Die Stiftung für liberale Politik

Friedrich-Naumann-Stiftung

Liberales Institut

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Peter A. Henning

The Impact of Decentralized Knowledge on Education

Occasional Paper 14

Imprint:

Published by
The Liberal Institute of the
Friedrich Naumann Foundation
Truman House
Karl-Marx-Straße 2
D–14482 Potsdam

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www.libinst.de

Production
COMDOK GmbH
Office Berlin
Reinhardtstraße 16
D–10117 Berlin

Printed by
ESM Satz und Grafik GmbH
Wilhelminenhofstraße 83-85
D–12459 Berlin

First Edition 2006

The Impact of Decentralized Knowledge on Education

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Paper presented at the conference
"Liberal Education – International Perspectives" organised
by the Liberal Institute of the Friedrich-Naumann-Stiftung,
Potsdam 2-4. September 2005.

Introduction

„Decentralized Knowledge" is an expression we associate with modern times, with globalization and other buzzwords used by the avid the scholar of the New Economy. Generally this expression is used to signalize that in some sense we are in a different informational situation today, which probably requires some organizational or political adjustment.

However, such a usage of the expression „Decentralized Knowledge" clouds historical reality and therefore obscures a clear definition and understanding of what has really changed and - more important - what has to change in the future. It is the purpose of this article to remove some of the clouds and shrouds, to draw strictly factual conclusions from this and to cast these into new paradigms for the wide field of education.

To begin, we consider Europe in the Middle Ages. In these dark times European civilization was maintained and spread through a loosely connected network of monasteries. Each of them was specialized on certain aspects of scripture - what passed as science in these days. Moreover, they exchanged scholars and thereby ideas, even across the borders of the developing national states. This exchange of human knowledge resources was even more important than the exchange of copied manuscripts, because the traveling monks knew, where certain manuscripts were found, hence - in modern language - provided the *links* in this network of knowledge.

While such an analysis of medieval Europe in terms of modern informational concepts might seem academic, it is important to realize the relevance of the *monastic network* on education: Our current way of teaching through lectures, and of learning by reading and attending lectures has been developed and formed in medieval monastic Europe. Our methods for learning and teaching therefore have been developed in a system where knowledge was strongly decentralized. The concept of „Decentralized Knowledge" therefore is not a new invention.

It might also be worthwile to recall, that our current system of teaching and learning has been much more stable than almost any of the current national states. This implies, that any attempt to modify teaching and learning should be based on very strong arguments that have nothing to do with comparatively short-lived political models.

Is knowledge today more distributed than in the past?

It is estimated, that in 2003 the volume of original, new data produced in the world amounts to 5.7 Exabyte (5.7 x 10^{18} Byte) [1]. Expressed in more human terms: The amount of original data created in 2003 sums up to roughly 500 trillion (5 x 10^{14}) pages, or 100 Million tons of printed paper. Note, that this is roughly equivalent to the world production of printing paper in that year. However, the major part of this information does not go to paper - which is mostly used up by multiple copies of the same content. As may be seen from table 1, the largest chunk of data was stored on hard disks or magnetic tape.

Another way to express this vast amount of data is to relate it to the world population: Per capita of the world, the amount of new and original data in 2003 comprised some 920 Megabytes - which may be roughly seen as the informational content of 1.5 CD's. Imagine each person in the world to produce a new musical album in 2003 !

Table 1: World data production in 2003. Data taken from [1]

Volume	Description
33 Terabyte = 33 x 10^{12} Byte	original printed text, no scanned pages
420 Petabyte = 420 x 10^{15} Byte	original filmed data, including hi-resolution medical imagery
5187 Petabyte = 5.1 x 10^{18} Byte	original data stored on magnetic media, e.g. hard disks and video tapes
102 Terabyte = 102 x 10^{12} Byte	original data stored on optical media, including CD and DVD

As an important figure also note, that the data volume produced in 2003 is roughly four times the data volume produced in 1999. One may therefore state, that in the five years from 1999 to 2003, roughly 17 Exabyte of new and original data have been produced.

As a final figure we might consider the historical data volume produced in the world. In the years from 1988 - 1998 a considerable fraction of the current data production might have occured (roughly 30 % seems a reasonable number given the fourfold increase from 1999 to 2003). However, things looked different before 1990: computer hard disks were about a factor 1000 smaller then and optical media were virtually non-existent.

To estimate the volume of printed data produced in history is quite a tedious task. However, even when one assumes a production of printed data as it is *now*, one would need all of human history to produce an amount of data even reasonably equivalent to the current production. We may therefore state:

In the past 5 years we have produced more data than in the 5000 years before – and this data volume increase is speeding up.

Consequently, the ratio of the amount of knowledge held by an individual person to the overall available knowledge has become vanishingly small. In this sense then, quite differently from the naive idea of spreading a given amount of data over more and more space, modern knowledge indeed appears more distributed than before.

Reading or Browsing?

Even though printed text makes out only a small fraction of this data, it is instructive to break this text part down to categories of text within a single country. As may be seen from table 2, the majority of printed text in the United States of America in the year 2003 consisted of office memos - more than 4 billion (4.3 x 10^{9}) pages were exchanged in a single year. Sadly enough, dreaming of a paperless office seems to be farther off reality than ever ...

Another figure from table 2 needs further consideration. According to the survey quoted, only 0.03 Terabyte (plain text, e.g. not in some text processing format) comprise all the scholarly periodical published in the U.S. in 2003. Note, that many international scientific journals appear in the U.S., hence this number does by no means reflect the intellectual output of this single country.

The bottom line of this is, that 0.03 Terabyte corresponds to a publication of *13.7 million new words per day* in 2003 ! A fast-browsing person may be able to browse (not study) 1000 words per minute. If browsing 8 hours per days, he or she would need more than 30 days to browse the intellectual output of a single day.

Table 2: U.S. printing volume in 2003. Data taken from [1]

Type	Items	Volume
Books	141 901 new books	0.1 Terabyte plain text
Newspapers	10 170 publications	0.3 Terabyte plain text
Mass market and trade Periodicals	16 615 publications	0.07 Terabyte plain text
Scholarly periodicals	10632 publications	0.03 Terabyte plain text
Newsletters	11 581 publications	0.006 Terabyte plain text
Archiveable, original office documents	4.3 billion = 4.3 x 109 pages	11.6 Terabyte = 11.6 x 1012 Byte

However, do people indeed read more today than in 1999? This is highly questionable given the data of table 3, obtained form the World Association of Newspapers [2]. While some countries apparently do not fit into a simple picture (e.g. Spain and Slovakia), this table nevertheless shows a global trend. We find a steady decline in newspaper copies sold throughout the industrialized countries with growing internet usage, whereas industrializing countries exhibit a growth in newspaper reading.

Table 3: Newspaper copies sold per year and relative change over a 5 year period. Data taken from [2], US data referring to 1999 (*), other data referring to 2001

Country	Sales (Million copies)	Relative change 5 years
Canada	1753	+ 2.3 %
Costa Rica	104	+15.3 %
Finland	87	-11.2 %
Germany	7368	-5.6 %
India	10893	+19.8 %
Netherlands	1338	-8.9 %
Slovakia	132	-50.9 %
South Africa	282	-3 %
Spain	1556	+17 %
Turkes	1061	-33.4 %
United States	17485 (*)	-2 %

If reading printed paper is in decline throughout the world, and much more data is produced - how then do people access this data? Of course, the main access pathway nowadays is the internet. It has been growing almost exponentially over more than 30 years, such that currently about 350 million computers are permanently connected to it and roughly 2 billion people more access it regularly. The graphical version of this article (see download information at the end) contains a graph on this development.

Data Heat

It is of course true, that „data", „information" and „knowledge" are distinct concepts. While a more detailed discussion of the actual differences of these concepts is necessary, it has to based on information theory and thus is certainly beyond the scope of the present paper [3]. We will therefore ignore these differences. However, one should keep in mind that certainly most of the data produced is either irrelevant or useless to gain *knowledge* from it.

This situation therefore is analogous to a physical system with ever increasing energy density: The energy may be present in a form useless to further processing, e.g. as heat. In analogy to this physical situation, we will therefore call the data volume increase in the world *Data Heat*.

Research and development are key factors to our modern world. Since, to a large extent, the way research is done affects *education*, we will first look at the influence of Data Heat on research. For a modern researcher (say in physics, mathematics, chemistry or computer science) the time needed to check whether his research is original and new is longer than the time needed for the research itself.

The idea of keeping one's overview, even of a limited field of science, up to date by *reading* scientific journals is therefore woefully inadequate to the current situation, and the relevance of a *library* for scientific work becomes smaller and smaller. This situation has been developing steadily since the 1990's, and it was the field of physics which pioneered a new approach to science: A serious scientist nowadays, before submitting a manuscript to a distinguished refereed journal, submits his manuscript to a so-called preprint server [4]. It is then available worldwide, at no cost save the access to the internet - and may be used for further research even before it has been subject to a review by peers of the scientist.

Any scientist searching for input therefore is subject to another consequence of Data Heat, the so called „Information Overload" [5,6]: The inability to extract needed knowledge from a quantity of data containing this information.

Data Heat and Liberalism

As was stated above, our culture of learning and teaching was developed in the Middle Ages - and it has not changed very much since then. Traditional educational models are tailored to transfer knowledge from a single person to his or her audience - and are not adequate to the information volume and flow of today. This creates a severe educational problem of the information society:

A person can only be considered an educated, well-informed and responsible member of society, if he or she has access to and a reasonable overview of a sizeable part of the information this society is based upon.

It is a basic principle of a *liberal* society, that its citizens are educated and well-informed. Consequently, a *Liberal Information Society* requires non-traditional educational models. Its citizens must be enabled to learn faster, better and more flexible than with traditional models. This flexibility encompasses four different skills to be mastered by citizens:

1. **Learning to learn:** Knowledge mining is a key skill which must be taught to any individual. Schools and universities therefore need to be less considered with factual knowledge, but more with methods for knowledge mining.
2. **Learning on demand:** Citizens must be able to learn small chunks of knowledge in short time when needed.
3. **Unlearning:** Obsolete knowledge must be purged from minds in short time - and also from curricula, which might be the more difficult task.
4. **Never ending education:** School and university may not be considered a final education. In the future we might be forced to learn two or more different professions throughout life.

Since we have argued, that these skills are necessary (yet perhaps not sufficient) for a Liberal Information Society, we may reuse a phrase originally due to the futurologist Alvin Toffler [7] in a slightly modified form:

The *illiberal* of the 21st century will not be those who cannot read or write, but those who cannot learn, unlearn and relearn.

In fact, we may consider this as a programmatic definition of liberal education: Non-liberal models of society do not require well-informed and responsible citizens, hence can go along with traditional learning methods indefinitely.

eLearning as possible solution

Requesting new methods of faster and better learning remains sterile as long as it is not matched by concrete ideas on how this may be achieved. According to the state of the art in educational studies, a solution may be the media based teaching and learning that is generally summarized under the conncept of eLearning: Teacher and learner are, to an extent that may vary, supported by computerized media and automated learning environments.

One of the sources for this claim comes from the corporate regime. A recent study about the usage of eLearning for employees in the corporate „SAP University" claims, that electronic teaching and learning allows for time savings of 25 - 35 % as compared to traditional learning methods, while financial savings of 30 - 40 % as compared to traditional teaching occur [8].

While these are very impressive numbers, they are not a priori relevant for education outside the corporate regime. Here, the quality of learning plays a dominant role. Unfortunately, there are very few scientifically sound studies on the quality of learning achieved by electronic media support - and even less, when schools and universities are concerned.

We therefore again look into the corporate sector: At the Robert Bosch GmbH, employees had to be trained for the usage of a new personnel management system introduced since 2002. The learners could choose between traditional training seminars and Web-based training (WBT). Questioned for their experience, the employees that took the traditional courses felt better prepared for the usage of the new system than the self-learners. However, a more or less objective test with the system showed an error rate of 61% among the traditional learners as compared to 24% among the self-learners [9].

On must exercise great caution to transfer these results into a different setting. First, the method for selecting the two learner groups is not based on random selection. Consequently, those who took the WBT may have been the better qualified persons with higher computer literacy. Second, the objective of the course was „training" of semi-manual skills - and not „education". However, the internal data of various international companies suggests, that these German results are indeed representative [10]. It is therefore safe to draw the following conclusion [11]:

In the corporate environment, eLearning allows to learn faster, cheaper and better than with traditional methods.

Lessons learned

Looking at the non-corporate environment, data is accumulating - with mixed results. In recent years Germany has invested several billion Euro to incorporate electronic media based teaching and learning into schools and universities [12]. Most of the investments went into hardware acquisition and skill development of teaching personnel, whereas the resulting structural changes are marginal considering the effort.

One of the few exceptions to this somewhat depressing result is the Virtual University of Bavaria - Virtuelle Hochschule Bayern vhb [13]. The vhb is indeed not a university, it is a joint project for all Bavarian universities. Any student of a traditional Bavarian university may enroll at the vhb, take certain eLearning courses there and transfer these credits to his home institution. So far, the enrollment at the vhb has been doubling every year, with roughly 20 000 enrollments in the academic year 2005/06 and even better predictions (see Figure 1). The courses are produced by members of the carrier universities, in general therefore by professors at a Bavarian university.

For the present paper, we will restrict the discussion of the vhb to an abstract view on success factors and the „market" for eLearning in the educational system and combine them with results from other experiments on eLearning, like ViKar - Virtueller Hochschulverbund Karlsruhe [14].

- One key factor to the success of eLearning in universities is a customer-oriented quality control system. All courses of the vhb are evaluated by a national evaluation committee, one of the main factors is the enrollment to the course. On this basis, courses have been discontinued or marked for rewriting. A second, international evaluation committee has evaluated the overall strategy and future of the vhb. The author of the present article is a member of both committees and is therefore familiar with the interlocking and complementary nature of these quality control measures.
- In high demand among the students are
  1. Courses with highly specialized content that is not taught at every university in Bavaria. Example: An excellent eLearning course on ophtalmology.
  2. Courses which cover key skills, such as basic internet literacy courses.
- As course material, students do not accept video clips taken in ordinary lectures. While audio files receive moderate acceptance, students generally request printable material, like transparencies and copies from electronic white- or blackboards.
- In high demand among students are virtual experiments, if offering a high degree of interactivity.
- In high demand among students are virtual seminars, if offering innovative methods of work.

It must be stated, that almost none of these eLearning courses is a purely computer based course - almost all of them have a high degree of tutorial training, hence fall under the label of *blended learning*.

Given these results, one may formulate the following conclusions [14]:

While eLearning is not suited to replace traditional learning and teaching in schools and universities, it may *supplement* these for highly specialized knowledge and for broad key skills. In these fields, one may indeed learn much faster and better than using traditional methods.

The successful integration of electronic media into teaching and learning at universities requires a 200 – 700 % higher effort in course production, a higher effort in tutorial guidance and does certainly not allow for saving money.

Indeed it has been estimated, that the introduction of computers into teaching at school might increase the cost of the school system by as much as 20 % [15]. One should, however, keep two things in mind:

1. Using traditional methods in teaching and learning to keep up with the Data Heat would be even more expensive - who would pay for 15 years of school visit, followed by 10 years of academic studies ?
2. The only alternative would be to drop requirements of educated, well-informed citizens.

Transformations

Having seen the effect of eLearning in the corporate and educational environment, we may conclude that eLearning indeed poses a solution to the educational problem of a Liberal Information Society. Two more aspects may be considered in favor of this conclusion. First, if a future citizen indeed acquires at least a sizeable part of his or her skills through eLearning, courses must exist on many subjects. The availability of knowledge within the data volume accessible by a person therefore is a prerequisite to *learning on demand and never ending education*.

Second, a prerequisite to *learning to learn* and *unlearning* is the availability of meta-knowledge. A person accessing eLearning courses needs tutoring and guidance, hence teachers with special skills. Consequently, the four key skills mentioned above require to change the roles of students, teachers and learning institutions:

- The role of a learner must change
  - from *learner attached to a single institution*
  - to *knowledge miner* in a worldwide network.

Learners must therefore maintain skills of media usage and media evaluation.

- The role of a teacher must change
  - from *carrier of knowledge*
  - to *carrier of information accessment methods and moderator of knowledge*.

Teachers must therefore maintain skills of media usage and media production.

- The role of institutions must change
  - from *keeper of knowledge*
  - to *provider of knowledge* to the network

Institutions must therefore maintain skills of media production and media evaluation.

These necessary reforms of our educational roles may be visualized in a triangle of the three skills of media competence - production, usage, evaluation, see Figure 2.

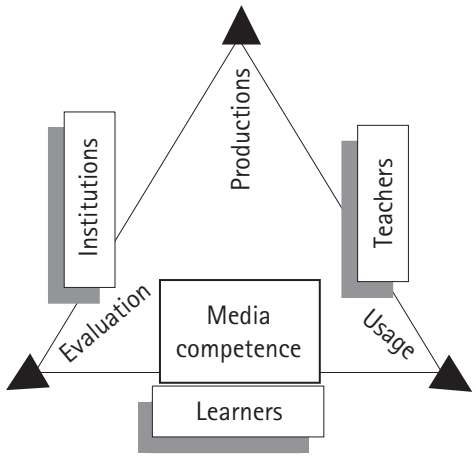

Figure 2: Skill triangle of media competence - production, usage, evaluation. Also given are the desired competence combinations for teachers, learners and institutions.

It remains to consider the current state of our educational system with respect to these goals. As a matter of fact, the role of a learner in Germany has indeed undergone dramatic changes and therefore the transformation above may be considered quite complete. Indeed, a recent study finds some 8 Million school pupils in Germany learning via internet [12]- and we are not far from having a computer in every classroom. Hence, skills of media usage are present among learners. Correlating the course quality and enrollment numbers in the Virtual University of Bavaria vhb one also sees, that evaluation skills are quite common - although they might be so on a subconscious level.

However, the other two players in this game present a rather bleak state: German teachers and institutions - and other studies indicate, that this is not a national problem - are far from having finished their role transformation towards a future educational system.

- While most modern teachers, through *learning by doing*, have acquired moderately sufficient media usage skills, their media production skills are usually stuck at the level of linear text production. Since their supervising bodies generally expect them to produce teaching media at no extra cost and with no recognition in case of success, teachers currently are not motivated to improve their skills. This is the main factor disabling current teachers from fulfilling their anticipated role as *moderator of knowledge*.
- Institutions are at least in the process of acquiring reasonable evaluation skills. Partly this has been brought forth by the Bologna process and its national interpretation, but also by the rather weak performance of German students in international educational rankings like PISA. One might say, that currently German educational institutions are in a testing and evaluation frenzy. On the other hand, they suffer from the same problem as teachers: Educational institutions are in bad shape when it comes to media production. Partly this is due to the fact, that - with some exceptions - universities do not have the personnel to produce electronic media for learning and teaching. This is the main factor disabling current institutions from acting as a *knowledge provider*.

Obviously, these two limitations are strongly connected. This situation allows for an easy reform and should receive high priority for a reform.

Accessability and its impact on education

The information provided through computers and the internet, apart from its sheer volume, also exhibits a qualitative difference when compared to the situation a few

decades ago: Much of this data is available outside the scholarly circles. The concept of preprint servers in science mentioned above [4] serves as a good example.

Consequently, *given the necessary skills*, any individual may obtain a reasonable overview on any desired subject even from today's network. The current informational reality therefore - for the first time in history - allows to educate any person such that he or she is subject to informational self determination and intellectual freedom.

However, such a high degree of accessability also has certain drawbacks. Consider, for example the financial markets which do heavily rely even on untested information: One must be aware, that a high degree of accessability inserts a dangerously destablizing factor into the world economy. This phenomenon was termed *hyper information efficiency* [15] Another drawback is, that the accessability of every kind of information also includes information that might be bodily harmful.

Whereas pornography, violence and political radicalism are remote threats on that scale, there is also data that in an age of fear from terrorist attacks is more obviously a danger. As an example, consider building instruction for potent bombs - actually found in protocols from U.S. senate hearings on the bombing of Oklahoma City and freely accessable via internet. However, as has been argued elsewhere in considering these different kinds of data perceived as harmful [16]:

Neither technical nor legal measures may give a complete protection from unwanted information. It is therefore the goal of a Liberal Information Society, that its citizens are able to evaluate any given information with respect to its

- **relevance and implications,**
- **correctness and factual basis and**
- **ethical value.**

Education for a Liberal Information Society therefore aims to develop these skills in individuals. As may be seen in the recent world wide media hype on terrorist attacks, such skills are the only safeguard against manipulation and misuse [17].

It is also clear, that this media competence education must start as early as possible - already in pre-school age. Such a training should then begin with television, because it is currently the first mass medium experienced by children - and with consequences far from harmless. One may safely estimate, that at the age of six an average child has seen several hundered of violent acts and unnatural deaths, even if it has been watching „childrens' programmes" only.

Our current educational system is not concerned with such aspects of media competence, instead the transmission of these skills to children is generally left to the parents. While this may be preferable from a puristic liberal viewpoint, it also denotes a principal weakness of a Liberal Information Society: Freedom and responsibility are clearly endangered, if such media competence is not present in children. It is therefore, even for a liberal society, a genuine task for a public educational system to provide these skills.

A concrete model may be suggested for such a change:

1. **Introduction of a course in „Media Competence", starting with television watching in pre-school, running through reading and writing in early school years and aiming at network literacy towards later years in school.**
2. **Teaching of language skills separately from reading and writing skills.**
3. **Teaching technological skills, if selected, separately of computer and network literacy.**

Classroom computers and Digital Divide

Let us revisit the transformation that learning has undergone at the client side. Recent studies [18] indicate, that students attending German high schools (Gymnasium) are, in later years, 94 % computer literate - whereass only 60 % of students attending the low level school (Hauptschule). This appears to be strongly correlated with family income and socio-economical status.

A consequence at the „high end" is the fact, that a large part of the students when entering a university own a stationary computer with internet access: According to a survey at the Karlsruhe University of Applied Sciences - Hochschule Karlsruhe, this is true for 81.5 % of the freshmen students (with minimum coverage of 45 % in one non-technical faculty) [19]. Similar results have been obtained in the ETH Zurich [20].

Surprisingly, it appears that also a lot of students own *notebook computers*. The quoted survey finds, that 71.6 % of the freshman students either own a notebook, or intend to buy one. This opens the possibility to establish a *notebook university*, where students have access to network an knowledge resources independent of classrooms and time - and running their own computer to do so. The university could then stop to buy general purpose computer pools that need to be replaced after a few years. Even for small universities (like e.g. Karlsruhe University of Ap-

plied Sciences with some 6000 students) this would lead to huge savings of some 120 000 per year [19]. For larger universities, the anticipated and measured(!) savings are really immense [21] - even when some more administrative effort from the computing center of the university is required.

It may be estimated, that the independence of space and time that is gained in this notebook university will contribute to the goals defined above, i.e., it will enable students to learn better and faster than in a traditional setting.

One may now extend this to earlier years and have a look at the school system. A big obstacle to using notebooks already at school is that German pupils of public schools enjoy the principle of „Lehrmittelfreiheit". This means, that the school or its carrier have to provide books and technology to students without any cost.

This may be reasonable for math books, because math taught at school does not change very frequently. However, when it comes to accessing the internet as part of the curriculum, or taking part in innovative working methods, this „Lehrmittelfreiheit" clearly becomes ridiculous. The rapidly evolving computer technology (where, according to the state of the physical knowledge, no limits to the development are known [22]) requires schools or their carriers even now to invest large sums of money *every few years* to keep up with technology.

„Lehrmittelfreiheit" of information technology is not adequate for an educational system that needs to incorporate new and innovative methods for learning and teaching. It would be appropriate, if every student owns a notebook computer – but this cannot be subject to public financing.

Such a statement is of course politically incorrect and might find enormous objections. However, in contrast to what one would expect, preliminary responses from parents of high school pupils have been quite positive.

It remains to consider the lower end of the computer literacy scale. The low computer literacy in the low-level „Hauptschule" may be interpreted in two ways. First it indicates, that probably a large part of our population will remain computer illiterates. It may expected, that up to about 1/3 of the population is affected by this structural illiteracy, which forms a national „Digital Divide".

However, an information society can hardly afford to lose these people - and a Liberal Information Society does not want to lose them. Simultaneously we cannot afford to slow down progress and development - a seemingly dead end. Only one conclusion is possible: An information society cares for its illiterates, by providing facilities for life-long learning („Never ending education") and by guiding its citizens to information access. This amounts to a re-definition of the role librarians play. The second conclusion is even more pronounced:

The low computer literacy in the „Hauptschule" shows, that this type of low-end school is inadequate to transmit education for an information society.

Information density and Globalization

A 1999 study reveals an average distance of 19 mouse clicks between two arbitrary web pages [23]. More recent results show a highly nontrivial structure behind this average: While a large amount of the data on the network ist densely packed and easily accessible, large groups of web pages (> 100 Million pages) exist, that have almost no connection to the main body. The information in the world is therefore still compartementalized, and the network is partitioned.

Part of this partitioning of course has been done for security reasons - but partly it is also due to access restrictions that do not have any sound justification. This then amounts to *censorship*. While a classical example for this is the People's Republic of China, which blocks a free access to the network for its citizens, one may also have a closer look at our national environment. The attempt of a *local* government agency in the region of Düsseldorf to block access of citizens to certain Nazi web pages hosted elsewhere in the world indicates, that ideas of censorship still float around also in democratic societies [24]. Clearly, such attempts are incompatible with the informational self-determination and intellectual freedom we demand for a Liberal Information Society. To summarize the results of a corresponding seminar of the Friedrich Naumann Foundation [25]:

In a Liberal Information Society there is no censorship. Any accessible information may be accessed and is open to discussion. Any information may be taught, *provided it does not violate the civil rights of other persons*. The *freedom of access to information* is one of the future civil rights – and it is intimately connected to the *freedom to protect information*.

Clearly these are visions for a future. While the worldwide network is acessible in principle, one may experience severe difficulties to get this access outside the industrialized countries. The state of realization of an „information society" is very different throughout the world. Africa in particular is in very bad shape concerning its informational resources. This international form of the „Digital Divide" is well known and subject to many studies. For the purpose of the present paper, one aspect is of special importance.

The fact, that we are experiencing the Data Heat, are about to adopt new methods of learning and teaching faster and faster and have at least partly realized a transnational informational society, decouples us from Africa even more than before. While our own development is speeding up, Africa is slowing down due to the AIDS pandemy - and the gap that we had been trying to close by financial aid widens again. Every single year of delay in bringing Africa into the informational network may destroy more, than 10 years of traditional aid could have built.

Our own educational development - desirable in itself and clearly without alternative - therefore occurs as a negative influence on others. While this may be considered a burden that has to be carried, it also indicates a field where we have to work:

Informational resources, internet access and participation in the global Data Heat may be key factors for development, even the basis for economic development – and not its result [16].

Closing the loop

In the present paper we have come a long way: Showing that the subjective feeling of „Distributed Knowledge" is indeed a symptom of the Data Heat, we have the derived conclusions for our educational systems. Some of these conclusions are high-level statements of political and sociological theory - like e.g. the demand to transmit media competence in education. Some are concrete and low-level action prescriptions - „Handlungsanweisungen", like the demand to enable teachers and universities to production skills.

It is interesting to see, that the same demands towards education for an information society are made by the OECD: „People are facing growing pressures to go on developing skills and knowledge over their working life-time as job mobility increases and job tasks become more complex, and governments in many countries need to do more to foster education and training at all stages of people's lives..."[26].

We will close the loop of this paper by clearly summarizing the conclusions drawn above:

Education for the 21st century means to provide access to and free usage of electronic learning resources at any time, any place and not ending with any age.

And finally, by summarizing the findings on a Liberal Information Society:

If one ever creates an Information Society, it will necessarily be a Liberal Information Society. If one ever wants to educate people for an Information Society, it will be using the paradigms outlined in the present paper.

As a personal remark at the end I would like express my belief, that exactly at this point we may find the future role of Liberalism.

Resources

Download of the graphical version of this paper and some of the quoted talks from http://medialab-karlsruhe.de/persons/phenning/start/startlect.html.

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