8th Conference of European Women in Mathematics, Loccum, August 30, September 5, 1999.

# Challenges for an Ideal University

Britta Schinzel

**Introduction:**

What do we need at universities both in short future and in the long run? The challenges of the short future might e.g. be reacting to the new needs of the job market, or to the actual financial situation of universities or to the new possibilities supplied by the new digital media. But university also must be ready for solving the long term future needs of preserving our world, of nature and environment as well as of mankind in a reasonable sense. The co-operation of all disciplines is necessary to help not only by scientific and technical means, but also by enabling the political, social and cultural needs to put through necessary changes. The challenge is to set up new measures and grounds and to develop theories, strategies, knowledge and aids for a new civilisation being capable of dealing with all these problems. There have been considerable changes in society, and in the integration of the whole world, shortly called globalisation. National governance looses its power in favour of European or global regulations.
As is well known the specialisation and particularisation of the sciences and even within the sciences is such that understanding between the disciplines is hardly possible, therefore even less scientific co-operation. Therefore the challenges of a new universitas should not only lie in the further development of sciences for their own sake, but also in a turn of the objectives of sciences away from the partition from life to a dedication to developments which imply the reduction of civilisation´s costs. Undoubtedly every civilisation is bound to change, and also to scientific and technological change. But differently from before the finiteness of the world, the circulation of materials, pollution, ozonhole, the global effects of synchronous local actions come into our sight. All potentials and efforts have to be used to care for future social developments without damage for the environment. Women and minorities have to be integrated more than before into the design of such changes in order to use all possible potential of qualifications, ideas and knowledge.

For meeting all these challenges one has to reflect the role of university:

- Is the integration of science and teaching still an apt model?
- Should the university education also qualify for the job market, or only for the reproduction of science?
- Should the university open itself for other courses of education, like adult teaching or continuation of qualification
- Is the Humboldt model of a genius scientist working in loneliness and freedom on self defined problems gaining objective results still a realistic one?
- Is it still adequate to leave sciences to their isolated developments, to follow intrinsic, i.e. self defined goals and subjects or should they be (or are they already) opened to influences of whatever type, e.g. by interchange with other sciences, by a kind of educational market, by political goals and there again, by which influences, for e.g. by directing money flows?

- What is “objective” science? Does it exist and can it exist, especially for interdisciplinary research? And if not, by what can or should it be replaced? E.g. : eproducibility of results? Postmodern coexistence of everything? Discourse?

Of course also the university structures have to be adapted to the new future roles and needs, including such structures enabling the integration of women and minorities.

## I. **Historical remarks**

Science of the middle ages in Europe science was above all theology with all other sciences contributing to it. Arts and crafts on the other side were the profane skills. Mathematics contributed to both science and profane skills. Science was universalistic in the sense that all subjects could be combined to a consistent architecture and all contradictions were ruled out by theological governing and dogmatic. It was also universalistic in the other sense that it was possible for skilled scientists to have an overview of the whole building of science. The monasteries held large libraries where the current scientific knowledge was kept and to some extent also distributed. Also the role of encyclopaedias, like the “speculum maius” by Vinznz of Beauvais in the 13$^{th}$ century, or one by Diderot and d´Alembert established in the mid of the 18$^{th}$ century for universal access to knowledge, universalsising this knowledge cannot be underrated.

The term and the institution university was created first in Italy during the 11$^{th}$ century. The first university of the world was the university of Salerno (1050) followed by a series of nearly 30 other universities throughout Italy: Bologna (1119), Ferrara, Siena, and others, then also Paris (1150)and later Prague (1348) as the first also German speaking university, Vienna (1365), Heidelberg (1386) and Cologne (1388). The (male) students then were the creators of these democratic universities: they paid their teaching personnel in e.g. civil right and health care, and they could dismiss them or enforce the subjects.

Renaissance brought a new definition of science: the rationalistic science, which was coupled with technological usage from the beginning. The Royal Society in London with Fracis Bacon as an outstanding contributor and the Academie Francaise in Paris with Reneè Descartes on the French side implemented this new science, now explicitly defined as male in opposition to a new notion of femaleness, which was identified with nature, feelings and a sexuality worth being feared. The consequences of this orientation have been widely discussed in women´s and gender studies (see e.g. Fox Keller). In Germany the founding of the university of Halle (1694) and of Göttingen (1734) represented the inclusion of sciences and the new rationalistic methods.

The 19$^{th}$ century again brought up new cultures of science and humanities, to be connoted with the foundations of the universities of Berlin, Breslau and Bonn and with the names of e.g. Virchow, Helmholtz or Linneè on the science side, and in contrast on the side of the humanities with e.g. Mommsen and Weber, showing a polarisation between disciplinary orientation. This divergence is exemplary with the scientific directions of the brothers Alexander and Wilhelm von Humboldt. Wilhelm put through the leading ideals for the culture of university in Germany. The so called Humboldt Universität still forms the current university: the duty to search for “the truth” for both science and humanities, the union of research and teaching, the serving of research only for its own sake, for nothing and nobody else, emancipated from feudal rules: research “in loneliness and freedom”. Of course life, body, subjectivity were eliminated when the scientist followed his objective epistemology (Janshen).

Alexander on the other hand favoured a scientific restoration for the sake of a progressive civilisation, and also he was successful, especially in economic respect. He wanted to implement the ecòle polytechnìque, founded by Napoleon in Paris, also in Germany. In the late 19th century this project finally was successful. The new foundations of technical universities were "cultureless" and had to fight for reputation for a long time. But the engineers gained resources and stood for the industrial civilisation, also apart from military engineering. Like for the Humboldt university the engineering culture was separated from body and life, but it took a turn to reality with the orientation to technical processes. Engineering moreover became a habitual model for male identity.

Today all these separations seem not to be adequate any more, nor it seems to be loneliness and absolute freedom of research. Technical education is more and more integrated with science and humanities and technical research has won the same validity as the one of the classical sciences. This integration is of urgent need, because social processes should no longer follow the quick changes of technological ones, but conversely. But the problems to integrate communicative, social and language qualifications into engineering education still show the strong cultural characteristic features of technology.

## II. Long term challenges

The major challenge of society and therefore also of sciences is to cope with the problems of the future: ecology, migration, globalisation, balance between rich and poor, women and men, minorities and majorities etc. For these aims all resources, powers and technological possibilities have to be used, because the challenge is nothing less than building a new civilisation capable to accept and solve these problems.
Special emphasis lies on research to find in every respect reliable solutions. Such solutions will not only include parts from natural science and technology, but also all the other sciences to cope with the meshed economic, social, juridical and cultural aspects of the problems and also of their possible solutions. This requires all disciplines to co-operate on scientific themes, which stem from the demands of building such a new civilisation. It is urgent now that the different disciplines not only follow their disciplinary goals and questions – this of course as well. But they also have to pursue research themes with external goals, goals which subordinate disciplinary development under research questions contributing to solutions for the urgent needs of the present society and ecology. Of course this does not mean that basic research within disciplines should be abandoned, nor does it mean that a basic training in the different disciplines can be abandoned. On the contrary, disciplinary training must be very good to be able to work in interdisciplinary contexts.

With the current faculty structures of today's university such a co-operation is hardly possible. The disciplinary ideals, goals, ethics, languages and cultures withstand heavily the necessary integrating features. But it is urgent need to lead the university away from the strong partition into subjects and sub-subjects, where crossing the border is hardly possible, to a new universitas, where an understanding and working together is possible without leaving ones disciplinary grounds and competence. Universality today cannot consist in integrating all scientific knowledge of the world in single minds, it can only be brought into life by co-operation between researchers from different subjects. This implies the willingness and possibility to subordinate under a common scientific aim.

New competence to work in trans-, multi and interdisciplinary way on the subjects mentioned must be developed. This requires to be able to speak a common language between scientists or at least to understand other scientific languages and to moderate between them. The universal language of mathematics is not capable of serving for this co-operation. Of course it is good for those parts which are able to be formalised and quantifiable, but this is the minor amount. For the whole range of meaning of life the language of mathematics is not apt to serve for such a co-operation. This has a lot of reasons: the necessitiy of prior rational reconstruction of reality, which would imply that all secrets of the world would have been recognised before formalisation; the integration of the different mathematical models for single parts of reality is mostly not possible, etc. Gödel´s results hint on such problems as well.

Challenge 5: Lifelong learning, flexibility and the adaptation to a global work market. But also capabilities to communicate, to value, to gain an inner stability through the dynamics of change. What is the role of the new technologies there?

Challenge 6: What do we need at universities in short future and in the long run?
The new technologies? Is it necessary for every course of study to have ubiquitous MBONE-access, to use authoring systems, to have network-and multimedia I/O, -hardware and -support for every student?

Challenge 7: The new technologies provide a chance to develop university didactics.

Challenge 8: The new order of knowledge: globalised universal knowledge?

Challenge 9: Possibilities for universalism today

Challenge 10: not to make the mistakes of socialism/communism: best goals, leave the pluralism and diversity by self restriction on these goals, not by a government, not by the rector of the university, by no power, but in making dicourse.

Challenge 11: getting rid of objectivism, uniqueness, not using the universal language of mathematics, because it is stratifying, not open to interpretation and discourse and moving targets. How do you say I in mathematical language?, why don't we speak to the aborigines in the universal mathematical language?

## III. Short term challenges
## IV. The Technical University of Women in Europe

Specialities of Mathematics:
In mathematical culture the university education is oriented to the reproduction of mathematical scientists mathematics and for those who go out of university to leave the adaptation to the job market to the individual.
There are quite some dangers with such a position. To withdraw from the power play and leave this to economists, sociologists etc. i.e. to people who scientifically are educated to treat this power play.

Mathematical narcissism is sympathetic, but dangerous:
- geniuses working in complete isolation and freedom, on themes selected in freedom, not participating in politics of whatever direction,

- not knowing what is important, i.e. the relativity of ones owns works importance.

As for mathematicians I plea for more a consideration of life, no withdrawing from social discourse, but being capable of discourse, by the way also to put through the (ethical) values of mathematicians.

Of course there must be enough, and this means - a lot more as it is now in usual university occupation with the drowning in organisation - room for contemplation, alone and in solitude to nurture ideas and creativity, but not only. There must also be enough time for discourse, innerdisciplinary as well as multidisciplinary one, both embedded in a “culture of quarrelling”.
Universal mathematical language, freedom, solitude for nurturing ideas, reproducibility of results, but reflecting ones own doing and importance and capability to participate in icourse, keep plurality of meanings and positions.

**TUFE**
The challenge of a new universitas should not lie in the further development of sciences for their own sake, but in a turn of the objectives of science away from the partition from life to a dedication to a development which implies the reduction of civilisatorical costs. Undoubtedly every civilisation is bound to change, and also to scientific and technological change. But differently from before the finiteness of the world, the circulation of materials, the global effects of synchronous local actions come into our sight. All potentials and efforts have to be used to care for future social development without damage for the environment. Women and minorities have to be integrated more than before in the design of such a change. One element and possibility to enable women´s participation is to set up universities, especially technical ones for women.

All methods and new technologies should be used to develop such a new university, nothing should be excluded (but the development of weapons for war). Internet and virtual universities should be integrated for the sake of using all aids available for the difficult task. But this does not mean an uncritical view on the potential of the technologies, as it is often heard with visions like solving all problems or even salvation of the world through technology, or through market and business. One actual example of such imaginations is the new digital media which should solve ecological, communication and economic problems, also by the universal economisation of everything, also the university teaching and research.

**Challenge 1 is**
to help coping with the **challenges of the future: ecology, migration, globalisation, balance between rich and poor, women and men, minorities and majorities** etc. For these aims all resources and, powers and technological possibilities have to be used, because the challenge is nothing less than **building a new civilisation.**

There have been a lot of names, like trying to characterise new types of society: post-industrial society, services society, consumer’s society, communication society, information society, knowledge society, risk society, virtual society. The huge variety of classifications shows that old structures are dissolving, but a (one) new formation has not arisen. Yet the visible changes indicate the break up into a new civilisation.

A new civilisation for the new millennium cannot be defined, even less implemented from scratch. It must and will use the structures defined within the last centuries. Therefore is also bears the burden of a male culture of progress: engineers, enterprise holders and colonisators. James Watts steam engine marks the beginning of a new epoch. The industrial use of fossil energies to run the machines led to the development of big industries in steel, machine construction, electric industry, mining and chemical industry. Productivity rose and with it the production and use of goods. Ships, railways and telegraphic aids had the effect of shrinking time and space for human activity. Rationalisation not only by machines, but also by bureaucracy and the formalisation of social processes made human activity more effective, but also enabled the potential of power by science and technology: Taylorism, Fordism, military weapons and mass-destructive technology, but also the decline of agriculture. Today rationalisation not only is restricted to public and institutional sectors, but in a rising amount also to the private one.
As well known technology also structured society: in the times of the first industrialisation the polarisation between the possessors and the workers, town as room for public action contra private room without possibilities for empowerment. Education and professionalisation are gaining weight compared with family and inherited position. Public health has rising standards, and also women's power is rising. So up to today. On the other hand also the threats by global damages have come into consciousness. The responsibility for ecological balance, pollution of air, earth, water and nutrition is not to be attributed to single persons, but they bear the load of the damages, just like flora and fauna.
It is time that not only one sex is in control of technological processes. The tendency to keep away social key qualifications from technical universities is still working. And it relies on structures and norms stemming from military rationality and order. Of course it is speculation to claim that our civilisation would have very different characteristics with a more active participation of women. But today break of old structures and still open future is a challenge especially for women. New basic technologies are opening new tracks. A new scientific practice should combine technical innovation with the social one.
Signs of a new civilisation are visible with the changing of norms, institutions, jobs. With post-modern plurality a greater tolerance against differences has arisen. The post-modern discourse about construction of social attributed and values lets bindings seem deconstructable giving dimensions of new freedoms. The fact that there is a lot of openness for structures and values calls for design, especially designing by women.
Universities cannot any more be shelter for socially isolated individuals, but they are embedded into variable social processes. Intrinsic motivations of subjects should move in favour of taking responsibility for scientific actions seen as part of a duty for building up a new civilisation and taking responsibility for the natural environment, more or less constructed or left to itself. Instrumental technology constructed for different aims is moving in favour of integrated technologies, processing relations and communication, but without explicit goals. The development and implementation of technologies for intrinsic reasons should be abandoned in favour of development for sustainable and social goals. This requires the co-operation of all sciences.

**Challenge 2: to co-operate for new scientific themes, which stem from the demands of building such a new civilisation, i.e. to subordinate research themes under the goals of the reality of the present and the urgent needs of the present society and ecology. (This does not mean that basic research within subjects should be abandoned.)**

But it means that also the basic researchers should co-operate with those working on problems of the future, in order to know what are the problems and what they might be able to contribute. It also means that with the new goals Humboldts ideals of freedom and loneliness

must fall. The freedom to choose ones subject of interest should obey a self restriction to the goals mentioned above. That is, not everything that potentially can be done, need to be done nor should it be.
Intrinsic goals of single sciences should be abandoned in favour of social and ecological goals. Problems of this sort have to be solved with the efforts of all sciences.

**Challenge 3: to lead the university away from the partition into subjects, dissipation to a new universitas. Universality today cannot consist in integrating all scientific knowledge of the world in single minds, it can only be brought into life by co-operation between researchers from different subjects. This implies the willingness and possibility to subordinate under common scientific goals.**

This kind of new universality consists in the possibility to gain access to all scientific results of all subjects relevant to the problems chosen and to scientifically contribute from all these subjects as well as from practice to solutions. This requires the giving up of quite a lot if intrinsic scientific values, goals to develop the scientific subject, also to give up hermetic language. It requires to make oneself understood, to communicate and to co-operate and to follow the common goals.

**Challenge 4: to work in trans-, multi and interdisciplinary way on the subjects mentioned. This requires to be able to speak a common language between scientists or at least to understand other scientific languages and to moderate between them.**

Other qualifications are required for this co-operation than before. Not the lonely hermetic genius working alone, but assisted and supported by an armada of women for his narzistic contentness, is the type required any more, but interested communicative people, being able to explain their own sciences contributions, and willing to co-operate on common aims without domination of others.

**Challenge 6: Lifelong learning, flexibility and the adaption to a global work market.**

Globalisation of work gives education and learning a new role. The most important goals of education are not any more to memorise subject contents, but to be capable of learning on demand, to find information where it is available, and to remain flexible. On the teaching side it requires a shift from support of the acquisition of knowledge to strategies for the acquisition of knowledge. The fixed knowledge bases and curricula have to be made flexible. The capability to acquire short time external knowledge effectively becomes more important than a huge amount of internalised (learnt) knowledge. The creation of new knowledge is becoming a globally coordinated activity of many people. Presentation and design becomes more important and even an educational goal, both for teaching and research. Scientific work tends to shift from “publish or perish” in the print media to a multimedia “demo or die” (W. Coy). And the necessity to communicate and to co-operate raises the importance of social, language and team competence.

This gives universities a new role and forces them to find a new standpoint. First of all new forms of study have to be found which can cope with the necessities of a new working society. A fixed division between learning phase and working phase does not exist any more. A continuous phase of working in a fixed career track will not be a general model any more. Lifelong learning also requires new courses and forms of study from the universities. They have to offer part time, short time and remote courses. Moreover they have to enable moving between different kinds of educational institutions, like Fachhochschulen and others, between

practice and research. Using webbed digital media can help for designing the necessary redefinition of universities.

By loosening and marginalising the traditional models of courses of study room is opened for new constellations, like overlapping and interdisciplinary courses grapping elements from different subjects and courses and combinig them unconventionally.
Gender Studies can serve as models – even if it is true that these prototypes arose from the lack of ressources -, or courses in media theory. Other courses directly oriented to certain professions are possible models as well.

**Challenge 5: What do we need at universities in short future and in the long run? The new technologies? Is it necessary for every course of study to have ubiquitous MBONE-access, to use authoring systems, to have network-and multimedia I/O, -hardware and -support for every student?**

Multi-media is the word selected by the Institut für Deutsche Sprache as word of 1995 and it is setting the pace for innovations in education, university and school since then. Virtual univesities, virtual courses of study, Schulen ans Netz, self organised learning, telelearning, education on demand and new knowledge society are the buzzwords of exposition. Euphoria and scepticism take great distance, as well as the estimations of costs such as those of potential savings. On one hand the technical possibilies are by far overestimated – they will solve all our problems of future education, on the other one their fundamental importance also mostly is undervalued. A third position is that there is now way to avoid the use of the new digital media for education for good reasons of enlarging means and possiblities of learning, but to use them critically, i.e. to select and to intergrate them into classical teaching.

Dennis Tschritzis, the director of the German GMD and professor at the university of Geneva writes in his article “Reengineering the University” in CACM 42, 6,1999: “Todays University is at a turning point, and turn it must. The time has come to recognise that education is a business and students are the customers. Pressure for such a change comes from the public, the media and political groups, which become aware of the new technological means and therefore demand new learning environments. He claims a radical restruturing of university and research, which abandons Humboldts ideals of a university integrating research and education, where professors are working in loneliness and freedom.
He claims that the new teaching environments are virtual classrooms, with the possibility to visit digital libraries. Students select from the best class from the world wide offerings, they can specialise in arbitrary direction, because every existing course is available also for them. Teaching personnel saves teaching time and wins it for research by using authoring on the fly-technology, and institutions have a valuable instrument of validation by just evaluating the market of course choices.

A similar vision is given by the Expertenkreis Hochschulentwicklung durch neue Medien with the commission BIG-Bildungswege in der Informationsgesellschaft of the BMB+F, the Bertelsmann Stiftung and the Heinz Nixdorf Stiftung by J. Encarnacao, W. Leidhold and A. Reuter: Universitary development by the new media; Vision 2005. The scenario outlines a global market of education, corporate universities, networks and international consortia, virtual universities, educational brokers etc., all mostly now centered in or around firms. Only a very small classical university is left with the task to do fundamental research and to educate its own personnel. According to the authors the very use of the new media creates

transparency and in consequence quality of education, the evolution of education according to the needs of the market, etc.
Accreditation of unconventional courses of study

A critical text is coming from a Canadian colleague, David Noble, resuming experiences from the UCLA and from the university of Toronto.

In order to find a rational position in this battle we ask: Which specific effects of support can be obtained by interactive computer systems (in the following comprising with respect to achievements like thinking, learning or processing of information? The possibilities of computers (here we mean by it computer, software, peripheric and network hard- and software) mentioned often are rationalisation (by money giving institutions like the Kultus bureaucracy) and quality improvements, especially in the process of appropriation (by the money taking institutions, as universities). The quarrel cannot be decided, because there do not exist reliable TA studies, but also because the technical potentials cannot be separated from other factors, like better didactical concepts, better preparation of the teaching materials, and third the implementation of the new technologies usually is supported by additional resources from projects, which finally are making comparisons impossible.
In principle technology only helps to solve technological problems. Didactic and pedagogical questions have to be solved with didactic and pedagogical means. But all thinking and learning heavily relies on media, which allow to see differences between ones own thoughts and other ones, to help our memory, to communicate.

Reinhard Keil-Slawik puts the questions into a more theoretical frame by differentiating between primary, secondary and tertiary functions of media. The primary functions of media are to create: making phenomena realisable, to arrange artefacts so that they can simultaneously be observed and their content relations are mapped by the layout relations and to combine connected artefacts. The potential of rationalisation by multimedia to his opinion lies in the possibilities to process these primary functions. The new media enable a pictorial turn, which reaches our mind more directly than the written and even the spoken word. By this the above functions gain even more relevance: arrangement, layout, room visions. The secondary functions, like selection of contents and instructional processes can be processed by learning software. The function of multimedia here is to improve the quality of learning materials. This cannot be parted from competence in the subjects contents and from didactic competence. The tertiary media functions lie in the implementation of systems that learn, used in teaching for example for filtering or in the form of knowbots for searching, selecting, combining and processing knowledge according to a person´s profile of interest. The higher the layer the more complex not only the media functions but also the intertwining with other competence and efforts.

A lot of questions and requirements still are left open with these scenarios.
1. To begin with the very use of global archives and of global teaching offer requires media competence in teaching and learning in all subjects. It also requires the shift already mentioned from the acquisition of knowledge to *multimedia strategies* for the acquisition of knowledge. Navigation, filtering and effective search within the huge amount of mostly not validated knowledge offered requires technological and strategic skill and knowledge to validate. That is, competent use of the mediated knowledge requires *new "meta"- skills and –knowledge.*
2. It requires *technical equipment* not only for scientists and teaching personnel, but also for every student, a very expensive task.

3. Along with the decentralised furtherance a *future universitary ordering of knowledge* also requires a new ordering of the traditional centralised carriers of technical media: the integration of library, computing center and media center in a universitary support unity: *"digital media" center*. And with the new institutions also modified and new professions are required: cybrarians who are able to integrate the skills of librarians, information brokering and technical capabilities for running the computer center and the multimedia equipment.
4. It will require a lot of costs of installation and also of the running. For students this also means a load of running telefone costs. The model of locally free telephone calls would help also in Germany to get universities and more people on the net.
5. Also the readiness of students in self engagement in using the digital media has to be supported by removing hinderances, like costs, access, teaching media competence, but also by the *quality of the offer*.
6. The preparation costs are extremely high. For example the Freiburg high tech project "*authoring on the fly*" computes 100 to 500 hours of preparation of one hour teaching unit at the computer. The preparation of synchronous on-line teaching in several places using MBone technology and shared whiteboard has similar requirements.
7. The forms of working of the teaching personnel radically changes by the use of digital aids for virtualised teaching . A traditional lecture with blackboard and chalk may be prepared in the evening before the lesson. A technically mediated demo, the use of a software package for simulation or animation during the lecture must be prepared with care and long time before.
8. One important aspect of technology for the **usability** and with it for really rationalising teaching and learning is that systems must be apt to direct everyday use. With the current state of the high-tech multimedia possibilities much more effort has to be put into making the offered learning units run than into the learning itself.
9. Another one is that isolated learning alone does not suffice. Learning also is a social process, where it is necessary to discuss, to compare ones performance with others.
10. High tech learning software has to be actualised, i.e. it does not suffice to build authoring on the fly – units once for all, they have to be supplied with possibilities for change, improvement, addition.
11. Usability, the possibility to combine, reusability, and the Verfügbarkeit of materials diversified according to learning type and quality everywhere and all the time are necessary prerequisites to make the program work.

Challenge: Use the new technologies in a way that it contributes to all the goals, but not with a technology centred habitus, but with a critical one which only seeks to use it for efficiency to serve for more effective learning, but also for the new challenges of the job market: flexibility for "learning how to learn", for lifelong learning.

1. Digital media have to stand in the second row: The use of digital media is an aid to establish the new overlapping courses of study, but not a goal for itself. Virtual teaching and learning has to follow non technological needs, not conversely. But it is helpful, both as stand alone remote universities, but more as a means among others.
Still also within classical courses of study a heavier use of webbed digital media is highly recommendable.
2. Teaching is a decentralised task and should remain so in general. But it can be extended by central provisions within the single courses of study.
Universities should support such activities by giving ressources and taking such efforts adequately into account. All subjects should be stimulated to participate in this reform and to use the existing digital networks as intranet of the university.

3. A side effect of such a networking will be the intended bridging within the university, from strengthening of the cooperation between faculties, better knowldege of one´s colleagues activities by looking into the www, and even interdisciplinary work.
4. Another side effect might be the quality of the teaching offer: multi media teaching is a lot of work, wich usually also flows into the preaparation of the contents and didactics. The competition between different offers might lead to better quality as well.
5. High tech variants should be handled with care. Professional TV-shows cannot become a model for universitary teaching. But low tech use of the new digital media, like email, newsgroups, mailing lists, web-archives, MUDs, MOOs and IRCs require considerably less efforts and time and they can be integrated into classical teaching much easier as well.
6. The potential of communication possibilities by using the new digital media has not yet been investigated thoroughly. But this must be done.
7. Technical visions of teaching and learning have to replaced *by social visions of teaching and learning. To learn how to learn* will be the most important challenge for our students, and with it *to teach how to learn* for us.

Challenge 8: The new order of knowledge in information and knowledge society

Another challenge comes from the *globalisation of knowledge and gobalisation of the production of knowledge*, moreover new knowledge orders (e.g. an internet governance of knowledge), again implying the use of the new digital media.
Open global computer networks by allowing new forms of communication, information, saving and archiving also heavily participate in building a new mediated knowledge order. This in the sense of Michel Foucault, i.e. not only with epistemological goals, but also goals of ruling in technology and society. The new instrumental media will be used to search, select, process information and to mediate it to users in adequate form. Users in turn have to involve with the media for being able to reconstruct relevant knowledge for themselves. If universities do not want to leave the evolving of a new knowledge order to chance and other powers it must participate in the structuring and design process of the order of knowledge. If according to F. Spinner knowledge can be structured according to zones of quality, shelter and distribution, also science has to take responsibility in the items mentioned.

Michael Nentwich describes in his working paper “the future of science” less the future of science but the actual use of digital media within the scientific communities. The changes are manifesting in new forms of publishing and in the ways scientists work and communicate. Communication via email, but also online in video- and online-conferences makes cooperation easier and allows the scientists to gain knowledge of greater actuality.
Texts are receiving a more dynamic component: with publication they need not remain fixed. The so called open peer commentary as well as the online-referencing can lead to modifications enclosed in the publication at later states. The role of authorship thereby is changed. Articles are becoming the products of groups of scientists with different roles in the production of texts. Rating of these articles can be done by automatic follow up of reading

Of course the changes also depend on the scientific subject. In areas where the winning of data is necessary, this can be done from remote places, exchange of data is eneasened, the access to large data bases gives as new empirical quality to research. Also extended research groups can be established working in virtual laboratories, so called collaboratories. They cooperate and coproduce in a modularised way, more independently of place. Of course there remains research which is bound to place, like field research, interviewing, etc.

This kind of remote cooperation also has its deficits, well known as decontextualisation of information, and as the lacking bodily information channels like mimics and gesture. On the other hand the forms of discourse enabled by electronic communication are capable of infinity (STICHWEH). And it also needs new forms of written moderation, which don´t exist yet.
As a whole there is the possibility to go from local and national discourses (which are more typical for social sciences, arts and humanities, less for science, mathematics and technology) to global communities and a democratisation of science, an break up of hierarchies, with on the other hand the well known specialisation and particularisation of knowledge and expertise.

It can easily be deduced that all the challenges mentioned can lead to convergent solutions, which I want to exemplify on the example of the TUFE.

## Constructive turn with Feminist claims at the Technical University of Women in Europe:

Women only-Universities

Not only among feminist discourses the concept of women's only Universities is discussed and claimed and realised since long time. Whether the fact that only women participate in the acquisition and production of knowledge will alter learning and scientific processes and with them science itself or under which conditions so is still open and need not be discussed here.

I would like to present concepts of a type of university that meets both desires of a group of women and claims to education and research for the needs of "tomorrow". Most of them have been discussed in the context of the development of the "Technical University for Women in Europe" leaded by Doris Janshen.

One starting point is the observation that the male power of definition in the process of civilisation rules out or marginalises female participation in this process, and this especially through the development of technology and technological skills. It is therefore necessary for women to define their own "universitas".
The second one considers the social and economic costs of today's richness through industrialisation, which is based on scientific and technological knowledge. The question arises how future civilisation can be developed also implying social and ecological responsibility, and how science and technology can integrate this in the very processes of teaching and research.

### Feminist positions:

Feminist research is favouring specific epistemological interests. That is, approaches which use the power of knowledge to support life, peace and the development of civil cultures are favoured against such which are used to gain power over nature, people and nations, like destructive and military technology. Consequently the focus lies on long lasting concepts and social and ecological aims instead of quickly economically and politically usable research.
A further feminist desideratum is to reintegrate epistemological questions and foundations into science in order to support self reflection into scientific discourses. Critical questioning sciences about their aims and their knowledge produced is a necessary condition for regaining an orientation of sciences towards social aims, away from Humboldts ideals of objectivity, (absolute) freedom (of research aims) and loneliness.

Moreover feminist scientists fight for a Streitkultur, a communication and discourse with Auseinandersetzung. They do not take the postmodern trend to “anything goes”. Instead of seeking for Bestätigung and Übereinstimmung a lot more of Erkenntnis is won by working on dissens and difference and their reasons.

Feminist critique in science and technology is well known: it attacks the “rational method” of recursive partition of problems into smaller parts up to atomic level, solving the parts and composing them to a general solution. Further the objectivist distance and view of scientific work and many other partitioning features, like the partition of science and life, of theory and practice, of subject and object etc. A constructive turn is seldom performed and it always bears the danger of essentialist positions. Here they are avoided by just listing aims and desires for change and by trying to set up conditions for their fulfillment.
One basic claim is to **use the potential of women**, and to use it not only as isolated women in science, but to bring women together in a technical university and to integrate different scientific views of women in one place, where teaching and research, practice and science is performed.

How to try to solve problems of the future

In order to set new grounds for solutions of **problems of future civilization** and of the world there is urgent need for **interdisciplinary, multidisciplinary and transdisciplinary work** and research. For this it is necessary to **dissolve the classical faculty structures** for the sake of setting up new structures which help to **investigate in cross section problems** both in teaching and in research.
In order to get to know the “real problems” it is necessary to **integrate science and practice**, i.e. to involve also people from business and firms in setting the themes of projects, in teaching and being taught, and from different countries.
Also there should be a commitment in taking responsibility for **ecological problem areas and problems of the third world** as well as socially and economically usable research results.
Women should have the power of definition in this university, but also cooperative male teachers and researchers may be integrated. This implies that possibilities to **integrate work and even carrier and family life** must be guaranteed, also for single mothers. Also the integration of students and practitioners in the research processes has to be enabled, among others by deconstruction of hierarchies, this also between scientific cultures and disciplines. This also implies a **social integration** for wellbeing of students and teaching and research personnel.
All this involves experiments with new structures for science and teaching focussing on the integration of women and the orientation on problems of the present. This has consequences not only on scientific subjects and forms of study, but on the whole culture of science and its mediation. Room for a different knowledge must be opened, for research that transgresses the borders of disciplines and which takes its motivation from social practice of today and tomorrow. Of course this implies also competence in and development of basic research within disciplines.

After a basic education in a main subject examples of courses of study might be the following

- **the future of work** with contributing subjects working scinences, psychology, sociology, computer science, but also machine engineering, juridical sciences, organisational sciences, etc.

- **Circulations and Littering** from wrong knowledge, collective mistaken convictions, e.g. about nutrition, Entsorgung from unnecessary too risky high technological products, from trash, from software Altlasten

- **Sustainability and progress** with environmental sciences

- **communication and media** via language, writing, technologically mediated forms with contributing subjects like linguistics, literature, electrical engineering, computer science, psychology, philosophy etc.

- **health sciences** with the subjects medicine, alternative medicines, biology, organisation of Krankenversorgung, insurances and hospitals, nutrition, preventive medicine implying a number of technological subjects, like architecture, water and Abwaaser technology, etc.

- **transportation** with contributing subjects like organisational sciences, operations research and mathematical optimization theory,

- **energy** with a number of technological sciences, geology, chemistry, biotechnology, etc.

- **virtuality** comprising philosophy, psychology, biology, computer science, media theory etc.

- **migration**

- **globalisation and (internet, economic or law) governance**

- **alternative economies,** like the open source movement with contributing law, computer science, economy

The target groups of the Technical University of Europe are
researchers, graduating students, fellow students, professionals, the areas of working, the whole society. Fellowships should enable women and men to study abroad, to make possible further development for undergraduates as for graduates with continued education or Postdoc-studies.
The people employed in an occupation should be able to study at the technical university of women, especially women after the family phase should get the possibility to reintegratre into the job market by receiving educational offers.
The new qualifications are standing in exchange with the whole labour world and society via influences by the research pools, further education, practice and industry, state and institutions.

**Outcome of the studies at the TUFE**

People of the new civilisation not only have to be more flexible, they also have to keep an gtzgbvfffffffbbbbbbbbbbbbinner stability and strength as well as social competences. Barbara Mettler v. Maibohm speaks of the necessity to develop a new ecology of communication.
Only those who treat others and oneself plus the new technologies ecologically w.r.t. communication will be capable of communication. The TUFE therefore develops learning modules for “social training in technology”.

The goals of technological development by the TUFE will not be innovation for the sake of being the first, but to find meaningful applications for ecologically neutral or positive processes and to develop technology for them afterwards. At the TUFE innovative processes will be embedded into networks of applications from the beginning.

## 3.2 Inhalte der Studiengänge

Die Planung der Studiengänge orientiert sich an den Vorerfahrungen in der Forschung. Die dort beteiligten Nachwuchswissenschaftlerinnen und Berufstätigen sollen wesentlich den Aufbau der neuartigen Studiengänge gestalten. Der Arbeitskreis "Frauen, Technik, Zivilisation" wird seine Vorstellungen strukturell weiter entfalten. Verbindlich ist bislang, daß auch die Studiengänge wie die Forschungsgegenstände Gegenwartsprobleme unter verschiedenen Sichten zusammenfassen. Zwar sollen im Grundstudium auch disziplinäre Kompetenzen vermittelt werden, doch zeigt sich im Hauptstudium überwiegend eine multidisziplinäre Vielfalt, die sich auf den Gegenstand bezieht.

Ähnlich strukturierte Studiengänge existieren bereits: das MIT/Cambridge (Mass.) und die TU Eindhoven/Holland erproben die Verbindung von ingenieurswissenschaftlichen und sozialwissenschaftlichen Qualifikationen, so wie dies für die Technische Universität der Frauen Europas gedacht ist. Überproportional häufig wählen weibliche Studierende solche Studiengänge.

In Deutschland entstehen zunehmend Studiengänge, die verschiedene disziplinäre Methoden und Wissensbereiche - an einem bestimmten Gegenstand orientiert - zusammenfassen. Was fehlt ist die Meta-Reflexion disziplinärer Sprachhaltungen bzw. eine Didaktik der Interdisziplinarität.

Wir stellen uns Studiengänge vor wie

> Zukunft der Arbeit, wozu die Fächer Arbeitswissenschaften, Psychologie, Informatik, Soziologie aber auch Maschinenbau, Organisationswissenschaften, Recht etc. gehören,

> Entsorgung von patriarchalen Altlasten, von kollektivem Fehlwissen, von großtechnologischen Produkten wie Kernenergie, von Müll, von Software,

> Kommunikation via Sprache, Schrift, technischer Vermittlung in verschiedensten Formen mit den beitragenden Fächern Germanistik, Linguistik, E-Technik, Informatik, Psychologie usw.,

> Gesundheit mit den Fächern Medizin, alternative Medizinen, Organisation der Krankenversorgung, Versicherung, Krankenhäuser, Ernährung, Präventivmedizin, Biologie etc.

## 3.3 Organisation

Die neuen Qualifikationen in Forschung und Lehre stehen in engem Zusammenhang mit der geforderten Interdependenz von Universität und Berufswelt. Außeruniversitäre Berufstätige mit besonderen Kompetenzen sind von Anfang an als Lehrende oder Beraterinnen in den Aufbau der Universität integriert. Später haben sie die Möglichkeit, durch zeitlich begrenzte fresh-up-Studien ihre Kenntnisse zu erweitern. Dabei kann es sich um Weiterbildung sowohl für Berufstätige handeln als auch für Frauen nach der Familienphase oder anderen Unterbrechungen. Die Universität der Frauen integriert demnach Menschen aus folgenden Bereichen: Forschung, Weiterbildung, Studium, berufliche Praxis, Staat, Industrie und Gewerkschaften etc.

Die Organisationsformen sind noch relativ offen. Neues soll erprobt werden. Hier besteht noch ein Bedarf an Konkretisierung für die endgültige Realisierung, jedoch soll auch eine relativ große Offenheit gewahrt bleiben, um die Organisationsformen erprobbar und änderbar zu halten. Dies auch im Interesse der zukünftig Studierenden, die eine Qualifikation für den Arbeitsmarkt erwerben müssen. Folgende Kriterien sind bislang abgestimmt:

> Es soll keine disziplinäre Ordnung nach Fakultäten geschaffen werden, sondern Fachbereiche neuer Art sollen begründet werden. Grundlagen der Disziplinen werden jedoch vermittelt.

> Die Lehre ist kommunikationsorientiert statt verschult und projektorientiert statt vorlesungsorientiert. Die Projekte, Seminare und Diskussionsveranstaltungen sollten im Hauptstudium an bestimmten praktischen

Aufgaben die verschiedenen Sichtweisen der Disziplinen integrieren. Wenn möglich und sinnvoll sollten jeweils mehr Vertreterinnen verschiedener Disziplinen eine Lehrveranstaltung betreuen.

> Im Lehrkörper sollten mindestens zwei Personen eines Fachs jeweils vertreten sein.

> Der Lehrkörper sollte sich vorwiegend aus Frauen zusammensetzen, und die Präsidentin oder Rektorin sollte eine Frau sein.

> Die StudentenInnen, Graduierenden und Berufstätigen, die die Hochschule frequentieren, sollten sich ebenfalls vorwiegend aus Frauen zusammensetzen, jedoch offen sein auch für quotierte Männer.

> Mit der Implementierung der Forschung und der Ausbildung von Graduierenden, Fellowships und Berufsfrauen wird die Planung der Studiengänge sukzessiv Gestalt annehmen, so daß eine Studienplanung erfolgen kann. Es sind neue Studiengänge, die neue Querschnittscurricula erfordern.

> Fellowships werden Frauen (und Männern) aus dem In- und Ausland Weiterbildung ermöglichen, bereits Graduierten Aufbaustudien oder Postdoc-Studien bieten.

Die Entwicklung von neuartiger Curricula beginnt mit Aufbau- und Weiterbildungstudiengängen. Fragen der Zulassung und der Certifikate sind noch nicht abschließend geklärt.

Neue Konzeption von F u L, die allen Studierenden, Frauen wie Männern und vermittelt der Gesellschaft zugute kommt. Vermittelt einmal, weil die AbgängerInnen dieser Universität mit - hoffentlich - neuen Kompetenzen in den Arbeitsmarkt entlassen werden, und zum anderen weil wir hoffen daß unser Universitätskonzept einen Innovations- und Reformschub auf die Universitäten insgesamt bewirken kann.
Die Einordnung von Fächern in Fakultäten, heute sogar von noch kleineren Einheiten in Fachbereichen grenzt die Fächer hermetisch voneinander ab, in methodischer Hinsicht wie in bezug auf die jeweiligen Erkenntnisinteressen und -ideale. Interdisziplinäre Interessen werden entwertet und interdisziplinäre Kompetenzen werden nicht honoriert - im Gegenteil: die jeweils anderen Fachmethoden werden verglichen mit den eigenen als unsauber empfunden oder die jeweils anderen erkenntnistheoretischen Grundannahmen als unhaltbar. Zum Beispiel kritisieren die auf mathematischen Methoden basierenden Wissenschaften an den auf Experiment und Empirie zurückgreifenden, und mehr noch an jenen, die von bestehender Literatur ihren Ausgangs- und Kritikpunkt nehmenden und in diskursiven Überlegungen Konsens oder Dissens findenden philosophischen, literatur- und kunstwissenschaftlichen Fächern die mangelnde Strenge und Beweisbarkeit und damit die Unhaltbarkeit der Ergebnisse. Die sich geistes- und sozialwissenschaftlicher Methoden bedienenden Wissenschaften kritisieren an Natur-und Technikwissenschaften die Nichtexplikation impliziter epistemologischer Ausgangspunkte und demzufolge die oft übergeneralisierende Interpretation und damit ebenso die Unhaltbarkeit der Ergebnisse.
In solchem Streit entwerten sich die Fächer gegenseitig, grenzen sich ab und hindern sich selbst an der Wahrnehmung oder gar Einbeziehung der Ergebnisse fremder Fächer - zum Schaden der Wissenschaft insgesamt und zum Schaden der die wissenschaftlichen Ergebnisse immer noch als objektive Wahrheiten akzeptierenden Gesellschaft - obgleich z.B. mit dem Dilemma der sich widersprechenden wiss. Gutachtermeinungen auch für die Öffentlichkeit der hehre Tempel der Wissenschaft zu bröckeln beginnt.
Für Natur- und technische Wissenschaften tritt eine spezifische neue Situation ein:
Waren sie lange Zeit von einem selbstverständlichen Fortschrittsglauben getragen, in dem sie auch ihre Legitimationsgrundlage hatten. Inzwischen sind jedoch in der Öffentlichkeit wie innerhalb der Naturwissenschaften und der Technik selbst Kontroversen aufgetreten: von der Diskussion um die Zerstörung der äußeren Natur bis zur Diskussion um die immer weiterreichenden Eingriffe in die menschliche Natur. Es scheint sich ein Ende des "Fortschrittskonsens", der die Industriegesellschaft lange getragen hat, abzuzeichnen. So tritt nicht nur die Risikodebatte der neuen Technologien sondern auch zunehmend eine umfassende Technologiebewertung auf den Plan, die sozialpolitische und kulturelle Folgen miteinbezieht,

Ziele und Konzepte der Forschung beleuchtet und grundsätzlich die Frage nach der Sozialverträglichkeit naturwissenschaftlicher und technischer Innovationen aufwirft. Für die naturwissenschaftlich-technische Forschung entsteht so eine neue Situation. Wir Wissenschaftler können die gesellschaftliche Akzeptanz unserer Arbeit und unserer Ergebnisse nicht mehr - wie es bisher war - als selbstverständlich voraussetzen, vielmehr muß diese Aktzeptanz erst hergestellt werden, besser aber sollten wir Bedürfnisse ermitteln und Wünschenswertes erforschen und entwickeln. In dieser Situation stehen sich die (sogenannte) Freiheit der Wissenschaft und die gesellschaftliche Zustimmung unter Umständen als Antagonisten gegenüber. Die Universität erhält so eine neue Rolle, die sie nur ausfüllen kann durch eine stärkere Integration ihrer Fächer, also durch interdisziplinäre Zusammenarbeit, sodaß die Erkenntnisse aller Wissenschaften den anderen zugutekommen.

Interdisziplinäre Kompetenzen also sind hier in besonderem Maße gefordert: sowohl in Forschung wie in Lehre, da Fähigkeiten z.B. zur Integration von Methoden und Erkenntnissen aus anderen Wissenschaften unabdingbare Erfordernisse an Techniker sind.
Die fachbezogenen Persönlichkeitsprofile von NATURWISSENSCHAFTLERN UND Technikern zeigen allerdings eher Inkompetenzen auf diesen Gebieten. Die Objektivitätsideologie ihrer Fächer macht die eigene Methodik unangreifbar und verhindert so zusätzlich die Kritikfähigkeit und die Einsicht in die Notwendigkeit einer solchen Auseinandersetzung.

**References:**


Wolfgang Coy: Zukunft der Ausbildung und der Lehre, lecture at the workshop “Informatcis and society”, Bederkesa 1999.

J. Encarnacao, W. Leidhold and A. Reuter: “Universitary development by the new media; Vision 2005”. Expertenkreis Hochschulentwicklung durch neue Medien with the commission BIG-Bildungswege in der Informationsgesellschaft of the BMB+F, the Bertelsmann Stiftung and the Heinz Nixdorf Stiftung.

Doris Janshen

D. Janshen, B. Schinzel, C. Schmarsow

Reinhard Keil-Slavik: Rahmenbedingunen für den Einsatz von Multimedia in der Hochschullehre; Thesenpapeir für den workshop “Informatcis and society”, Bederkesa 1999.

Michael Nentwich: Cyber Science: Die Zukunft der Wissenschaft im Zeitalter der Informations- und Kommunikationstechnologien. Working Paper des Max Planck-Instituts für Gesellschaftsforschung www.mpi-fg-koeln.mpg.de/publication/working_papers/wp99-6.

David Noble: Digital Diploma Mills: The Automation of higher education; October 1997.
Dennis Tschiritzis: “Reengineering the University” in CACM 42, 6,1999