

A Change Process at German University – Innovation through Information and Communication Technologies?

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Abstract: In this article, we describe the current situation of virtual universities in Germany and pursue the question of whether innovation processes taking place throughout the entire higher education landscape. Our study shows that the integration of ICT not only changes the medial characteristics of the learning environment, but also results in innovations on the micro-, meso- and macro-levels of higher education. The empirical basis of our inquiry is a program sponsored by the Federal Republic of Germany, which promotes the utilization of ICT in universities.

Keywords: ICT, Higher Education, Innovation

1. Introduction

In the past few years, information and communication technologies (ICT) have become more widespread in all parts of society. They have also become more prevalent in educational institutions at various educational levels, from elementary schools up to universities. Our paper examines the question of whether ICT instigate innovational processes at institutions of higher education. Our thesis is that the integration of ICT not only changes the medial characteristics of the learning environment, but also results in innovations on the micro-, meso- and macro-levels. The micro-level is the level of teaching and learning. The structure of the university is considered the meso-level. The macro-level is the policy level.

In this article, we describe the current situation of virtual universities in Germany and pursue the question of whether innovation processes taking place throughout the entire higher education landscape.

To show the extent of this change process we apply selected results of our investigation to the situation of challenged students at university. We support the hypothesis that this innovation can reveal numerous opportunities for challenged students to better participate in the process of knowledge acquisition and communication.

The empirical basis of our inquiry is a program sponsored by the Federal Republic of Germany, *New Media in Education – Universities*, which promotes the utilization of ICT in universities with an enormous financial budget of approximately 400 million euro. One hundred project coalitions with a total of approximately 540 individual projects in nearly

every field of study have been supported between 2001 and 2003. Due to the sheer size of such a program in this field, the support program is considered a novelty internationally, as well. The question is, if the government representing the macro-level can initiate a change process within the universities with such a top-down program.

Our project (Concepts and Elements of the Virtual University) uses this unique database to evaluate the current state of the (partially) virtual university, and to determine the trends in further development.

2. Innovation and change processes in higher education

In modern societies, the systems of higher education are in a process of change (Castells 1996, WBEC 2000 [<http://www.ed.gov/offices/AC/WBEC/FinalReport/>]). According to the definition of innovation, change processes can solve problems by introducing new products, as well as new processes (see Duden 1994). Applied to institutions of higher education, the question arises, which problems currently exist and have to be solved on the process and product levels in general? In current literature on higher education, there are reports of difficulties at traditional universities. The problems seem to exist on different levels and are primarily related to a rapidly changing world. A modern university in a global world will have to stand comparisons with international standards (see Stichweh 2001). Encarnação et al predict that traditional universities will probably play a secondary role in the educational landscape of the future, as they will no longer be able to compete with the global activities of the consortia of virtual universities, neither financially nor qualitatively

(Encarnação, Leidhold, & Reuter 2000 [<http://www.wissenschaftsforum-saar.de/docs/2003-05-13-Szenario2005Deu.pdf>]). According to Encarnação's scenario, in the future, students will conglomerate their studies modularly, by choosing university events, which are distributed all over the world. Therefore, it will be possible to take the world's best course for each topic (see *ibid.*)

From the didactical point of view, it is of considerable importance that many authors connect the virtualization and globalization of learning to a modification of the instructional paradigm. For instance, Linda Darling-Hammond from Stanford University prognoses that learners supported by ICT are becoming citizens of the world, as well as competent writers, researchers, mathematicians and scientists. Teachers will assume the role of coach, directing students to the resources they need to solve problems (see Darling-Hammond cited in Tergan, & Zentel 2002 [<http://www.iwm-kmrc.de/kevi/workshops/plattformat/Tergan.pdf>]). The statements vicariously show the high expectations for the innovation potential of ICT. In addition to the vision of networked learning communities, many authors expect a change of the instructional paradigm.

In order to validate these expectations, we have to take a deeper look at the change process, which is observable in the research field of higher education. ICT has a key function for various dimensions of this change. The 'driving forces' of change include, for example, the integration of the Internet into instruction, the improved possibilities in the use of multi-media, a world-wide educational market, speedier innovation cycles and increasing competition in the educational markets. These global developments lead to a greater flexibility in education and require lifelong learning. They increase the customer orientation and vary the extent of educational opportunities being offered. They also have led educational providers to offer new forms of organization. However, a term like 'virtual university' embraces a great variety of opportunities within higher education, some more widespread than others. Which of these forms will succeed in the long run is not yet decided. Current practice appears to embrace the following forms (see Brockhaus, Emrich, & Mei-Pochtler 2000):

- *Corporate university*: The term covers a broad range of different models of

continuing education including new (virtual) forms.

- *International educational consortiums*: International corporations have joined forces with renowned universities. Their customers will be students from all over the world who participate in 'virtual' seminars and form (virtual) communities with other students.
- *University networks*: Within university networks, those who elect to cooperate will exchange content presentations with the aim of sharing resources.
- *Virtual universities*: In the future, distance-teaching universities will offer – this we can assume – the complete subject range of a traditional university in 'virtual' form.
- *Alma Mater Multimedialis*: Increasingly, the traditional universities will integrate some online components into their on-campus courses, using different possible forms. Such online components may be add-ons to traditional lectures and seminars, offering some kind of reinforcement, or part of a 'mixed mode' course model with on-campus and Internet components. The established universities will be less likely to offer distance education in its pure form.

International experience gained so far with ICT in the higher education sector would suggest that *Alma mater multimedialis* is now the most common form of 'virtual' structure and will remain so in the future. On the one hand, it reaches many students while maintaining a high quality and intensity of the teaching presentations. On the other hand, it conforms to the desire of students between 18 and 24 years to be part of a 'real' learning community (see Brockhaus et al. 2000 p. 19).

An international study on 'Models of Technology and Change in Higher Education' (Collis, & van der Wende 2002 [<http://www.utwente.nl/cheps/documenten/ictrapport.pdf>]) raises the following question: 'Which scenarios are emerging with respect to the use of ICT in higher education and how can future developments be predicted and strategic choices be based on that?' (*ibid.* 8). One of their main findings is that regular on-campus enrolment is still the prevailing situation in most institutions of higher education. This is referred to as 'Back to Basics'. But many universities and colleges have begun to integrate multi-media elements into their regular courses and enable students to study without the restrictions of personal

attendance and of time. This may lead to some form of 'Global Campus'. Many universities and colleges are already heading in a direction, which the study calls 'stretching the mold'. This 'relates to increased flexibility with or without changing the underlying pedagogical model within the institution' (ibid. 12). One interesting result of this study is that, internationally speaking, there is very little difference in the use of ICT in higher education in different countries. An investigation of the change in institutions, of the use of ICT in teaching and as a medium of instruction, and of the role of instructors showed that differences were less significant between different countries than within these countries themselves.

To get a clearer picture of this process of change in Germany, we have undertaken an evaluation of existing concepts for integrating ICT into higher education. We want to investigate the extent of the change, as well as the sustainability of these effects.

3. Methodological and empirical background

Our study is based on „New Media in Education“, a program funded of the Federal Ministry of Education and Research (BMBF), which includes 100 projects involving 541 partners, and the expectation is that the projects will stimulate 'virtual' teaching substantially. This is the largest sponsored program ever launched in this sector in Germany (<http://www.gmd.de/PT-NMB/>). Our project keviH is concerned with the supporting research for this program. Our aim is to establish and analyze the present state of 'virtual' teaching at German universities and other relevant institutions in order to identify the potential for development and to assist both universities and political decision-makers.

In our evaluation study, we have analyzed project proposals for the sponsored program. Our method was to first draw up a list of criteria that covered all relevant factors for an evaluation. We then went through all written proposals, quantified the data, entered it into a database and processed it. The complete report of this study is downloadable at http://www.iwm-kmrc.de/keviH/infos/Virtuelle_HSLehre_Teil1_eng.pdf (see also Wedekind et al. 2002 [<http://www.iwm-kmrc.de/keviH/projekt/ICT-keviH.pdf>]) for an overview of the study). Recently, an online survey was conducted, in which the current developments in the

participating projects were investigated. Our focus and interest lie in the project guidelines, meaning their regional scope, professional disciplines and target groups, as well as the available topics, the extent of the implementation of multimedia and telemedia elements, and media competency. The complete report of our second study is downloadable at http://www.iwm-kmrc.de/keviH/infos/Virtuelle_HSLehre_Teil2_eng.pdf

4. Findings

In this section, we describe selected results from our two empirical studies. It is structured in the different levels described above: the micro-, meso-, and macro-level. At each level, we try to identify innovations in products, as well as processes. Percentages, given in the following paragraphs, refer to the total number of 100 projects. Multiple mentionings were possible.

4.1 Innovations on the micro-level

Starting on the micro-level, we explore the potential of new media in the realm of teaching and learning. In this connection, it is of interest, which objectives the projects pursue with the integration of ICT at the university-level. Analyzing the project requests, we discover that the projects aim to enhance the availability of contents (85%), to make teaching objects more illustrative by using visualizations and animations (82%), and to improve the motivation of the students (74%). In total, 74% of the projects expect an improvement of quality by using ICT. In order to carry out these goals, contents are provided in all projects. The degree of innovation is shown through the kind of contents generated. In many projects, the content is visualized and made interactive by multimedia applications like simulations (72%), animations (63%), or hypermedia (53%) (see Fig. 1).

A few years ago, most projects coping with ICT at the university-level were limited to supplying information to students, such as the download of lecture notes, literary references, appointments, etc. (Lewin, Heublein, Kindt, & Föge 1996 [<http://www.his.de/Service/Publikationen/Kia/pdf/Kia/kia199607.pdf>]). Thus, the innovative part of these ambitions dealt only with the better availability of contents. The data represented above show that now the formats and - relating to the technical animation - also the clarity of contents change. Self-learning processes are thereby supported.

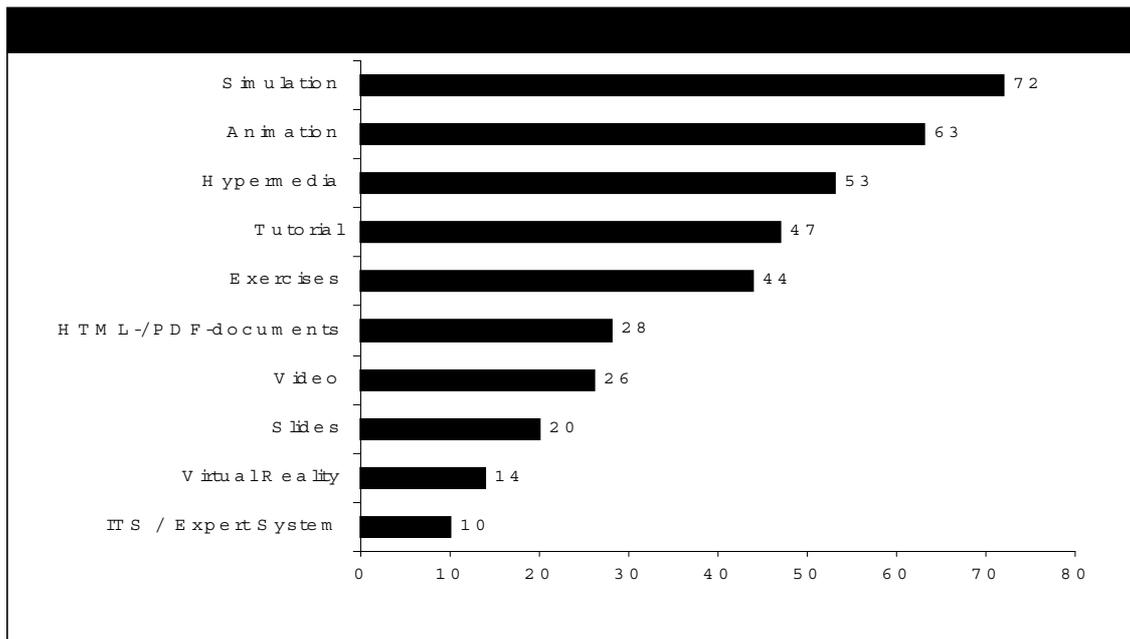


Figure 1: Multimedia applications (n=100 projects, multiple items possible)

Further innovative products, which evolve by the integration of ICT, can be constituted on the level of teaching and learning forms. Whereas the main forms of instruction at traditional German universities are

presentation-based, such as the lecture or the term paper, we investigated whether the implementation of new media would be accompanied by an increased implementation of new forms of teaching or learning.

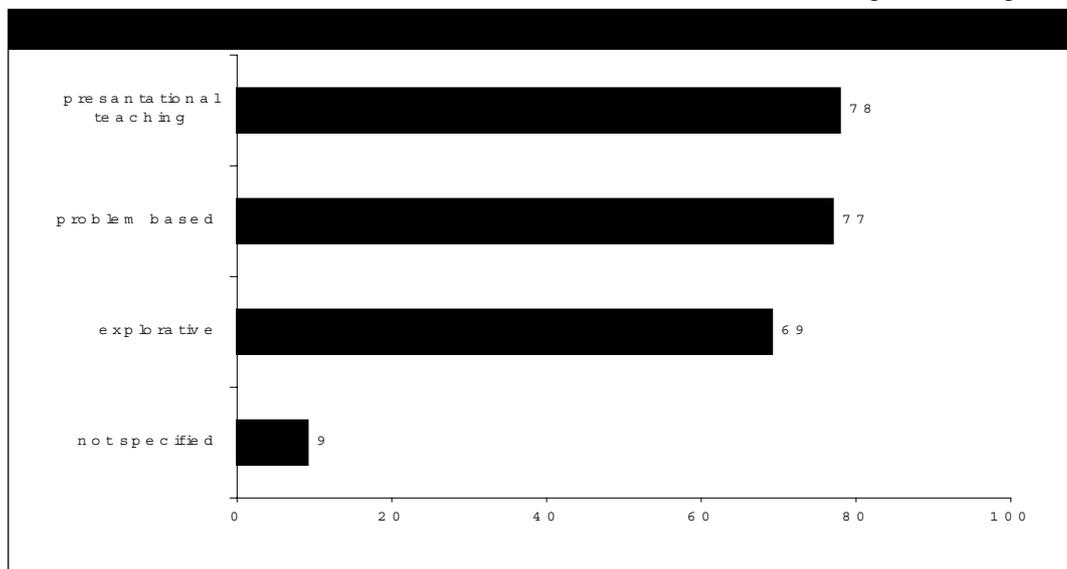


Figure 2: Forms of instruction (n=100 projects, multiple items possible)

Figure 2 shows that, in addition to the traditional presentational teaching form, the projects also implement problem-based learning and exploratory forms of learning (i.e., case-based learning, project learning).

In comparison with traditional university learning forms, a clear expansion of the

methodical scope appears to be emerging, which certainly benefits the quality of instruction. The more problem-based and exploratory orientation of instruction corresponds with the growing requirements for students to study independently, an ever-increasing demand due to the rapidly changing information society. Terms, such as Lifelong

Learning and Learning on Demand are cited as catchwords, representative of the changing educational and work domains. In addition to new products based on the utilization of ICT new processes emerge, which expand the possibilities for cooperation among teachers and students. In this context, the possibilities of net-based communication are relevant, which can be realized by e-Mail, Chat or Newsgroups, for example. Figure 3 illustrates

the forms of net-based communication at the virtual university. Implemented tools span the entire range of network-based communication. The integration of simple telemedia elements like chat or e-mail is frequently mentioned. More complicated applications, such as video conferencing or application sharing, are planned on a much smaller scale.

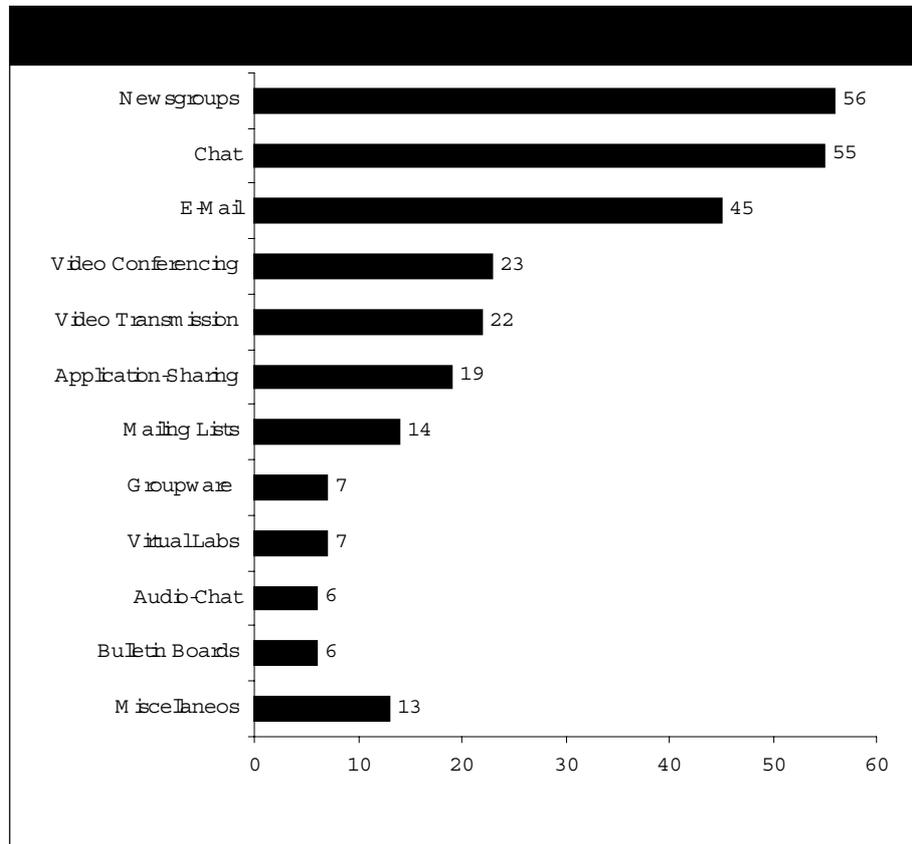


Figure 3: Telemedia applications (n=89 projects, multiple items possible)

The projects use these tools to cover several functions within the instructional process. In 77% of the projects, communication is a component of the learning environment. Net-based communication proceeds between instructors and students, as well as among students themselves. In 49% of the projects, net-based cooperation is intended. 26% of the projects use the net to implement coordinating tasks. As a result, the leeway in designing the instructional process has been expanded by extended temporal resources and the independence of space. New operational sequences of cooperation between instructors and students, as well as between students themselves, are possible.

4.2 Innovations on the meso-level

Innovations can also be observed at the university level, or meso-level. In our survey, the projects indicate that in addition to the traditional university facilities, such as libraries and continuing education centers, there is also a cooperation with media centers. This means that the integration of ICT on the micro-level requires structural changes that ensure the activities will be sustainable. The development and relocation of central university facilities to support instructors with the planning, conception and implementation of (partially) virtual functions is currently being intensively discussed (i.e., Kerres 2001, Dittler, & Bachmann 2003). In addition to this new media center product, processes on the meso-level are also changing. 41% of the projects indicate

on the application that they outsource portions of the project work to external partners. In

Figure 4, the respective sections are named.

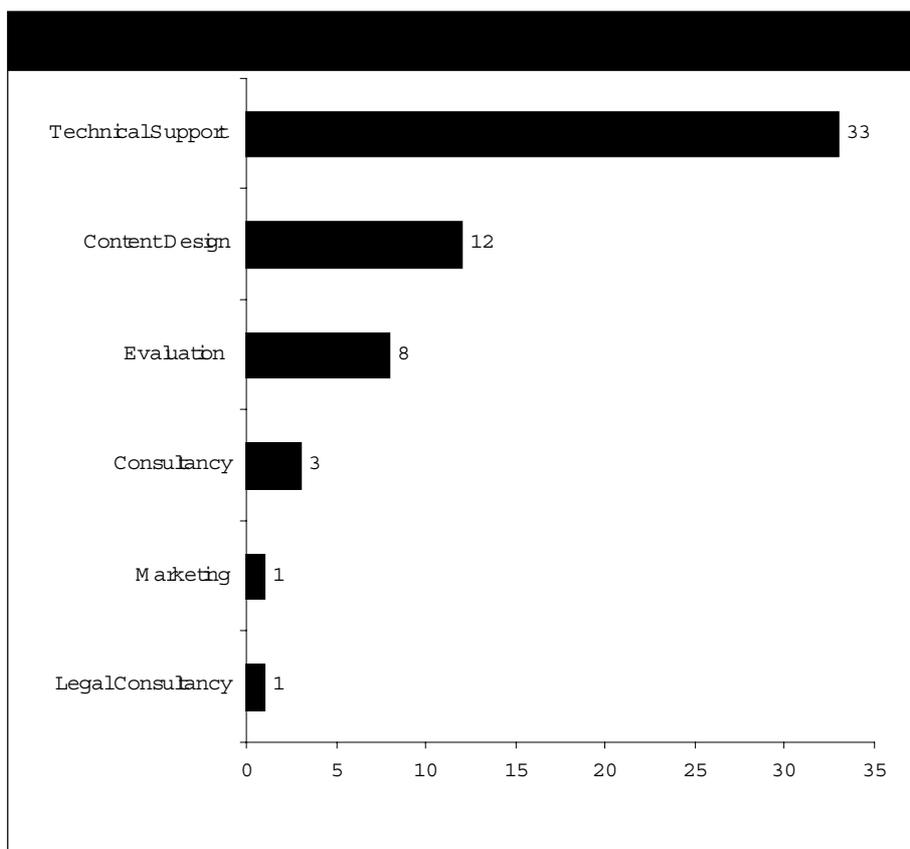


Figure 4: Outsourcing (n=41 projects, multiple items possible),

It turns out that the integration of ICT in instructional learning contexts results in numerous tasks, the nature of which go far beyond the conventional demands placed on scientists, requiring the consultation of external experts. This generally interdisciplinary cooperation requires a greater structuring of the planning and development processes than would be the case with traditional types of events.

4.3 Innovations on the macro-level

The macro-level is the policy level that extends beyond the university itself. On the one hand, it is surely the level in which changes occur only slowly. On the other hand, an important impetus can be given by the government. The sponsored program, which is investigated in this paper, is an example of such a top-down action.

In the project requests, we can identify indications that innovations take place at the macro level. One such indication is the establishment of courses of study, which can be accomplished at more than one university in different countries (see Fig. 5).

It is obvious that, similar to international developments (Brockhaus et al. 2000), university instruction is primarily enhanced by virtual elements. Nevertheless, there are at least 10 projects planning a complete course of study. Without ICT the only possibility to perform a distance study would be through the Open University. Due to the increasing integration of ICT in traditional universities, new possibilities for distance studies will emerge.

Another innovation on the macro-level is closely connected to the last point mentioned above. According to the criteria of the ministry, nearly all funded projects (92%) cooperate across state boundaries (cooperation was one of the central prerequisites to get funded). Beyond this, in our online survey, 30% state that they cooperate with international partners. The national, as well as the international, cooperation requires new processes of coordination between the partners to organize the instructional process. It implies e.g. the assimilation of curricula, which, at least in Germany, are different in every federal state.

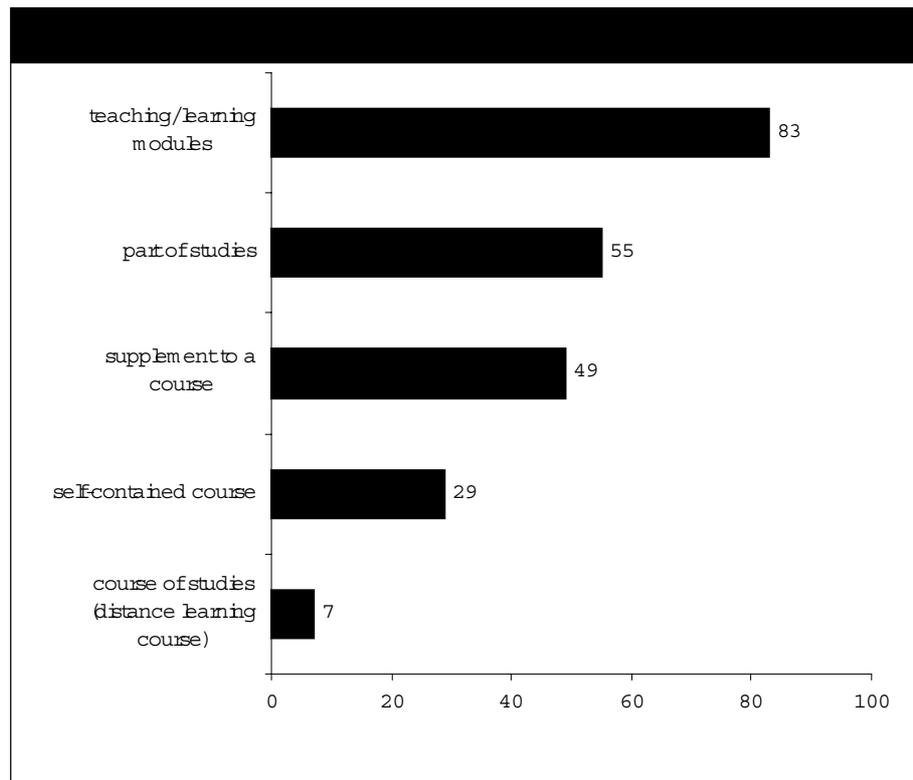


Figure 5: Granularity of products (n=100 projects, multiple items possible)

5. Implicit Potential for Challenged Students

We want to exemplify on the special target-group of challenged students how far-ranging the innovations of ICT at university can be. Therefore we use selected results of our investigation and apply them to the situation of challenged students at university. Their situation is characterized by problems and hurdles that hinder the actual goal of successfully completing their studies (Boehmler 1996). Depending on their particular disability, challenged students have to live with varying limitations: from stairs that cannot be negotiated by the physically challenged, thereby blocking their access to lectures, to blackboard diagrams drawn too small for the visually challenged to decipher.

One possibility for improving the situation of challenged students, which has been neglected up until this point, is that of the increased integration of ICT into traditional university-learning. ICT in the form of prosthetic aids has enjoyed broad implementation, especially for the visually and mobility challenged, clearly expanding their ability to participate more fully in society (Coombs, 2000

[\[http://www.rit.edu/~nrcgsh/arts/dublin.htm\]](http://www.rit.edu/~nrcgsh/arts/dublin.htm)).

Albeit there are some studies relative to distance learning and challenged students (Ommerborn, & Schuemer 2001

[\[http://www.fernuni-hagen.de/ZIFF/ommsch4.doc\]](http://www.fernuni-hagen.de/ZIFF/ommsch4.doc),

Schmetzke 2001

[\[http://www.rit.edu/~easi/itd/itdv07n2/axel.htm\]](http://www.rit.edu/~easi/itd/itdv07n2/axel.htm),
Stewart 1999

[\[http://www.dinf.org/csun_99/session0179.html\]](http://www.dinf.org/csun_99/session0179.html)

), the potential of ICT as an instructional medium in traditional learning environments -- beyond the use of simple CBTs -- has not been sufficiently explored. We support the hypothesis that the utilization of ICT can reveal numerous opportunities for challenged students to better participate in the process of knowledge acquisition and communication.

To determine this opportunities, we must specifically analyze our investigative data on the situation of the virtual university in terms of its relevance for challenged students. Even though the project proposals and our online-survey contain no explicit references as to which measures would be advantageous for challenged students, the implicit potential for this target group is, nevertheless, ascertainable from the data.

5.1 Multimedia

Multimedia study materials can present information in various modes (visual, auditory) and codes (various symbol systems). Examples of multimedia products implemented in the virtualization of a university are shown in Fig. 1. Multimedia products span an enormous range, from simple PowerPoint slides to intelligent tutorial systems. The implicit potential of Multimedia for challenged students lies in its redundancy. The more redundant the presentation of information (i.e., visual and auditory), the greater the potential for challenged students to process information in accordance with their respective capabilities (Coombs 2000

[<http://www.rit.edu/~nrcgsh/arts/dublin.htm>],

Ommerborn, & Schuemer 2002

[<http://www.fernuni->

[hagen.de/ZIFF/behfs3.pdf](http://www.fernuni-hagen.de/ZIFF/behfs3.pdf)]). Simulations are especially meaningful, since they allow challenged students to experience various phenomena in a plot-oriented fashion.

5.2 Network-based communication

In network-based exchange processes (see Fig. 3), communication conditions are fundamentally altered. Typical reference stimuli for face-to-face situations, such as the conversation partner's appearance, facial expressions or gestures, are reduced in network-based communication (i.e., video conference) or are simply not conveyed (purely text-based communication). Effects of this media-generated anonymity include the blurring of differences in status and roles in conversations, resulting in a democratic effect on communication, which can then lead to uninhibited behavior (Sproull, & Kiesler 1986, Dubrovsky, Kiesler, & Sethna 1991). This anonymity provides challenged students the opportunity to appear and operate as equal communication partners, without the stigma of a disability.

Reduced output speed during text-based communication can be an impeding factor for students with limited motor capabilities. Communication via synchronous communication tools, such as chat or application sharing, often proceeds too quickly for them. The more free the communication situation (time and place), the better the chance of compensating for problems caused by a disability.

5.3 Didactic organization

The expansion of the methodical scope induced by ICT (see Fig. 2) is a decisive advantage for challenged students. Representational forms of instruction reduce the opportunities for instructors to address the specific needs of individual students. Both tempo and representational form are tailored to "normal" students. The concerns of the challenged students become very difficult to assimilate in this scenario. In contrast, problem-based and explorative forms of instruction enable the students to be actively involved in the teaching-learning process. With these forms of instruction, students can much better regulate the tempo for advancement and choose for themselves what information they need in order to acquire the knowledge desired.

6. Conclusion

The integration of ICT in instructional contexts changes the learning environment to a greater extent than traditional media would, because of the computer's universality. The implementation of ICT enables not only the visualization of information, but the combination of computer with online capability is an essential part of the learning environment. This combination induces innovations on all university levels. Figure 4 summarizes the innovations.

	Micro-level	Meso-level	Macro-level
Innovative products	New forms of learning and instruction	Establishment of media support centers	New possibilities for distance study
Innovative processes	New communication processes	Increasing necessity of interdisciplinary cooperation	Increasing cooperation with distributed partners

Figure 6: Innovations induced by the integration of ICT in institutions of higher education

Figure 6 clearly illustrates the emergence of changes on every level, which expand the

possibilities for instruction and study. It is important to note that innovations on the lower

level can only establish themselves long-term, if the appropriate basic conditions are created on the upper levels. In other words: innovations in higher education will fail, if they are not sufficiently institutionalized (Levine 1980). In contrast to the above-mentioned prognoses, the innovations are closely linked to the traditional university. Therefore, no independent virtual universities originate within the framework of the funded program, but rather partial areas/segments o. subareas are virtualized based on the traditional universities. The innovations expand the spatial and temporal flexibility of instructional events and make information access easier. Expanded flexibility leads to new event forms, which constitute themselves from the interplay of real and virtual components (Blended Learning). This corresponds with the results from the above-mentioned international study by Collis & van der Wende (see Collis, & van der Wende 2002). The integration of ICT at universities does not, therefore, lead to a radical change of the institution. This was also not the objective of the sponsored program. Their integration does lead, however, to greater didactical and organizational diversity. The reason for this lies in part in the narrower bandwidth of virtual communication. Despite the possibility of an audio-video conference, virtual communication can only produce a limited connection between people: the „aura“ of a professor is still not transmittable via media. In this respect, the traditional, „real“ event remains the first choice for the socialization of young students into the alma mater.

Also in relation to the asserted innovations in the area of didactics is a certain level of scepticism appropriate. It remains questionable whether the changes will really be implemented broadly. The introduction of all media into the instructional context has raised hopes for a change in the didactics in addition to new pedagogical conceptions. Regardless of whether radio, television or language lab, none of these media has fulfilled expectations over the long run (compare with Haugan, & Hopmann 2003). It is becoming apparent that the university is stable at its core; in other words, the bulk of instructors will continue to teach in the traditional form and the bulk of students will enrol at a traditional university. The university is, however, most definitely flexible in its peripheral zones (ibid.). What we have been able to observe over the past few years, as well as in our study, is that many more changes are carried out that supplement the „core“. This can consist of additional

information or communication for an instructional event in the net, for instance, or better virtual access to university facilities, such as libraries.

By applying our data to a special target group like challenged students, we could show the potential within the process of innovation experienced by the university as a result of ICT integration. Even if those students with disabilities are not the primary target group of these integrative efforts, they still profit from the resulting intrinsic possibilities.

Tendencies, which alleviate everyday student life should be continued in a purposeful manner. Their execution should not, however, be technologically driven. Rather, it is necessary for participants at all levels to actively and jointly develop the university's future through the use of ICT.

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