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Internet Use at the University: A Comparative Analysis Between Students of the Pennsylvania State University (USA) and the University of Cologne (Germany)

Patrick Ploenes
University of Cologne, patrick.ploenes@uni-koeln.de

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Patrick Ploenes
IEEE Conference Publishing
University of Cologne
Department of Media Management
Pohligstr. 1
50969 Cologne
patrick.ploenes@uni-koeln.de

American universities are thought to be ahead of universities in Europe in terms of use of the Internet for students' learning processes.

This study with a total of 893 participants in the US and in Germany investigates the use and the perception of the Internet for educational purposes with a special focus on three learning scenarios, *instructional*, *collaborative*, and *autonomous*.

The study confirms the more extended use and the better perception of the Internet in the US. It outlines several explanatory factors and concludes with the need for further investigations regarding the reasons behind this too easily accepted well-known trend.

I. INTRODUCTION

The Internet is quickly becoming the dominant mass medium of the digital age. As such it has strong educational impact [1]. But although academic institutions create and acquire knowledge, universities typically lag businesses by roughly a decade in the adoption of new technologies that make students' learning processes more efficient [2].

In the age of globalization, rapidly shortening innovation cycles permanently produce new knowledge. Most of it is stored and accessible on the Internet. Today´s student will become the knowledge worker of the 21st century, who has to constantly deal with pieces of information of different significance, validity and importance. Consequently, the students must be prepared to the challenge of a lifelong learning process and their universities should help them to get ready for it.

The Internet is both resource and mediator of information. If mastered carefully, the Internet may remove "boundaries inherent within the traditional classroom, facilitating the extension of learning paradigms that support active learning and ease of communication [3]." Moreover, with the vast resources the Internet provides students will have to learn, as MacFarlane [4] puts it, "to manage their learning processes to an unprecedented degree... to swim in a sea of information, to use the rich resources of a supportive learning environment, to self pace and self structure their own programs of learning."

II. RESEARCH OBJECTIVES AND QUESTIONS ADDRESSED

The more market-driven business schools of the Anglo-American hemisphere are traditionally setting the pace in the application of new innovations. In United Kingdom, The Open University [5] has been using computer conferencing systems since 1986, in the USA, Peterson's college guide had already listed 762 so-called cyber schools in 1997 with more than one million students, many of them providing degree certificates [6].

Compared to that, German universities are only making slow progress. Most of the 151 guided projects reported in 1997 that dealt with online learning environments were early pilots, and only a few were considered to be a serious alternative to the traditional way of learning then [7].

To get comparative data on this issue, the students of the University of Cologne (UC) and the Pennsylvania State University (PSU) were interviewed on how they use the Internet for their educational purposes. Specifically, the following research questions were raised:

Research question 1: In what way do students of both universities differ in the amount of the Internet use and in the attention they spend on the different Internet services?

Research question 2: In what way do students of both universities differ in the Internet use with regard to different concepts of learning, as suggested in learning theory?

Research question 3: In what way do students of both universities differ with regard to certain factors that have proved to promote Internet use for learning purposes due to empirical research?

III. THEORETICAL FOUNDATION

Learning theory often suggests two different perspectives known as objectivist and constructivist models of learning.

The predominant objectivist (or behavioral) paradigm holds a single reality that can be modeled and mapped onto the learner [8].

According to the behavioral roots of the objectivist view knowledge is understood as a completely and correctly structured complex of coherent information that must be absorbed by the learner in order to reflect reality as interpreted by the instructor [9]. Consequently, learning means a change in the behavioral disposition of an organism based on the new insights gained.

The traditional teaching-centered, *instructional*, model stems from the objectivist approach. Thus, the presentation of knowledge is essential to the objectivist in order to effectively transfer the knowledge from expert to learner [2]. The passive role of the learner is often criticized since it is thought that acquired knowledge remains inert and as such can hardly be applied in ill-structured situations.

The constructivist view assumes that the individual actively constructs reality. The mind filters and interprets its perceptions according to its experiences and values, rather than seeking to remember, and keep objective knowledge. Learning occurs while interacting with the surrounding environment in order to build up a personal view of reality. Consequently, the constructivist way of learning requires learner-centered instruction. The instructor rather supports than directs the learning process enabling the learner to discover things by himself. According to the constructivist view, a higher engagement level during the learning process makes it easier for the learner to apply knowledge within different contexts.

During the *constructive* learning process the learner either acts *collaborative* or *autonomous*.

Autonomous learning focuses on the way the learner himself explores unstructured knowledge domains from different intellectual perspectives [10], whereas, collaborative learning occurs due to peer interaction and emerges from shared concepts of understanding.

None of these models necessarily has to be the best approach. Indeed, the choice of the learning model should depend on criteria, like students experience, maturity, motivation, and instructional objectives, among others.

Euler [17] suggests that the Internet enhances the presented forms of learning in two ways: Firstly, Internet services facilitate the accessibility and the flow of information, and in doing so enable better learning conditions. Secondly, the Internet mediates educational concepts of learning, such as multimedia, hypertext, and groupware, which are thought to provide richer learning environments and pose as an added value compared to traditional teaching.

Both the different Internet services and the educational concepts correspond more to some forms of learning than to others [11]. In terms of instructional learning it is mainly the Internet services called the World Wide Web (WWW) and File Transfer Protocol (FTP) that help to access the learning material more efficiently. Lectures can be broadcast real-time by means of Audio- and Videoconferencing via the World Wide Web or may be stored on an FTP-server to enable access to the course content regardless of time and place. Moreover, Multimedia as educational concept helps to enrich the presentation of the course content, e.g. with tone or film documents or even with tricky animations.

Contrary to the objectivist approach that aims at transmitting knowledge as efficiently as possible, the constructivist view intends to provide complex learning environments. This assists the learner in active knowledge acquisition [12]. For the autonomous learner, the hyperlink structure of the World Wide Web may provide such a constructivist learning environment. The node structure allows the learner to access, analyze, and organize pieces of information due to his own intellectual capacities. The continuous process of reasoning and personal judgment is believed to let the learner internalize the knowledge in a more valuable manner than by means of instructional learning. However, this way of learning may not always be useful. Thus, students with little working knowledge may feel a lack of structure and may be disconcerted by the richness of the available information [2]. This phenomenon is often referred to as being lost-in hyperspace or as information overload.

As to group learning processes, asynchronous Internet services such as email and mailing lists ease the exchange of data and help to discuss course content and validate different views and insights. The chat systems also do the same function with regard to synchronous communication tools. This way, group-learning processes are supported as shared mental models emerge within a learning group of remote users.

Groupware as an educational concept also offers a learning environment of added value. It is specifically designed to foster group-learning processes and therefore contains shared workspaces that allow creating something collaboratively at the distance. Within these shared workspaces remote screen sharing, decision support systems, and brainstorming tools help to efficiently design the learning process.

A hybrid form of both cooperative and autonomous learning is the gathering of information through Newsgroups. The blackboard of a Newsgroup can be seen as a resource of expert knowledge to access further information in the sense of autonomous learning. But it can also serve as a forum for people who share the same interests, and thus provide the breeding ground for collaborative learning.

Table 1 outlines potential applications of technologies with regard to learning processes.

Type of learning	Instructional learning	Collaborative learning	Autonomous learning
Learning model	Objectivist	Constructivist	Constructivist
Learning by	Presentation	Interaction	Exploration
Internet services	▪ WWW ▪ FTP ▪ AC[a] ▪ VC[b]	▪ Email ▪ Mailing list ▪ Chat ▪ AC ▪ VC ▪ Newsgroups	▪ WWW ▪ Newsgroups

[a] Audioconferencing
[b] Videoconferencing

IV. EMPIRICAL FOUNDATIONS OF THE STUDY

Empirical research suggests some success factors that proved to promote Internet and computer use for learning purposes [14-16]:

A. Experience with technology

A large body of research has been done to demonstrate the effect of computer/ Internet experience on the educational use of information technology (IT) at the university. Selwyn [13] indicates in his study that home computer experience especially influences the use of the Internet services, WWW, and email. To evaluate students' experience with technology the respondents were asked about the period of their computer and Internet experience in general, whether they had a homepage or not, and, what their primary source of learning about the Internet was.

B. Connectivity and access

High connectivity and easy access to the Internet services are thought to be one promoter for integration of those technologies into students' learning processes [14-16]. This is also backed by diffusion theory that says an innovation (i.e. the educational use of Internet services) depends, among other things, on the quality of the channel (i.e. the Internet) by which the innovation is disseminated [18]. To assess the feasibility in Internet use at the university, connection speed and the location from where students accessed the Internet were evaluated.

C. Perceived characteristics of the Internet

Anderson's [14-16] empirical research on network use indicates, that the way students perceived certain characteristics of the Internet, plays an important role in the adoption process. She specifically asked about what students thought of the quality of their Internet connection, how they perceived the Internet services in general, how they rated them in terms of the value for their studies, and what they thought about the quality of assistance they got at their university when accessing the Internet.

The study was part of the VIRTUS (Virtual University Systems) Project of the Faculty of Economics, Business Administration and Social Science at the University of Cologne.

The students of this faculty and its counterpart at the PSU, the MARY JEAN AND FRANK P. SMEAL College of Business Administration, formed the target group. When the study was conducted, the Cologne faculty counted approximately 10,000 and the PSU faculty more than 6,300 students.

In order to follow the given time restrictions and because of the difficulty to get the personal data of the UC students due to Germany's high data security standards, a cluster sample was chosen over a mailing survey, whereupon each course of the course curriculum formed a cluster. Courses to participate in the study were selected at random. The lecturer was contacted and asked, if the questionnaire could be filled out during class time. Almost all of the lecturers cooperated. The completion of the questionnaire was estimated to take between 10 and 15 minutes per student.

The survey was conducted in December 1998 at PSU and from January to April 1999 at UC. 446 students at PSU and 447 at UC responded giving a response rate of close to the expected 100 % due to the overall support and cooperation of the instructors. A 78-item questionnaire, based on the work of Anderson [14] served as instrument to evaluate how the students deal with the Internet in terms of learning. Thus, reliability and validity of the questions were ensured through their use in previous studies.

V. RESULTS

A. Demographical data of the respondents

UC students usually enter university about two years later than their fellow students in the USA. Consequently, the mean age of the respondents at PSU was 20,5 years compared to 22,8 years at the University of Cologne.

The participants were mainly in the second (PSU) or third year (UC) of their studies. 62,3 % of the UC and 50,6 % of the PSU students were male.

Most of the UC students were financially better situated with 80,4 % (PSU 48,2 %) responding to the category of more than $ 350 being monthly available to them (after deducting housing and food).

B. Amount of use

The total amount of Internet use was subdivided into the categories 'Email', 'WWW', 'Mailing Lists', 'Chat',

'Newsgroups', 'FTP' and 'Audio- and Videoconferencing', i.e. the Internet services that were thought to improve learning processes (see Table 1). A general use of the Internet services was evaluated as well as the time the respondents spent on them each week. Students were asked to rank the importance of the different Internet services with regard to their studies. The students also assessed how many people they regularly contacted via the Internet.

1) *General use of the Internet*: At both universities, the use of email and WWW has dominated other services. 91,5 % of the PSU students used email, compared to 74,5 % of the UC students, and 90,2 % of them browsed the WWW for information, compared to 73,8 % of their UC fellow students. Other services were not by far as popular: Mailing lists were employed by 19,7 % of the UC and 13,6 % of the PSU students, 25,3% PSU students used Chat services as against 15,7% at UC. Regarding Newsgroups and FTP at both universities it ranged from 7,8 to 12,1 %. Audio- and Videoconferencing were neglectable to students from both countries (see Table 2).

2) *Amount of connection time:* As outlined in Table 3, PSU students spend, with 10,6 hours compared to 5,7 hours per week, almost twice as much time on the Internet than their UC fellow students. Both, PSU (4,7 hours per week) and UC students (3,2 hours per week), favored the WWW as their prime source of information. With 4,5 hours weekly, PSU students devote more than twice as much time for email and use the chat services even four times more than the students of the University of Cologne. The other Internet services had minor importance to the students and only counted for 0,2 hours per week in each country.

3) *Ranking of Internet service with regard to studies:* Students had different ideas regarding the importance of the countries. While 61,4 % of the PSU students considered the WWW more important than email with regard to their studies, the majority of German students (58,9 %) ranked email as their first priority followed by WWW as their second priority.

TABLE 2
GENERAL USE OF INTERNET SERVICES(IN %)

	WWW	Email	ML[a]	Chat	NG[b]	FTP	Other
UC	74,5	73,8	19,7	15,7	10,7	9,8	5,6
PSU	91,5	90,2	13,6	25,3	12,1	7,8	4,5

[a] Mailing list
[b] Newsgroups

TABLE 3
WEEKLY USE OF THE INTERNET (HOURS PER WEEK)

	WWW	Email	Chat	Other	Σ
UC	3,2	2,0	0,3	0,2	5,7
PSU	4,7	4,5	1,2	0,2	10,6

4) *Interpersonal contacts over the Internet*: PSU students used the Internet more often as a communication tool than UC students. Over 50 % reported to contact more than 6 persons from their university (peer students or faculty/ staff members) regularly as opposed to only 17,9 % of the UC students. 28,8 % of the German students even claimed not to contact people from their university over the Internet, whereas 50 % of them (and 64,7 % of the Americans) kept in touch with more than six people other than from their university.

C. Use of the Internet in terms of instructional, autonomous, and collaborative learning processes

Following the concepts shown in Table 1 the items evaluated both the frequency with which those technologies were used within the corresponding forms of learning and the gratifications the students obtained from their use.

Answering categories comprised the statements *never, seldom, sometimes,* and *often* for the autonomous and collaborative learning processes, and *none of my courses, some of my courses, most of my courses* and *all of my courses* for the instructional learning domain.

1) *Instructional learning*: In the domain of instructional learning the attitudes of the UC students towards the employment of the Internet were more positive. 37,7 % reported to download course material for most of their courses compared to only 27,2 % at PSU. 46,9 % of the German students, compared to 62,2 % of their PSU fellow students downloaded course material only for a few of their courses. Additional material provided by the instructors was accessed by 55,7 % of the UC students for certain courses and by 58,3 % of the students at PSU.

2) *Autonomous learning:* Autonomous learning within the context of the university takes place when students have to do research on a certain matter, e.g. while preparing a paper or a thesis. As such the learner has the need to acquire expert knowledge. Newsgroups and email can be powerful tools to contact experts all over the world in a direct and informal manner. Unfortunately, neither PSU nor UC students made very much use of this possibility. 40,2 % of the UC and 36,6 % of the PSU students even said that they had never contacted an expert by email, and 75,3 % of the UC and 77,9 % of the PSU students had never used email with regard to their studies.

The WWW, however, was much more popular with PSU students. 88,4 % of them indicated the use of WWW for research on a paper/ thesis often (53,3 %) or at least sometimes (35,1 %). As opposed to that, 34,5 % of the UC students denied the employment of Internet for those matters, and only 9 % reported to use it often.

A similar discrepancy was noticed in the use of databases provided by the universities, i.e. CD-Rom databases. 78,7 % of

the PSU students reported to use those tools sometimes (37,7 %) or often (36 %), whereas the majority of the UC students (38,8 %) never or (29,9 %) seldom made use of it.

3) *Collaborative learning:* Groupware, email and mailing lists can enhance cooperative learning processes. However, neither PSU nor UC offered a groupware application to the students. Still, there are many groupware applications available on the WWW, and in addition some widely accessible software, such as Microsoft NetMeeting or Microsoft Outlook offer groupware features. However, especially students from the University of Cologne hardly use these tools. Thus, 66,6% reported of never having used the Internet to collaboratively work on a paper or thesis. And only 2,4 % indicated to use it often. The PSU participants had a slightly more positive attitude: Altogether, 27,7 % said to use Internet services in terms of collaborative learning while more than one third (35,4 %) fully denied their use.

The coordination of learning groups via email proved to be relatively popular at PSU. More than 71,6% indicated to use this way of communication to coordinate the schedules sometimes (41,7 %) or often (29,9 %). Opposed to that, 68,2 % of the German students said they never used email for those matters. Mailing lists, on the other hand, were hardly employed at both universities. 96,4 % of the UC and 80,4 % said they had never subscribed to a mailing list of a course.

D. Factors influencing Internet use

1) *Experience with technology*: PSU students showed much more experience with Computer and Internet use. Over 65 % (UC 39,9 %) of the respondents had already been using a computer for more than five years and only 0,9 % (11,2 % at UC) reporting to have less than one year of computer experience. Most of the PSU students had been using the Internet between three and five years (69,2 %) while 78,7 % of the UC students had done so for between one and two years (41,8 %) or even for less than a year (36,9 %). 23,2% of the PSU students said to have a homepage of their own compared to 9,9% of their UC fellow students. When asked for the primary way they learned about the Internet, 73,0 % of the PSU students and 34,6 % of the UC students responded to the category self-taught, while 19,1 % (PSU) and 33,7 % (UC) named friends or peer students as their primary source.

Table 4 outlines students' computer and Internet experience at PSU and at UC.

TABLE 4
EXPERIENCE WITH COMPUTERS AND INTERNET

	No statement	< 1 Years	1-2 Years	3-5 Years	>5 Years
Computer use					
UC	1,6	11,2	18,6	28,7	39,9
PSU	0,7	0,9	4,3	29,5	64,6
Internet use					
UC	0,1	36,9	41,8	19,9	1,3
PSU	0	2,5	22,0	69,2	6,3

2) *Access and connectivity:* Both at PSU (59,2 %) and at the UC (58,7 %) the majority of students logged on to the Internet from their homes while 35,5 % of the PSU students (28,6 % of UC students) used computer labs for Internet access. 6,0 % of the PSU and 3,5 % of the UC students reported to get into the Internet from somewhere else, e.g. from a friend's house. 6,7 % (Germany) and 1,8 % (USA) made no statement to this question. Connectivity speed was usually much higher in the USA, since 47,4 % of the PSU students, as opposed to only 13,8 % of the UC students, had the possibility of a high speed Ethernet-connection to log on to the Internet. However, 37,9 % of the German students compared to 12,4 % of the PSU scholars had a connection speed of more than 56,000 bits second (b/ps). This comprises ISDN connections being far more popular in Germany than in the USA. 32,6 % (USA) and 34,5 % (Germany) used a modem speed of less than 1,200 b/ps, and 5,7 % of the PSU, and 15,4 % of the UC students made no statement to this question.

E. Perceived Characteristics of the Internet

Four categories - each subdivided by several items - measured how students think about the Internet in general and how they perceive the Internet connection facilities of their University. Semantic differential scales measured all the items, with one as the lowest and five as the highest value (see Table 5).

1) *General perception of the Internet:* Students responded to five items that measured perceived ease of use and utility of the Internet. PSU students found that the Internet is relatively easy to use while rating it easier, simpler and more understandable than their UC fellow students. Also, the PSU students appreciated the utility of the Internet as highly efficient and more useful than the German students.

2) *Value for studies:* 23,8 % of the PSU students found that *the Internet had revolutionized their work/ communication processes* as opposed to only 9,4 % of the students of the University of Cologne. Further 56,9 % of the Americans said it was useful to them in many respects compared to 41,5 % of the UC students.

TABLE 5
STUDENTS' PERCEPTIONS OF THE INTERNET[a]

Value (1)		Value (5)	UC ∅	PSU ∅
General perception of the Internet				
Useless	-	Useful	3,3	4,0
Confusing	-	Understandable	3,6	2,8
Efficient	-	Inefficient	2,9	3,8
Perception of the Internet equipment at the university				
Distant	-	Close	2,8	3,7
Inaccessible	-	Accessible	3,1	4,1
Convenient	-	Inconvenient	2,9	3,9
Slow	-	Fast	2,5	3,5
Perception of computer consulting services				
Distant	-	Close	1,9	2,9
Inaccessible	-	Accessible	2.0	3,1
Poor	-	Excellent	2,1	3,0

[a] The items were all measured by semantic differential scales, with one as the lowest and five as the highest value.

3) Quality of Internet connection: The items accessibility, distance, response, and convenience measured the students' perception of the Internet connection. The PSU students perceived their Internet access, compared to their UC fellow students, as faster (mean 3,5 compared to 2,5), more convenient (mean 3,9 compared to 2,9), better accessible (mean 4,1 compared to 3,1), and nearer-by (3,7 to 2,8).

4) Assistance: The students were also asked how they rated the computer consulting services their university offered. This category comprised the items accessibility, distance from the next help desk, and quality of the assistance received. Again, PSU students had a better impression of the quality of their consulting services than their German fellow students. However, the items did not get such a high rating as the quality of the Internet connection did.

VI. ANALYSIS

The study indicates that PSU students are more familiar with Internet than their UC fellow students. The respondents in both schools had a similar attitude towards employing different Internet services, with WWW and email being the most popular Internet services at both universities (research question one).

The following numbers are especially noticeable: With 10,6 hours, the PSU student's weekly Internet time was almost twice as high as the time spent on the Internet by UC students. With a penetration rate of over 90 % almost every PSU student used Internet and email, in contrast to approximately 75 % of the students in Cologne.

However, this discrepancy does not show in the employment of more sophisticated means of communication. At PSU too, the more recent media achievements like Videoconferencing and Groupware are of lower significance.

Regarding the employment of Internet services for different forms of learning PSU students used the WWW more for autonomous learning processes, e.g. browsing the Web to find valuable information, while their UC fellow students in particular downloaded course material. As to collaborative learning, PSU students coordinated most of their group work over email, this was not the case for UC students, and they had also more had email partners.

These findings generally show that the Internet is taken more for granted among the PSU students than at the University of Cologne. At PSU, the Internet has already become an everyday communication and research tool. It helped and integrated in students learning processes.

Possible explanations could be that PSU students had about two years more experience with the Internet technology and computers in general, and that about 25 % of the PSU students had a homepage of their own, compared to only 9,9 % of the UC students. Also, perception of the Internet was more positive at PSU than at UC. In addition, PSU students rated equipment and support far higher than their fellow students at the University of Cologne did.

VII. CONCLUSION AND OUTLOOK

The study explored differences in the actual use and the perception of the Internet in two graduate schools, PSU and UC. It indicates a generally speaking higher use and better perception of the Internet at PSU.

While this result may not be surprising, it triggers the need for more detailed explanations as regards the driving factors behind the stated results. The general answer that the US is ahead of the Internet is too easy and insufficient.
Additional studies are planned to further exploit to what degree

    a.) the more market-oriented US university system, or

    b.) the main focus on different learning styles

can serve as explanatory footers.

For the time being, this study tries to create some awareness in Germany and German universities in particular concerning the *room of improvement and extension* of Internet use for learning processes.

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