, access appears to be more regulated and limited. Because the rooms are open all through the school day, each pupil has basically the opportunity to do their

exercises on the computer to use learning programmes or the internet. This obviously does not happen, otherwise the computer room with nine work stations would not be sufficient for almost 1200 pupils. The teachers estimate that in the Upper School of the grammar school almost all the pupils possess their own PC or have access to their parents at home. In lower forms, about half of the pupils are estimated to have access and in the Hauptschule the number is even lower. According to the Headmaster:

The figures decline enormously in the Realschule and the Hauptschule. I imagine the financial resources in most of these families do not stretch to a computer. Already, a sort of second class system is being established and the gap is increasingly widening.

The Headmaster is of the opinion that those who have access to a computer at home are privileged but he also convinced that this does not simultaneously lead to worse performance in these pupils because *even the best equipment is of no use if those using it try to do so with a minimum of effort*.

He sees a restricted opportunity for the school to balance out these differences simply by providing the conditions in a PC room at school as currently the computer room is often too full between lessons and in free periods and many pupils are not willing to remain behind after school to use it. One possibility to strive for is to concentrate in future on those children who are financially at a disadvantage and have no computer. His aim is to offer these pupils special support through targeted promotional measures.

All pupils in Junior School are offered a basic PC training, but, as all computer science courses, is on a voluntary basis. The number of places in a course is limited., but efforts are made to include those children in the courses who have little computer knowledge and to ask those with more knowledge to wait until later in order to balance out differences step by step.

However, there is no way of establishing whether the better pupils are those who are familiar with the computer. One teacher has observed that that some of those pupils who otherwise are rather unremarkable are the ones who really put their mind to computer science because the PC is often their one great hobby. Regarding pupils from the Hauptschule, one teacher observed that *pupils from the Hauptschule want to use the computer but for different purposes as here and so we never see them in the courses*. They are more interested in games, chat sites and internet pages and are not familiar with a more serious handling of ICT. She says:

Not all pupils have a preliminary knowledge of the computer. I spoke to one pupil who did not know how to handle it and took him over to the computer room. They don't usually have a computer at home and that means they try to hide the fact that they can't handle one with silly behaviour. In that case, you have to approach the matter very sensitively and try to explain how it all functions.

Another group who might be given special treatment in the future are the girls. >From the majority of those questioned it was established that girls in general have less experience with computers than boys. There were no girls among the so-called computer freaks, and until now, none in the Upper School DFÜ work group. In the meantime, the balance has been redressed and in the Junior School work groups there are now more girls. The boys are still in the majority in the computer science courses. Boys and girls apparently use the computer for different purposes, whilst boys and girls are equally good in text processing the girls seem to have more interest in creating the contents whilst the boys prefer to occupy themselves with the systems and technologies. Some teachers have noticed that boys on the whole act more dominantly, have a higher degree of self-confidence and are sometimes feel themselves to be more superior whilst the girls are more timid as they deal with their knowledge more modestly than boys, even when they know just as much as the boys. For that reason, considerations are being made concerning separate computer courses for girls and boys, whereby there was already good feed-back from one teacher.

4.3 Projections

4.3.1 Sustainability and Scalability

According to a statement given by the Minister of Education in Germany, each pupil is to have his/ her own notebook by the year 2006. In order to carry through such an undertaking it will be difficult enough to provide the necessary capital for this venture it would be necessary to have a new educational concept, simultaneous set-up of comprehensive further training for teachers and a professional maintenance service for schools.

These are the crucial points which will play a decisive role in continuing the innovations in the

Freiherr-vom-Stein-Schule as ICT can only be used in a sensible way when the teachers are competent enough to handle it and have sufficient technical resources, when they need not bother with technical details and well thought out didactical and methodical concepts are available. Regarding technical maintenance, the Technical Specialist is personally convinced that maintenance work should be taken care of by experts and not teachers and would like to see definite support:

This sector should not be placed into the hands of educationalists but ought to be carried out by experts who have been trained to do this work. And instructions must function without the teacher having to lift a finger, I mean, it is not really my job, I m an administrator. But I believe it s just wishful thinking.

Several teachers point out that it is particularly important to provide the pupils with a media competence in the future which reaches beyond just technical applications and which, in particular, promotes an ability in critical reflection. This must be objectively trained. Also important for the future that ICT does not represent an end in itself or that it is simply used because it is there or because there just happens to be a certain software at hand, but critical considerations must be made as to which sector it can find sensible application.

The Headmaster deems it important to continue with the school programme and to think about the effects of the new media what is desirable and what is questionable. He aims to carry out a regular evaluation of the innovations in order to correct undesirable developments and to form focus points. The control group is such a motor which will continue to take over these tasks. The headmaster plays down his role somewhat but is seen as many teachers as a major figure in maintaining the innovations in that he encourages the teachers with financial support and time. However, it is the individual teacher who pursue his/ her own ideas, realise them and incorporate them into their school sector.

Further developments in future depend decisively on the financial, human and time resources available. One of the Headmaster s targets for the near future, ignoring actual possibilities, is the creation of computer support bases in the form of an island with focal points in various subjects such as art, biology and the environment. He would also like to see the installation of new learning software. Teachers who have, up to now, worked with the new media, have a lot of ideas for further projects so that innovations can most certainly be continued, as far as the resources allow it.

Conclusion to the Hypotheses

1. Hypothesis: 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 improvement is found throughout the whole school, technology served only as an additional resource and not as a catalyst and the forces that drove the improvements also drove the application of technology to specific educational problems.

At the Freiherr-vom-Stein-Schule it is established that strong innovative elements are not to be found in the ICT sector but originate in from educational innovations. The new media is primarily used as an instrument for researching information or as medial representation of topics in a lesson, for learning information and designing texts. They are therefore largely instrumental in character and serve innovative potential at the school for further creation of ideas: It is to be assumed that the innovative use of the new media will increase as technical possibilities and personnel skills increase. The basic innovative potential, however, would seem to come from educationalists and contacts to the outside world and ICT has up to now been monopolised rather by these two sectors fur their own purpose i.e. innovation is not necessarily linked to new media. Nevertheless, ICT is increasingly being established at the school as an independent branch of innovations.

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

The diffusion theory assumes that innovations only spread gradually through an organisation. A new idea or technology must first be made known to members of an organisation via various information channels. And this takes time. The innovation is stimulated by one individual who massively supports the innovation and is responsible for its gradual spread.

At this point, it can be clearly stated that the introduction of new media in the Freiherr-vom-Stein-Schule spread according to the diffusion theory. ICT was stimulated by the Headmaster and the Technical Specialist and has been increasingly embedded in the school during the past three to four years. The commitment of the Technical

Specialist and his pupils resulted in ICT finding increased application and this was communicated to others in the school. The in-school courses of further training support this process so much that the innovations were able to spread further.

3. Hypothesis: Successful implementation of ICT depends mostly on staff competence in the integration of ICT into lessons and the learning process. 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 it is the school's technical infrastructure and pupil ICT competence rather than staff competence that determine ICT implementation outcomes.

The introduction of ICT at the Freiherr-vom-Stein-Schule depended heavily on the commitment of the Headmaster, the Technical Specialist, the teachers and the pupils. Further factors were teacher training and the technical infrastructure.

The headmaster's commitment was particularly visible as it was he who advocated the reshuffling of costs to finance internet access, who allowed teachers more free time for their ICT tasks or innovative projects and who personally supported and encouraged teachers.

Internal teacher training resulted in the personal interests of individual teachers being passed on to others together with the appropriate skills. The technical infrastructure is a further major factor which depends on the competence and willingness of pupils and without which the whole of the innovations would not have been possible.

Achieving a critical threshold value in the infrastructure is in so far of importance that teachers and pupils alike are more motivated to working with the medium when equipment is up-to-date, functioning and available in sufficient numbers. Furthermore, the implementation depends equally on the competence of teachers pupil skills regarding the maintenance sector.

On the whole it can be said that the successful implementation of ICT at the Freiherr-vom-Stein-Schule depended on the support of the Headmaster, competence of the Technical Specialists and their pupils as well as three to four other teachers. But it did depend on teacher competence, their skills in using ICT in lessons only increased during the innovation process of including ICT into their lessons. A successful implementation of ICT would appear at first not to depend on teacher skills. These must increase as the infrastructure grows., whereby the infrastructure alone does not result in a successful implementation of ICT.

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

It would appear that through open and equal ICT access at school the gap between poor and rich pupils does not decrease. On the contrary, it will increase as children with richer parents will be able to have a computer at home which is not the case for children from disadvantaged families. That means some can practise more at home whilst others do not have this opportunity. In spite of having equal access at school, this does not reduce the gap as the computer room is always crowded during free periods and most pupils do not feel like staying on after school has ended.

The problem of self selection unfortunately often means that those who are interested in computers use them and thus gain skills that other pupils do not necessarily gain via the in-school offer as they tend not to take advantage of it. Without a special promotional programme for weaker pupils, it can be assumed that the gap will increase and not decrease.

5. Hypothesis: 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 pupils spend more time on marginally beneficial searches and in browsing poor quality Web and courseware contents.

The quality of pupils learning standards with the use of ICT must be judged in many ways. The experience of some teachers show that the use of ICT in lessons does not automatically lead to better academic results. ICT does not automatically lead to increased motivation for learning, an important contribution to learning performance. If the new media is not used in a sensible didactic way, it could take on the function of a stopgap, which would be a very negative development. The advantages resulting from easy access to information do not necessarily lead to good academic performance as not all the information is of high quality. Pupils often do not deal with information found in the internet so intensively as they would have to without the media. They simply use it without thinking

too much about its contents. And this results in a loss of quality in the learning process. Learning is threatening to become superficial, as pupils are using pre-fabricated information without checking it.

Projection to the Future

The ability to transfer innovations to other schools is possible even though innovations are very dependent on the personal commitment of the Technical Specialist, the headmaster, a few committed teachers and pupils. Moreover, particularly in-school training in small groups, as in this school, plays a considerable role in spreading innovations as it removes inhibitions and is carried out by persons who are known to the participants. This is transferable to other schools and would appear to be a good opportunity to spread innovations through an organisation. Other schools can also consider trying out a cooperation with pupils on a trust basis. This would open up considerable resources which are always present in a school.

Nevertheless, it would seem that it is always essential to have a headmaster to support the innovations, to create time and financial support as well as interested, motivated and committed individuals.

Two other important factors for a transfer to other schools appear to be the raising of additional financial resources e.g. through sponsors and commissioners as well as building up contacts and cooperation with the social and local school network.

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APPENDIX A: METHODOLOGY

The school was selected through the homepage, at the same time taking into consideration the criteria concerning school selection in the OECD Workbook.

The research team consists of two researchers, Franziska Seeber and Ulrike Weininger from the FWU Institut für Film und Bild in Wissenschaft und Unterricht in Grünwald near Munich, who work for the OECD study and two researchers from the Institut für Schulentwicklung der Universität Dortmund (Institute for School Development at the University of Dortmund), Rebekka Dlamer and Birgit Fuchs, who work for Sites Study. The school was examined on four successive days from 27 August until 31 August 2000. The two lady researchers from Sites Study were present only on the first two days.

The combined IEA/OECD instruments were used for the interviews. The OECD amendments to questions from August were integrated and the interviews translated into German.

The Headmaster was interviewed (about 3 hours), the Technical Specialist (about 2 hours), two art teachers

(approximately 2.5 hours, one male teacher and one female teacher who offer computer science courses, one female teacher who works actively with ICT in her lessons and one male teacher who is responsible for administration (each approximately for 1 hour). In addition, two parents were interviewed (about 1.5 hours) and two groups of pupils with four boys and two girls (about 45 minutes). All the interviews were recorded on a mini-disc recorder. The suggested observation protocol from Norway from the OECD Workbook was used. Three lessons were observed: an English lesson in the computer room, a computer science lesson and one lesson working with the X-Y-Table.

Furthermore, 116 questionnaires ICT utilisation by teachers were collected and the selection form for schools which the Headmaster had completed. As material we took material from the school development programme, a book about the 50 years jubilee of the Freiherr-vom-Stein-Schule and two catalogues on the Czech project. Photos of the school were taken and the homepage was inspected.

The interviews were transcribed from the mini-discs and coded by the two researchers from the OECD team via WinMax, a German software programme for analysing qualitative data. It is based on the Grounded Theory of ANSELM STRAUß and is accordingly openly coded. The evaluation was discussed and the report was drawn up based on division of labour.

APPENDIX B: ICT PRACTICES SURVEY FOR TEACHERS

Table 1: Teachers' feelings regarding different ICT tasks

How comfortable are you with using a computer to do each of the following?	Very comfortable	Comfortable	Somewhat comfortable	Not at all comfortable
Write a paper	13	3	0	0
Search for information on the World Wide Web	8	5	2	1
Create and maintain web pages	1	1	6	8
Use a data base	5	5	4	2
Send and receive e-mail	11	1	2	2
Programming	3	1	3	9
Draw a picture or diagram	5	6	4	1
Present information	0	7	5	4

Based on the responses from 16 class teachers.

Table 2: Frequency with which teachers assigned different types of ICT work

During the past school year, how often did your students on average do the following for the work you assigned?	Several times each week	Several times each month	A few times	Never
Use the World Wide Web	1	3	9	2
Create web pages	1	3	1	10
Send or receive e-mail	1	2	4	8
Use a word processing program	1	10	3	1
Use a computer to play games	0	0	2	13
Use a spreadsheet	0	3	6	6
Use a graphics program	1	3	6	5
Join in an on-line forum or chat room	0	1	2	12
Use a presentation program	0	1	4	10

Use an instructional program	1	2	8	4
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Based on the responses of 15 class teachers.

Table 3: Teachers about their use of ICT in classes

Answers based on experiences or policies from the last school year.	Yes	No
Was student computer use ever evaluated for grading?	6	9
Did you create or modify a Web site with any of the classes that you taught?	3	12
Did you participate as a student or instructor in a virtual course through the Internet/ World Wide Web?	0	15
Did you involve your students in collaborative learning over the Internet/ World Wide Web with students from other classes?	0	14

Based on the responses of 15 teachers

Table 4: World Wide Web searching restrictions

	No restrictions	Some restrictions	Designated sites only
If you assigned World Wide Web searching, how much freedom did you allow students in locating sites to visit?	7	3	3

Based on the responses of 15 teachers

Table 5: The portion of computer use in class

	All	Most	Some	Very little
What portion of the computer use in your classes was directly related to the course content?	3	5	5	2
What portion of the computer use that you assigned was done by students individually?	1	11	2	1

Based on the responses of 15 teachers

Table 6: Frequency of using a computer at home to prepare for teaching

	Several times a week	Several times a month	A few times	Never
How often did you use a computer at home for preparing for teaching?	12	2	1	0

Based on the responses of 15 teachers

Table 7: Carrying out programming and installation tasks

Have you ever done any of the following?	Yes	No
● Made changes to a computer's hardware	9	6
● Updated an application program (word processor, graphics program, etc.)	13	2
● Recovered a damaged file	5	10
● Created a web site	6	9
● Developed a data base	10	5

Based on the responses of 15 teachers

APPENDIX C: DOKUMENTATION

Site documents collected:

- Freiherr-vom-Stein-Schule: Schoolprogram
- Freiherr-vom-Stein-Schule: Timetable August 2000
- Dokumentation 50 years Freiherr-vom-Stein-Schule
- Catalogue: Kunst und Natur (art and nature), pictures from pupils in the Tschechienprojekt
- Catalogue: Eigenheiten, Fremdheiten (peculiarity, foreignness) pictures and von Schülern aus dem Tschechienprojekt
- Photographies from the school