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ICTs and e-learning in Austrian Schools.

In: International Journal of Educational Policy, Research and Practice, Vol. 1, Nr. 3, Fall 2000, pp. 307-316.

ABSTRACT

This paper provides an overview of the status and prospects of e-learning in Austria and some conclusions from a three years research project on the implementation of information and communication technologies (ICTs) in six Austrian schools. The overview presents measures already implemented or planned concerning networking of schools, online resources, teacher training, and expansion of "computer literacy" and specific ICT-qualifications. For these topics the general background and trends are also outlined. The conclusions drawn from the research project relate to the question of "efficiency of learning" ICTs and crucial points in the process of implementing ICTs. Furthermore, some problematic aspects which should not be missed in a non-fictitious picture of schools "going online" are addressed.

Key words: ICTs • e-learning • schools • evaluation • Austria

Countries in the transition from industrial to information societies are eagerly trying to implement information and communication technologies (ICTs) into school education. These cost-intensive efforts are connected with high pedagogical expectations: Both teachers and students shall have access to the constantly growing global inventory of information, to multimedia teaching and learning material, and to exchange and co-operation on a regional and international level. Often, however, there is a huge gap between expected and experienced "educational added value". This discrepancy is particularly notable wherever technical aspects are overemphasised and idiosyncrasies of school culture and teaching are neglected or underrated.

In this paper we will first give an overview of the status and prospects of e-learning in Austria. The context of this overview is that the Austrian government is willing to implement the measures introduced under the label "eEurope" by the European Council in Lisbon on 23/24 March 2000. The e-Austria initiative will have a strong focus on the educational sector, with a suggested investment of 1 billion Austrian Schillings ("Computer Billion") within the next three years.

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[1] *Salzburg Research* Forschungsgesellschaft m.b.H. is a non profit research organisation and the official research organisation of the Province of Salzburg at the Salzburg Techno-Z, the regional technology park. We would like to thank Prof. Peter A. Bruck (Scientific Manager of *Salzburg Research*) and Hannes Selhofer (Head of Information Society-department) for advice and support.

Secondly, we will present some conclusions which are drawn from a three year empirical project on the implementation and use of notebooks and the internet in six school classes in Austria. These findings indicate that behind such figures as schools connected to the Internet or teachers and pupils with "computer literacy" there is an other – sometimes – disillusioning truth about schools "going online".

E-Austria: A strong focus on ICTs and e-learning

On March 24 the European Council decided on a European itinerary called "e-Europe" for further accelerating the use of ICTs in all areas of life. It is the explicit goal to empower all European citizens to master and use new media in a meaningful way and thus to play an active role in the information society. This process is considered a decisive factor for securing economic growth and employment in Europe.

The European strategy will be put into practice in Austria through the project „e-Austria". A detailed work plan was agreed on by the government and the current and planned activities in all ministries up to the end of the term of office are introduced. The taking of inventory was carried out by the Federal Minister of Education, Science and Culture, Ms. Elisabeth Gehrer.

The current and newly planned measures in the field of e-learning will be summarised with a focus on school education. The basis for the summary are: (1) a catalogue of measures presented by the Federal Minister on April 4 entitled "Learning – Teaching - Research for a connected knowledge society"; (2) the relevant issues in the default to the Council of Ministers referred to as "e-Austria in e-Europe: Follow-up to the European Council in Lisbon" (Gehrer 2000a, 2000b); (3) as well as some other sources of supplementary information.

According to the catalogue of measures by the government, all activities regarding learning on the Internet, the education of teachers, e-learning for universities, adult training, etc., shall be promoted by what has been referred to as the "Computer Billion".

For this purpose, a steering committee has been established which will make propositions on how to make best use of the budget. Furthermore the committee will support measures for evaluation.

Target 1: All schools should have access to the Internet and to multimedia learning resources

Already implemented:

- By the beginning of June 2000 there were 6380 schools in Austria. The level of connection to the internet among those schools amounted to 100% for secondary academic schools and 43% for compulsory schools providing general education. The latter consist of 3,412 primary schools of which 34.1% had access to the Internet, and 1,193 lower secondary schools with 73.5% having access. (A detailed statistical overview, which is updated on a monthly basis, is offered at the main server of the Federal Ministry of Education, Science and Culture: <http://www.bmbwk.gv.at>, see: Schulen im Netz).
- Virtual learning resources are available via 9 educational servers, one for each province in Austria. Additionally, a platform called "Virtual Schools" containing subject related material, and a communication platform, "schule.at", which is supported by the Federal Ministry of Education, Science and Culture (for these platforms see: <http://www.de.eun.org/vs/austria> and <http://www.schule.at>).

To-do by 2003:

- Compulsory schools providing general education (supervised by the provincial school authorities): It is the goal to have all schools on-line and to win the favour of the regional decision-makers for this ambitious project. Furthermore, it is planned to set up regional intranets interconnected with the Austrian School Network (ASN).
- For the federal schools the goal is to upgrade the bandwidth of internet connection to 2 Mbit/s – 10 Mbit/s.
- Extension of the educational servers with data banks and learning resources. By the end of 2000, all (audio-)visual media like slides and educational films offered to schools by the Ministry shall be digitised and retrievable via the Internet.
- State-of-the-art computer equipment shall be implemented and used according to latest research. For instance, the employment of laptops shall be further promoted. Currently there are only several laptop classes with a total of 500 pupils.
- Further transformation of all federal schools into multimedia learning centres.
- Expansion of the pilot project Web-Based Distance Training (virtual university). At present a distance university course is in use for the Science of Justice at the distance education centre in Bregenz (for this „multimedia study“ see: <http://www.esc.ac.at/bregenz>).

Background and general trends

The technical “networking” of schools and other educational institutions in Austria has occurred at a remarkable pace. This process, however, was not primary driven by pedagogical motives but rather by the demand from school administration. By school term 1999/2000 the entire accounting for staff, extra time, substitution, etc., should have been done over leased lines to the central data processing centre of the Federal Ministry of Education, Science and Culture (Schulrechenzentrum). For this reason a separate administrational network has been established.

Prior to that, initiatives in different Austrian provinces had already started to bring schools on-line. Then, with the establishment of the Austrian School Network (ASN), launched by the Federal Ministry of Education, Science and Culture, a nation-wide infrastructure had become available which incorporates a number of regional networks. Today, the ASN is the technical heart of bringing schools on-line, yet, there are still some separate regional networks. Additionally, many schools are given access to the Internet by a special offer from the Internet-provider Netway.

The level of connection within Austrian schools is therefore characterised by a diversity in modes as well as great regional differences. The activities by the government which have been mentioned so far are not likely to change this present state until 2003.

It should also be stressed that mere access to the Internet does not reflect its actual use in schools. There is a ranking which mirrors the effective use of the Internet reaching from technical and vocational schools – with fast internet connections, upgraded LANs and a regular use of the medium- to many elementary schools which only allow school administrators to use the Internet.

Concerning learning resources, the educational servers in the provinces offer content which vary significantly in depth and quality. Offered are services for teachers such as overviews of educational institutions, links to different subjects and topics as well as courses regarding the Internet. Well-prepared material on topics and useful project documentation are rare. Best

practice examples have been gathered in the already mentioned platform "Virtual School" under the initiative of a work group from the Federal Ministry of Education, Science and Culture which is affiliated with the European School Network. All content on this platform are adapted on a regular basis by committed teachers.

Austrian school book publishers have also evolved as key-players in the provision of digital learning resources. Driving force in this field is a co-operation of several publishers called LISA – LehrerInnen InformationsSystem Austria (see: <http://www.lisa.or.at>). One reason for the intensified involvement of publishers is the fact that schools can use up to 15% of the budget provided by the government (100 Mio. ATS) for purchasing learning software or other multimedia products.

Target 2: All teachers should be individually equipped and skilled in the use of the Internet and multimedia resources.

Already implemented:

- 17,000 teachers have access to the Internet via the Austrian School Network (ASN); the number of teachers using alternative providers is unknown.
- Post-secondary colleges for teacher training will promote courses on new media. Two specific training programmes for teachers are already offered: "Multimedia and Telecommunication" and "Informatics for Businesses". The course "Development of Learning Software" is planned for 2000/2001.

To-do by 2003:

- A representative survey on the state of "computer literacy" of teachers, and identification of all teachers who have access to the Internet.
- Intensified training of teachers in the basic use of computers and the Internet, as well as further in-service training (universities, teacher training schools and centres). Particular courses should also be offered in tight co-operation with private companies.
- Introduction of the university course "Information Manager". Graduates will be in charge of administering the ICT infrastructure and of conducting further training for teachers at the assigned schools.

Background and general trends

No reliable data is currently available on the state of "computer literacy" in regards to teachers in Austria. According to the "Computers in Education" study (COMPED) from 1992, 36% of teachers do not have the opportunity to use computers, neither at work nor for private matters (27% men, 44% women).

A total of 4,500 teachers from lower secondary schools and secondary academic schools were interviewed. Those familiar with ICT had rarely gained their knowledge during their teacher training. Rather, the teachers indicated that 90% of their knowledge and skills with regards to computers result from attending privately financed courses, on-the-job training or through self-study. (cf. Haider 1994, 1997)

Generally, a gap exists between 2 different subject cultures: those subjects related to computer and natural sciences versus human sciences. Naturally, IT-teachers are dominant among the computer-skilled teachers. Additionally, those teachers are in most cases qualified who teach subjects that lend themselves to the use of computers, e.g. calculating, designing, etc.,. In subjects which do not necessarily require the employment of computers all levels of qualification are possible – from expert to beginner to no-user. Generally speaking however, there is a lower skill level observable compared to teachers with a natural science background.

A problematic issue is the fact that female teachers lag behind in the development of ICT skills. In the COMPED study three quarters of the teachers who exposed themselves as having no computer knowledge whatsoever were women. It is assumed that this figure is still valid. It can be seen that in schools with a lower percentage of female teachers the level of computer knowledge is greater on average.

In general, ICT related training and further training – in particular at teacher training schools – are much more prevalent than in the 1990's and pressure on teachers to attend those courses for acquiring computer skills has increased. However, an occupational field where the majority of employees are female and over 40 does not provide the optimal conditions for achieving a high level of computer competency. Not only are technical related qualifications absent but also the pedagogical and didactical orientations do not meet the demands of an ICT-enhanced classroom. Consequently, the expansion of computer and internet competency is one of the most challenging within the e-learning initiative, especially since the further training of teachers is voluntary.

Target 3: The European Computer Driving License (ECDL) as standard, intensified expansion of specific ICT-training and establishment of innovative training centres

Already implemented:

- Since the beginning of 1999, ECDL examinations, a uniform 'base qualification' in computing skills, have been regularly conducted in schools. At many schools, in particular secondary technical and vocational schools, the ECDL syllabus is taken as a foundation for relevant subjects and lessons.
- So-called Competence Centres for Information Technology (see: <http://www.ccit.at>) procure relevant courses and company certificates (currently courses are offered by Cisco and Microsoft).
- By the end of term 2000, there will be approximately 20,000 graduates who will have competence equivalent to the ECDL, 8,000 of which also have specific subject-knowledge.
- Polytechnical schools in Austria already offer more than 13 ICT-related courses with emphasis on e.g. Information Economics, Telecommunication Systems, Software Engineering or Multimedia Design (for a systematic overview on these courses see: <http://www.fhr.ac.at>).

To-do by 2003:

- By 2003 there will be approximately 21,000 graduates each year which possess knowledge equivalent to the ECDL of which at least 10,000 have specific competence.
- At the secondary technical level, six innovative disciplines with a focus on data processing and computer & communication technology will be established by 2001; by the beginning of fall 2000 all higher technical schools can individually set up computer workshops.
- The knowledge acquired at schools will be made widely available for adult training. For this purpose educational consultants in ICT will be trained.

Background and general trends

The efforts put in for expanding IT-related offers in the educational sector primarily aim at providing the labour market with an increasing number of qualified graduates. In this initiative, the European Computer Driving Licence represents a general competence, while the mentioned company certificates demonstrate a more specific competence. However, only relevant polytechnic and university courses and training at higher technical schools can guarantee a solid subject training.

The Austrian Institute of Economic Research (WIFO) recently presented a study on the labour and qualifications requirements in the telecom and media sectors. (Leo 2000) The survey covered companies operating in the telephony (fixed and mobile networks), data services (ISP, ASP, content), cable TV and broadcasting, software, multimedia and telecom hardware sectors. The study finds that 58.300 people have been employed in these sectors in Austria in 1999, which is 1.6% of the total work force.

Based on interviews with business representatives which included questions about future demand for employment in their companies, WIFO forecasts that the number of employees will increase to 69.020 people in 2003. About 44.000 jobs out of these 69.000 will be located in Vienna. The highest increase in demand for IT professionals is expected to occur in the following sectors: network infrastructure, IT, software development.

Employment in the Austrian telecommunications and media sectors

Sector	Employees 1999	Employees 2003	change	change (%)
Telephony	23,000	26,450	+ 3.450	+ 15
Data services	3,500	6,650	+ 3.150	+ 90
TV / Radio	4,600	5,060	+ 460	+ 10
Software	12,200	15,860	+ 3.660	+ 30
Hardware	15,000	15,000	0	0
TOTAL	**58,300**	**69,020**	**+ 10.720**	+ 18

Source: WIFO (Leo, 2000)

A study by Arthur D. Little on behalf of the Austrian Federal Ministry of Economic Affairs (1999) focused on employment developments in the telecommunication market. The study finds

that the number of employees in the Austrian telecom industry has increased from 36,000 in 1997 to 42,000 in 1999. Growth is expected to continue over the next few years. Mobile operators and new competitors in the fixed sector are the main 'engine' for new jobs in the telecom markets. Employment at internet service providers is showing high growth rates, but has still little impact on the overall statistics in absolute figures. The study also points at the lack of qualified staff available. It does not provide figures how many of the jobs cannot be filled, but reports that only every tenth applicant satisfies the industry's requirements.

Evaluating ICT-related projects in schools

Public authorities and private sponsors would like to point to a substantial investment in technology and to a parallel improvement in "efficiency of learning". But, most evaluations of ICT-related projects in schools do not tell what really happens in the classroom. Much of the published work concerning the use of PC's and the internet are anecdotal descriptions. Conclusions often are that it was hard work, but much fun, and anyway worth the effort.

Yet, empirical findings about the problems teachers and students have when they use ICTs and new media *in the classroom* are very important. After all, we want to know what can be expected from all the investments in infrastructure, content development and teacher education described above.

During the last few years we have gathered at *Salzburg Research* some experience concerning the evaluation of ICT projects in schools. We have conducted the research project "Networked education" (1996-1999) and have supported the European Commission (1998) and the Austrian Federal Ministry of Education, Science and Culture (1998-2000) in the Europe-wide as well as national Netd@ys initiative.

In the NetEducation project, six Austrian secondary school classes and their teachers were equipped with notebooks and modems and given access to the Internet. Central research questions were: What were the effects on the classroom situation, how did ICT change the roles of teachers and pupils, and what was the impact on teaching and learning processes? (Bruck/Geser 2000; for a description of the projects and some of the results see: <http://www.newmedia.at/projects/vb>).

Two standardised questionnaire surveys, one before and one after the introduction of notebooks, have been conducted to find out if and how ICTs have been implemented into the curriculum. In focus group interviews, teachers and pupils were asked to comment on their experience in order to determine factors which might inhibit, hamper or encourage the use of ICTs.

Focus on learning effects not "efficiency of learning"

From the evaluation of the notebook project we have learned that an increase of "efficiency of learning" is difficult to measure, and results do not tell an interesting story. The focus group interviews made clear that relatively little could be achieved in terms of *efficiency* of learning (exceptions being computer and business related subjects).

What really is important are related *learning effects* - as for example:

- technical & social problem solving takes place when ICT is integrated in the classroom;

- students train others by taking part in project management and teamwork;
- changes in the roles of teachers and pupils occur, leading to forms of e.g. co-teaching between teachers and student peer to peer teaching;
- new social contacts and learning fields emerge when projects include businesses or cultural institutions (extra-mural learning contacts).

Implementation of ICTs in schools – crucial points

On the basis of this empirical evaluation, there are some important points in the implementation process which should be paid attention to:

- ICT-projects in schools need a systematic project management both for technical as well as didactical issues – teachers are often not in the position to do this on their own;
- the classroom-structure of schools and the traditional time table is a difficult working environment for the implementation of ICT – schools need to go through a complex process of innovation;
- in the first stage of ICT-implementation in school classes students (and some of the inexperienced teachers) are more concerned with learning *how* to use the technologies, rather than learning *with* the technologies – lower expectations in terms of subjects and time are needed;
- special attention should be given to the "gender-gap" in the usage of ICT – boys dominate girls as long as hardware/software issues dominate.

The disillusioning truths

The implementation of ICTs in schools is surrounded with many positive visions of how technology could change and improve the teaching and learning process. Often reality proofs different. At times, the encouraging results from well-financed projects can be misleading due to the inability of scaling up the pilot projects to broad usage while maintaining quality.

One can present a more realistic picture of ICT implementation in schools. Some facets of this picture include:

- *Technology impacts budgets:* The follow up costs in schools are spiralling. Normally, only 20 percent of the total cost of ownership (TCO) are due to the initial investment in technology, the follow up costs make up 80 percent, and are rarely budgeted for.
- *Technology impacts teachers:* The good message is that the TCO of schools is much lower than the TCO of businesses. But, the bill is often paid for by a burn out of computer science teachers serving as system administrators – and little is being planned to counteract this.
- *Technology impacts pedagogy:* The technical environment of networked PC's is not very favourable to learning processes: boot time is to long, if 1, 2, 3 PC's crash the entire class stops. Most of the Internet tools available are not robust and simple enough for use in average classrooms, or translatable to the classroom setting. Furthermore, when exchanges between teachers and students outside school are concerned, typical Internet

chat or bulletin board systems do not organise conversations well for learning – alternative architectures are not being implemented.

- *Technology impacts content:* Applications are too restricted, usually not integrated with services, and contents seldom are personable – content often comes last.

Final remarks: changing the "mind-set" of schools and teachers

As the survey in this paper illustrates there are several initiatives in full swing in Austria which aim at implementing e-learning in schools on a broad basis. The ICT-qualification of school staff is among the long-term critical points.

The real problem in the process of „going online" seems not to be connecting schools to the Internet, but connecting the "mind-set" of schools and teachers to the Internet. It is clear that many positive learning effects for both teachers and students can be expected, if ICTs are well-integrated in the classroom. However, what is necessary is a radical change in the perspectives on ICT implementation and usage.

What clearly is not true, is the frequently forwarded assumption that the introduction of "learning technology" in schools can serve as a means and motor for change. In practice, such notions often lead to short-sighted ICT-projects. What is true, is that the implementation of technology can have a severe impact on school budgets, for example.

Instead of incessantly stressing the omnipotent power of technology, a new culture of teaching and learning has to be developed making use of ICT where appropriate. But, in order to develop such a culture the social institution school has to go through a complex process of innovation, with radical changes of curricula, classroom-structures and the traditional time table to allow new project-oriented forms of learning.

Furthermore, rather than making computer literacy the focal point, social learning skills have to become an important part of the discussion regarding ICTs in schools. Students have shown the quick acquisition of computer skills. However, group project learning for instance requires much time and practice. What we need therefore is a renaissance of the teacher, a teacher who is fit for working in a networked learning environment and ready to be "the guide on the side instead of the sage on the stage".

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