DEUTSCHE INITIATIVE
FÜR NETZWERKINFORMATION E.V.

Learning Spaces in Higher Education

2013 - Recommendations of the DINI-Workgroup „Learning Spaces"

Recommendations – Summary

Let's talk about „Academic Learning Spaces"
Institutions of Higher Education have to take up the issue of learning spaces on the level of strategy and central management. This extends to their conception, controlling, profile building, planning of organization and development, allocation of resources and the need for research.

Promoting Development of Competence – Information Literacy
Information literacy is a key competence in academic education. Learning spaces support its development by extending views on contents and by enabling important academic cooperative work.

Conception instead of Isolated Solutions
Definite planning and design of workplaces - in the context of learning spaces - starts from a conception, centred on the requirements of users. For this it is necessary to zone and differentiate sectors of work places.

No Stereotype
A wide variety of workplace settings and equipment are available for individuals and groups reflecting the diversity of learning scenarios. Also, training rooms, which form an important part of the infrastructure, need to be oriented towards user requirements. Workplaces supporting BYOD (Bring Your Own Device) are necessary to provide for the „Digital Natives".

Learning Spaces 2.0
Present day students, with their affinity to media and technology of web 2.0, expect to use technology for teaching and learning. Virtual spaces supplement and enrich physical learning spaces – technically as well pedagogically.

1. Introduction

The number of students in Higher Education in Germany is constantly on the rise: The present number of 2,5 million is the highest ever. Therefore, the universities are faced with the challenge to provide conditions to accommodate these numbers and still ensure up-to-date and attractive offerings for students' studies.

According to Friedrich Schleiermacher student studies are the raison d'etre for universities, which are meant to be a "House of the Mind" – a place, "where singular phenomena are recognized in their scientific context and specific capacities for independent thought, research and invention are developed…"[1]. Universities provide a formal framework for this with courses in different didactic formats, such as lectures and lecture halls, laboratory work or courses in virtual learning environments.

Yet, students do not only learn in set courses in dedicated rooms, but also in the library, computer rooms or the canteen. Furthermore, students meet in faculty halls, on stairs or the university green. They work by themselves, in quiet concentration, or in groups, discussing loudly, reading and drawing, on- and offline, mornings and evenings, formally and informally. Physical delineations fade away and the vision of students learning extends forever further afield. More than ever learning takes place autonomously, self-determinedly, independent from formal teaching. This is underlined by the „Shift from Teaching to Learning"[2]. Learning activities get focused on the development of competences. This introduces a new quality into the learning experience, for instance in project- und problem-oriented learning, group work and e-learning.

Experience and expectations of the „Net-Generation"[3] also play a great role in this. Present-day student generations are so much used to and experienced in relying on information technologies, that they simply expect to find appropriate infrastructures and working environments in their university. This includes WLAN, access to the Internet, access to the social networks, and the infrastructure for mobile devices.

This raises the level of requirements for learning environments. They have to support the practical application of what has been learnt. But at the same time, learning environments are expected to inspire, to accomodate socio-communicative needs of the learners, to offer comfortable access to IT and media – and, last not least, to enable flexible shifts from one learning scenario to another.

Learning spaces in universities not only extend perspectives beyond formal university learning. They also create pedagogical context for rooms and infrastructures.

This publication is based on this understanding of learning spaces: Learning spaces interlink all measures, resources, infrastructures and services, shaping the learning and work situation of students. Defined in this way, learning spaces enable holistic and flexible conceptions of support for learning activities for students.

These conceptions of learning spaces are oriented throughout on the requirements und needs of student users. Their general frameworks take into consideration existing conditions and infrastructures (information technology, media equipment, information and staff resources), as well as the architecture and features of the rooms. All these elements need to be designed and combined while considering service, pedagogical and social aspects, too.

In the mid-90s developments and trends concerning "Learning Spaces" began to appear quite clearly internationally. But what happened so far in Germany in terms of developments on learning spaces? The Workgroup Learning Spaces in the German Initiative for Network-Information (DINI) presented first results based on a survey in 2010[4]. The synoptic view derived from this survey plus additional discussions and research form the basis for the DINI Recommendations on Learning Spaces published here. The present document includes key developments in selected case studies with comments on

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[1] Quoted from Franke er al., 2012, p. 79
[2] Wildt 2003, p. 14.
[3] Vgl. Tapscott 1997
[4] DINI Survey on Learning Spaces: http://www.dini.de/ag/lernraeume/beispiele-infos/lernraeume-national/umfrageergebnisse/
[5.04.2013].

these practical experiences and illustrations. Other institutions are welcome to use these examples for orientation, support and inspiration in planning and building their own learning spaces.

The work group upholds the conceptual-strategic dimension of the topic "learning space" against a tendency in various communities (libraries, computing centres) to reduce the discourse, erroneously, to isolated aspects, such as building, information technology or even „sofas and thick rugs"

To achieve successful conceptions, it is necessary to develop an integrated view and vision on the level of the university as a whole. For this reason, the authors of this document begin by outlining strategic dimensions. Focusing on information literacy, they further elaborate how learning spaces contribute to advancing the development of student competences.

Taking up the very concrete issues of design and equipment of learning spaces, the authors describe a variety of individual and groupwork places and training rooms. They also present and illustrate concepts, highlighting the impact of learning spaces beyond their physical dimension. Finally, in the summary, the authors integrate their results once more into their strategic dimensions.

2. Development of Learning Spaces as a Strategy and Management Task for Universities

Universities have to align their buildings and infrastructure to student requirements. This was the conclusion of British education policy makers in 1993, introducing a fundamentally new direction in Higher Education, in response to the "Follett-Reports"[5], involving substantial investments in new buildings and information technology.

Those planning learning spaces in many British institutions of Higher Education linked new buildings and re-dedicated rooms to services, accommodated services together in (partly spectacular) new buildings. Hitherto independent institutions, especially libraries and computing centres, began to develop joint service conceptions and raised user-group specific service-orientation to a new level.

These institutionalized forms of co-operation are known as *Learning Resource Centres* (US) and *Information Commons* (UK). In the beginning, they were centred on the convergence of Information and IT. Later, planners extended their vision on learning and support for learners. From this point of departure, exemplary new institutions developed, such as the Saltire Centre of Glasgow Caledonian University[6], with new integrated services and consulting/training for competence development like ICT-skills or in a wider framework of Learning Development Centres[7]. Further on, universities extended this to include additional partners (matriculation office, student advisory bureau etc.), in order to provide all services relevant to students' studies under one umbrella.

In Germany, the idea to link computing centres, libraries and media services organizationally, was taken up only several years later - triggered by the tender issued by the German Research Foundation (DFG[8]) in 2004 under the title "Performance-Centre for Research-Information". The exemplary bid, proposed by the University of Oldenburg, took up a great number of elements of learning spaces[9]. Since then, various approaches have appeared in German connected to the term "Lernraum" (Learning Space) or "Lernort" (Learning venue).

Since 2007 the present work-group Learning Spaces (AG Lernräume) exists under the umbrella of the German Initiative of Network Information (DINI). Its members, mostly staff of university libraries and computing centres, advance the discussion on the national level. In 2009, for example, the work group called for an idea contest on "Live Learning Spaces"[10]. In the following year, it conducted a Germany-wide survey on initiatives for learning spaces in universities. In this survey, the workgroup presented the first systematic assessment of the status of academic learning spaces in Germany[11].

Whilst in the UK the Follett-Report set the ball rolling in a top-down-approach, German initiatives almost always originate bottom-up. Mostly, they started from bilateral local initiatives. From their recognition of changing conditions in studying they followed up with proposals for optimization. As a rule, they did not proceed from an all-university strategy, but rather in response to technological change and changed services or to delays in over-due redevelopments.

To this day, a strategic funding programme, clearly dedicated to optimizing "the learning space university" is missing. Whilst BMBF and ministries in the Lander launched several programmes to improve teaching[12], the „quality of learning" so far never made it to the attention of funding agencies and university developers. Only various bottom-up initiatives and articles in library-related and

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[5] The Report of the Joint Funding Council's Libraries Review Group of December 1993.
[6] http://www.gcu.ac.uk/theuniversity/universityfacilities/thesaltirecentre [12.02.2013]
[7] http://www.gcu.ac.uk/learningdevelopmentcentres/ [12.02.2013].
[8] http://www.dfg.de/en/index.jsp [16.04.2014].
[9] http://duepublico.uni-duisburg-essen.de/servlets/DerivateServlet/Derivate-12238/WaetjenUniOldenb.ppt#256,1,DFG-Projekt i³ [12.02.2013].
[10] http:/ www.dini.de/fileadmin/docs/dini_lernraeume_print.pdf [12.02.2013].
[11] Summary of DINI survey 2010 in http://www.dini.de/ag/lernraeume/beispiele-infos/lernraeume-national/umfrageergebnisse/ [6.04.2013].
[12] Quality Pact for Teaching (Qualitätspakt Lehre), in: http:// http://www.qualitaetspakt-lehre.de/[12.01.2013]

university-planning journals[13] brought the strategic and developmental issue of the "University as a Learning Space" to the fore.

2.1 Specifics of Implementing Learning Spaces in Universities

Universities as organizations have a number of characteristics, setting them apart from other organizations, such as private companies. Universities can be viewed as "organizations of experts"[14]:
Their basic structures are bureaucratically defined, yet key decision-makers are employees with specific and specialist academic expertise. They are not necessarily skilled in management, though. From this follows: numerous different and conflicting interests arise on the same level of hierarchy. To safeguard its ability to act, the organization university usually falls back on a 'loosely-coupled system'[15] with the experts acting on a low level of inter-connection and commitment. For initiatives on learning spaces this means to move within a field of conflicting priorities, which brings them up against the following barriers

- Isolated initiatives dominate instead of an overall strategic approach
- Controlling is limited
- Traditional structures and services
- Insufficient internal cooperation
- Insufficient understanding of being a service provider
- Problems with funding.

To overcome these barriers, these initiatives need to integrate the following aspects in their planning and implementation processes:

- Dissolution of traditional responsibilities and cooperation beyond institutional boundaries
- New definition of the role of service providers
- Establishing an understanding of change as a continuous process, in which all interested parties have to be involved (e. g. central actors, students, university teachers).
- Setting up central bodies for coordination and controlling.

If a great number of actors are involved, isolated initiatives are at risk, when there is no central steering body and no strategic integration of the learning spaces initiative. And yet, there are many aspects to such initiatives, which prompt for integration.

2.2 Advantages of Strategic Integration

These issues underline, that setting up and running innovative learning spaces is a challenging undertaking for any university. They involve a degree of complexity, which puts them well beyond the capabilities of a single institution or faculty. Therefore, integration of learning spaces into the strategy of the university concerned is definitely advisable and implies a number of advantages:

To Determine Requirements for Learning Spaces
Students spend a lot of time in various types of learning spaces to meet the demands of their studies. A choice of rooms meeting their requirements is conducive to their success in studying, and supports their acquisition of social competences.

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[13] Special edition on learning space of the Journal Library Research and Practice (Zeitschrift Bibliothek Forschung und Praxis) 34(2)/2010; Journal for University Development (Zeitschrift für Hochschulentwicklung) 7(1)/2012, „Cooperation in the University - Learning Space, Buildings, Campus Planning" (Zusammenarbeit in der Hochschule - Lernräume, Bauten und Campusplanung); Adult Education (Die Erwachsenenbildung) 3/2012 on Architecture for Adult Education – to quote just a few
[14] See Mintzberg 1983.
[15] See Weick 1976, Sass/Jansen 2012

Learning spaces need to accommodate students of all disciplines. Therefore, they need to correspond to numerous different requirements, according to faculty culture and information behaviour of students.
But – how do students learn? Which kind of learning environment, support and advice do they need and want? Apart from a few isolated local surveys and studies on selected aspects of learning spaces, there are no representative studies on the information and learning behaviour of students[16]. Even the „ Social Survey of the German Studentenwerk on the social and economic situation of students[17] – brought out roughly each third year since 1951 by the HIS GmbH[18] – is just touching upon some of the aspects relevant to learning spaces.
For this reason, it is most urgent to integrate students into the planning processes for learning spaces. This could be done by including representatives of student bodies and groups in university-wide work-groups, combined with qualitative and quantitative needs analyses on the development of learning spaces in the universities.

Learning Spaces for Imagebuilding
Successful developments of learning spaces impact positively on the image of the universities in their competition for the best students. To achieve this, it is necessary to take on board students' requirements for contemporary learning environments, but also local needs for change arising therefrom. Distinction of the university as a learning space can only be gained, when developments start from local specific characteristics. Central questions might be:

- Which kind of learning technologies follows from the choice of subjects on offer?
- Which general set-up is determined by physical structures in the university?
- Which services are available, which are missing? Where is it necessary to cooperate?
- Which strengths can be used, where are deficits to overcome?

Taking down Barriers between Responsibilities
To build a versatile, sustainable concept of learning spaces is unthinkable without cooperation of the actors named above. This applies to developing and running infrastructure (technology in rooms and work-places, learning platforms) as much as to further development of advisory and training services, such as a helpdesk for learning spaces, dealing not only with IT-related issues such as WLAN, passwords etc., but also with questions about online services of the library and their rights of access. Service cooperation is necessary to cover demands related to learner support, such as advice on academic writing, information- and media literacy or testing eBook readers.

In a similar context Graham Bulpitt speaks about the „super-convergence of organization, structures and business processes"[19], which will not come about without its integration into the university strategy. Also, continuous operation and further development of the university as a learning space is unthinkable without embedding service cooperation in the strategy of the university. Moreover, such integration will prevent regression - in times of tightening budgets.
In view of the long time horizon in conceptualizing and operating modern learning spaces, this seems to be essential. Along such a trajectory, service quality will become the dominant concern, while the question, who provides the service will fade into the background. And this is certainly something of significance for organization- and staff development in the university.

On the basis of collected data, the institution is able to formulate catalogues of requirements and guidelines to provide internal promotors with precise standards for change processes. A close alignment to quality management is imperative. It should be noted, at least in passing, that in addition to internal cooperation structures, external cooperations across universities have their own impact on learning spaces, for instance concerning implementation of virtual learning environments.

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[16] The so-called „SteFi-Studie", „Studying with electronic expert information" (Studieren mit elektronischen Fach-informationen) focused on information literacy, see Ennen 2005. The University of Rochester (USA) presented an interesting study, „Studying Students" in 2007, discussing requirements for learning spaces, providing impetus for new concepts in terms of methods as well as contents, see Fried Foster/Gibbons 2007
[17] http://www.studentenwerke.de/se/2010/Hauptbericht19SE.pdf [21.03.2013].
[18] Higher Education Information Systems
[19] Bulpitt 2012, p. 5.

2.3 Future Developments

The vision of the university as a learning space has its role to play not only in the strategy and operation of the university, but also in future extended conceptions: to understand more clearly how students learn, and which kind of support is sensible and effective. For this, empirical studies are needed, as well as dedicated academic research. Currently, no budget lines are available for this type of research. Academic inquiry into learning spaces has only just begun with a few empirical findings. Ideally, universities including learning spaces into their development plans should also provide for academic basic research and the evaluation of their own activities.

On the operative level, learning spaces can evolve into interfaces for implementing new services, technologies and infrastructures in the university, „incubators" and test fields for new developments. Thus, they will also enable insights into what needs to be covered in training and further education within the university. In the US, for example, it can be seen how this can be implemented organizationally: „Participatory Design"[20] is part of the strategies of the universities as a matter of course.

2.4 Examples

1. The brand "University-wide Learning Space": University Bremen

The University of Bremen has opened multimedia-equipped learning spaces all over the university. Students can book these rooms through the learning-management system „Stud.IP". Department 5 and the Centre for Multimedia in Teaching (ZMML - Zentrum für Multimedia in der Lehre) are responsible for this initiative, which is integrated in general policies and covers the whole university.
Their tasks include university wide marketing via core elements such as a logo and claim: "Where this logo appears is learning space", which are – in their simplicity - memorised and re-recognised very quickly by students. Moreover, value is added by linking the logo and the booking facility.
This anchors the Learning Space initiative as a definite 'brand' in the university and creates a foundation for a unique selling point, easily communicated, also externally.[21]

Fig. 1: Logo of the Learning Space Initiative at the University of Bremen

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[20] See Simonsen/Robertson 2013
[21] http://www.uni-bremen.de/lernraum.html [26.03.2013]. Picture credit p. 57

2. Learning Spaces as strategy: Leibniz University Hannover

Fig. 2: Actors of the Learning Space University – Leibniz University, Hannover (Source: DINI Workgroup Learning Space)

From "12-11 o'clock":

- *Centre for University Sports*

- *Central Unit for Teaching*

- *Academic Departments*

- *Student delegates*

- *Library*

- *University Directorate*

- *Computing Centre*

- *Media Centre*

- *Centre for Key Competences*

- *Administration (Departments for Building and for Student Affairs)*

- *University Language Centre*

Learning Space is a core issue in the strategy of Leibniz University Hannover (LUH). Its goal is to establish the „Learning Space LUH" as an identity marker of Leibniz University. To achieve this, LUH has created a post, dedicated to identifying, coordinating and documenting learning activities university-wide. This concept of development starts out from the situation of de-centralised real estate plus various, mostly bilateral, service initiatives. New Learning Spaces are initiated through consultation with the university directorate and a highly representative workgroup.

3. Learning Spaces as a parity initiative: University of Bielefeld
The University of Bielefeld established a university-wide initiative for Learning Spaces, in which the relevant players are equally represented. The Workgroup Learning Sites is made up of the Chief Information Officer (CIO), the computing and media centres, an architect and representatives of various service units related to learning. The workgroup develops and reviews concepts for the university as a learning site; it also accompanies the implementation of learning space projects in an advisory capacity.

As a second authority, the directorates of the various units concerned, including the university administration are involved in this process.

Fig. 3: Redesign of the University Library, Bielefeld, following recommendations of the initiative for learning spaces.

4. Learning Spaces as a bottom-up-initiative of various actors: University of Regensburg

At the University of Regensburg, a project group, made up of staff members from the computing centre and the university library, is active in the development of learning spaces. Following the bottom-up-approach, the group worked out recommendations for the enhancement of existing learning spaces to initiate the development of innovative learning spaces. This was accomplished on the basis of a survey amongst students and the analysis of a variety of user data.

The university directorate endorsed their recommendations and commissioned the project group to elaborate a fine-tuned concept for implementing a need-based, user-oriented solution.

Currently, the project group works on a catalogue of measures, in cooperation with different departments. At the same time, work has begun to improve learning spaces in the central library. The group also tries actively to involve additional cooperation partners, to extend support for learning spaces.

Fig. 4: Online Survey of the Project Group Learning Spaces of the University of Regensburg[22]

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[22] University Library Regensburg. Picture credit, see p. 57

5. Learning Spaces combined with research: Karlsruhe Institute of Technology

The Karlsruhe Institute of Technology (Karlsruher Institut für Technologie) was founded in 2006 on the initiative of the University of Karlsruhe and the Land Baden-Württemberg, in order to establish a research university. Responding to fundamental change processes in Higher Education, University and Land re-conceptualized existing research, administration and service structures towards greater integration. The „House of Competence" (HoC) was founded as one of the results of this process: a central service unit, acting as a service centre for capacity building and effective learning, catering to all members of the university. HoC ties together all competence-oriented services from all the service-units including the LernLABOR (Learning-Lab), operating the learning spaces on campus. Services relevant for learning are brought directly to the work- and learning places: students are able to take advantage of advisory, relaxation and activation services (e.g. Yoga). To make services available at the point of work places is the basis of the concept "Learning Space Plus", which is complemented by research, which in turns feeds into further developments of the learning spaces.

Fig. 5: Logo of the Learning Lab (LernLABOR) of Karlsruhe Institute of Technology[23]
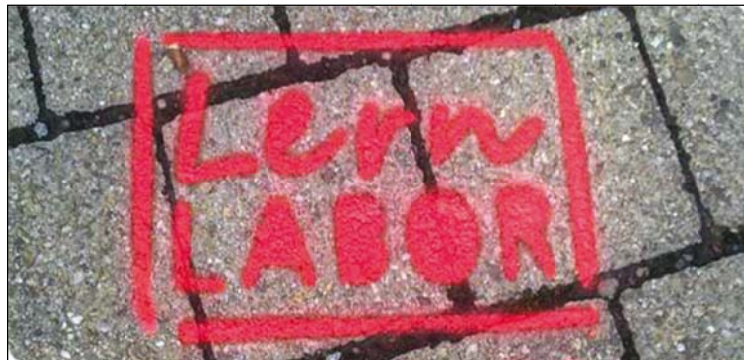
2.5 Recommendations

1. Research into student learning, suggesting budget lines
It is essential to research systematically student learning and the requirements resulting from it. Funding agencies have to re-align their budget lines towards supporting the development of learning spaces in universities adequately. Universities need empirical studies on student learning and incentives to work on the development of learning spaces. Existing programmes supporting "Quality of Teaching" can be extended to include such projects.

2. Develop local profiles
To turn learning spaces into an asset adding edge to the profile of the university, its concept has to be built from local conditions and specifics.

3. Embed conception and central controlling
Integration of all projects into one conception is the sine qua non to achieve their most effective coordination. Therefore, the conception has to be embedded into the strategy of the university to secure long-term success for the learning spaces initiative. This has to be complemented with a fully transparent process involving all actors.

4. Initiate staff- and organization development
Learning spaces have to be considered as a crosscutting issue, which means to draw in many actors from different sectors to enable them to proceed towards joint projects. This needs to be taken on board from the very beginning on the level of overall staff and organization development. In cooperations and mergers the teamplay of the actors has to be encouraged, especially when instutional boundaries are to be crossed. Standards for communication and quality have to be worked out jointly by these actors.

5. Secure resources longterm
Sustainable learning spaces cannot be operated on one-time investments, but need continuous funding. Essential resources to run Learning Spaces have to be provided and secured centrally; this applies to rooms, staff (coordination, planning, service and support, maintenance) and equipment (initial and maintenance).

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[23] http://www.hoc.kit.edu/lernlabor.php [25.03.2013]. Picture credit, p. 57

3. Information Literacy

Teaching and learning at universities are undergoing deep changes, mostly as a result of the Bologna-process, specifically the introduction of Bachelor and Master degree courses. Much emphasis was put on 'key competences', which now form part of the curricula. In this context, fostering information literacy also moved to centre stage at universities[24]. In recent 10-15 years, university libraries have systematically build a basis by developing concepts for the Teaching Library[25].

3.1 New Approach to Information Literacy

Recent developments in concepts and practices of learning spaces at universities also opened new approaches and possibilities to facilitate information literacy as shown by the following examples.

Extended Scope

Traditionally, information literacy is focussed on information resources, retrieval processes and assessment of retrieval results. Driven by technological change, current information behaviour in universities has reached out beyond this level.[26] In response to this, the Conference of University Rectors (Hochschulrektorenkonferenz), for example, includes also "literacy in organisation-related information"[27], i.e. information linked to "all processes within the university". This means, information literacy is seen as a fundamental capacity of all members of the university.

This implies various overlapping "production phases":

- Processing retrieval results
- Creation of new content from these results
- Use of current Internet technologies
- Working with research data, and finally
- Communication of results.

From this alignment to the work of students and academics the level of information literacy is permanently increasing and diversifying. This is reflected in the service portfolios of universities, which are found to include, for instance, the production and communication of academic research.

Current topics include:

1. *Academic Writing*: This means support for mastering the entire process of preparing and writing academic papers – from finding the subject to research, processing research results, academic standards of referencing and quoting and, finally, the technical production of the document.

2. *Electronic Publishing*: Electronic media have affected standards for publishing research results in final papers and dissertations. Universities today offer specific courses and consulting services on these subjects as a complement to their documentation and publishing services.

3. *Management of Literature*: Structuring, ordering and managing information resources are essential in the age of information overload. Electronic tools for managing bibliographies etc. are common standard by now. Many universities take out campus licenses for these systems, and provide training to facilitate their use.

4. IT and Media: To work daily with e-mail, learning management and university management systems requires, that people are comfortable using log-ins, WLAN, VPN clients etc. Consulting and support needs remain high in these areas. Also, these questions are closely linked to access to information resources, for instance, when a user wants to access a licensed academic journal from home.
Advisory and training support are offered, wherever the need arises. In this way, they provide context to learning. Students also have the possibility to enhance their academic documents through additional media. In regard to the level of multimedia and e-learning in modern universities, this is a complex

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[24] http://www.hrk.de/themen/hochschulsystem/arbeitsfelder/informationskompetenz/ [12.02.2013]
[25] Sühl-Strohmenger 2008, p. 11-15
[26] Huvila 2011, p. 240-241
[27] Hochschulrektorenkonferenz 2011/2012

undertaking. Therefore, universities provide hard- and software, as well as additional training and advice - often in specially equipped training rooms or media workshops[28].

5. *Internet Knowledge Management im Internet*: The Internet offers many effective channels to find, process, transfer and even publish information, often free of charge. Therefore, social networks, virtual research environments and data repositories are important for universities. Not only students, but academics, too, need to learn how to respond to these developments. They have to understand background business models and to assess ethical consequences, not only of their own activities on the net, but also in handling information of contacts of others, especially in identifying high-value reputable offerings. For this they need the support by „dataprofis[29]"

The extension of this complex of issues demands the cooperation of different institutions in the universities, such as libraries and computing- and media centres, but also the central student advisory body or the didactic centre. This leads to service-partnerships and functional cooperations to enable service conceptions crossing organizational boundaries.

Active Development of Information Literacy

University didactics underwent significant changes: ex-cathedra teaching is being replaced by activating forms of teaching and learning, such as project- and problem-based learning. Based on constructivism, these methods support students and their learning needs by focusing on the concrete, practical learning experience – as close as possible to the information needs of students. This is borne out in practical exercises on the PC or in workshops demanding the intense participation of students. Later, students can continue their practice in their learning spaces. Consulting hours and other forms of personal consulting make for a high degree of flexible and individual support. Students can raise their particular issues in these sessions.

Social situation of learners

Developments of learning spaces in universities are aligned to student needs and include the social dimension of learning. Students are – voluntarily or involuntarily – autonomous, while passing through the days of their studies. Electronic and net-based resources, available everywhere and always, further increase their independence. This implies a high risk of being/feeling isolated. It is all the more important to respond effectively to their obviously strong social needs for communication, exchange and cooperation. Corresponding activities serve student learning best, when students are related to as equals within a shared field of experience. Such peer-to-peer-concepts may benefit tutor programmes advancing information literacy.

Open formats within training enable informal learning and open up latitude for spontaneous decisions. Drop-In-Workshops[30] may be seen as an adequate solution. Plain speaking in consulting settings also contributes towards creating an atmosphere of trust, where asking questions comes easier than in the more formal situation at a consulting desk. In open situations, consulting directly at the tutorialswork place of the student can morph naturally into an ad-hoc training session. Competence-agents – librarians as well as IT specialists – thus turn into 'coaches' and 'facilitators'[31].

3.2 Training Rooms for Information Literacy

Dedicated rooms for training information literacy are standard in universities. Originally designed for IT training and oriented towards technical concerns, they often fall short in the wider understanding of information literacy, because of rigid arrangements of desks and lack of space for project and group work. To work on the basis of activating forms of teaching and learning, room concepts have to be adapted. Equipment, furniture and their arrangement in the room should encourage participants to interact.

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[28] http://www.sub.uni-hamburg.de/service/medienwerkstatt.html [21.03.2013]

[29] The Conference of University Rectors (a.a.O.) calls these „data librarians".

[30] Drop-In-Workshops are training/consulting sessions where interested students can participate without prior notice.

[31] "Coach" and "Facilitator" are terms from the professional area of coaching. A coach assists learners during the learning process (i.e. he intervenes actively), while the facilitator supports the learning process (i.e. remains rather passive). Hence, the roles of coach and facilitator determine to what extent learners may become active.

In addition to media-technology (computer, beamer) modern training rooms should be equipped with presentation technology (e.g. flip chart, moderation pinboard etc.) Notebooks and tablets on site provide further flexibility.

Training rooms should stay open to be used freely by student groups outside scheduled sessions[32].

3.3 Online Progammes on Information Literacy

To foster self-paced learning many universities put web tutorials, films and videocasts online as a supplement to face-to-face consulting/training, where students have to appear in person. Furthermore, social media formats, such as blogs, wikis and forums, encourage debates in the wider net-community. To allow easy access for students, these tutorials etc. are delivered from inside the learning or learning management systems of the universities providing digital "add-ons" to learning spaces[33]

3.4 Integration in the University-wide Strategy

As mentioned above, development of learning space has to be decided and implemented by the university as a whole. Similarly, information literacy has to be approached from the same level, by integrating services in such a way, that they provide optimal support to students acquiring key competences. In this context, information literacy can be viewed as belonging to the „academic skills" – alongside media and IT literacy, self-management, communication literacy, critical thinking and academic writing.

Synchronizing offerings on information literacy with requirements from the academic departments round off this holistic approach. Embedding these topics into curricula is not new, but meaningful for the learning space, because it leads to important links and shared views of information literacy. Offerings range from complete courses with their own ECTS-credits to modular formats on different contents to be integrated into the curriculum of departments.

3.5 Examples

1. Academic work-cycle
Academic Writing: „Nights of Writing" at the University Library Kassel[34] include a holistic range of support – from advice on retrieval of information and PC tips to yoga for relaxation.

Electronic Publishing: Consulting and training on university publishing services are provided, for instance, by the Humboldt University, Berlin[35]. Others are offering training modules on electronic publishing (e.g. Free University, Berlin[36]; University of Applied Sciences, Münster[37].

Literature Management: The University Library Bamberg[38], Library and Information System (BIS) Oldenburg[39] and Humboldt University, Berlin[40] developed training on the tools offered under campus licenses.

IT-/Media: The Centre of Information- and Media Technology (IMZ) of the University Paderborn runs a „Notebook-Café"[41] in the University Library. The „Digilab" in the University Library Münster offers

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[32] Training rooms are discussed more fully in chapter 5.

[33] More details, see chapter 7, „Virtual Learning Spaces"

[34] http://www.dini.de/fileadmin/ag/lernraeume/Lange_Schreibnaechte_Dini_Mai_2012.pdf [21.03.2013].

[35] http://edoc.hu-berlin.de/e_autoren/beratung.php?arbeit=Magister-%20und%20Diplomarbeiten%20%C2%BB&index=diplom.php&nav=diplom [21.03.2013].

[36] http://www.fu-berlin.de/studium/studienangebot/abv/infomedien/index.html [21.03.2013].

[37] Modul 3: Elektronisches Publizieren im Internet, https://fh-muenster.de/bibliothek/benutzung/modul3.php?p=3,5,2 [21.03.2013].

[38] http://www.uni-bamberg.de/ub/einfuehrungen/kurse/citavi-kurse/ [21.03.2013|

[39] http://www.bis.uni-oldenburg.de/lernen-und-arbeiten/angebote-fuer-studierende/schulungen/schulungsangebot-in-drei-stufen/literaturverwaltungsprogramme/ [21.03.2013].

[40] http://www.ub.hu-berlin.de/bibliothek-benutzen/literaturverwaltung-1[21.03.2013

[41] http://nbc.uni-paderborn.de/cnt/service.php [21.03.2013].

advice on the hard- and software used in the university. The library of the University Göttingen[42] complements infrastructural services for media production with trainings.

Internet Knowledge Management: The libraries of the Universities of Bamberg[43] und Tübingen[44] offer courses on professionally researching the Internet, web-based literature management and webpublishing.

2. Active development of Information Literacy: University of Hannover and TU Munich
The Technical Information Library/University Library, University of Hannover runs a workshop tiltled "Academic Writing in the Digital Jungle"[45]. Didactical core elements are active learning and exploration of a subject by the participants. The University Library at the Technical University Munich provides consultation hours on literature management, where students get advice on how to work with Citavi and EndNote, but also first introductions to Zotero and Mendeley are on offer.[46]

3. Students' advice offices: University of Bielefeld and University of Hannover
The tutors' concept at the University Library, Bielefeld is inspired by examples from other countries, for example, the „Learning Grid" of the University of Warwick. At "Learn Space-B1" students find comprehensive technical equipment for experiments in new forms of learning and teaching. Trained contact persons are available to give support and advice. This team is made up of staff members of the library, tutors of the "Co-Learning-Centre" („MitLernZentrale") and advisors on writing.[47]
At the University Library of Hannover, the "eLearning Help-Desk" supports students on technical issues related to media-supported learning, such as how to access the university WLAN from their mobile devices, using Stud.IP or which media tools may facilitate their learning.[48]

4. Workshops: TU Harburg
The University Library of the Technical University Harburg runs drop-in-workshops for students of technical and engineering disciplines: „SearchING at Noontime" is a series of regular sessions, where students receive information and tutorials on academic work and publishing, as well as current trends and developments such as OpenScience.[49]

Fig. 6: Students advising students at the eLearning helpdesk of TIB/UB Hannover[50]

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[42] http://www.sub.uni-goettingen.de/lernen-lehren/multimedia-produktion/services-fuer-studierende/ [21.03.2013].
[43] http://www.uni-bamberg.de/ub/einfuehrungen-kurse/im-netz-der-wissenschaft/ [12.02.2013].
[44] http://www.ub.uni-tuebingen.de/lernen-lehren-forschen/information-einfuehrung-schulung/schulungen/fachuebergreifendesschulungsangebot/deep-web.html [12.02.2013].
[45] http://www.tib.uni-hannover.de/de/tibub/lernraum-tibub/schulungen- und-fuehrungen/schulungs-und-fuehrungsangebote.html [21.03.2013].
[46] http://www.ub.tum.de/workshop-beschreibung/sprechstunde-literaturverwaltung [21.03.2013].
[47] http://www.ub.uni-bielefeld.de/library/learn/lernort_b1.htm [21.03.2013].
[48] http://www.tib.uni-hannover.de/de/tibub/lernraum-tibub/elearning- helpdesk.html [21.03.2013].
[49] http://www.tub.tu-harburg.de/fachinformation/informationskompetenz/[21.03.2013].
[50] Christian Malsch. Picture credit p. 57

5. Linking learning-management systems and tutorials: University of Hannover, University of Konstanz

The Online-services at the University of Hannover include tutorials on topics such as self-organization and learning strategies. The tutorials are created in ILIAS, and then integrated into the learning management system Stud.IP.[51]

The University Library at Konstanz also chose ILIAS for tutorials on information literacy, tailored to the level of studies of students. There are tutorials for beginners and bachelor students and the „KOPILOT"-Tutorials, on research and information retrieval strategies geared to PhD candidates and academics.[52]

6. Cooperation of service providers – integrated services for students, University of Lüneburg and University of Duisburg-Essen

One example of an integrated concept is the "Study Workshop" (Studierwerkstatt) of Leuphana University, Lüneburg. On offer is a comprehensive package of trainings by the Central Student Advice Office, the University Library plus the Computing and Media Centres to introduce students to methods of academic work.[53]

At the University of Duisburg-Essen students can turn to the "e-Point" for help and advice on IT and media technologies. The Centre of Media and Information Services (ZIM) and the University Library run "e-Point" jointly. In addition to advice on the topics mentioned, students can apply here for their user accounts or passwords, sign up for online-courses or get information on further training. For a deposit, students can also get magnet cards to open access to the PC-rooms[54].

Fig. 7: The services of the e-Point at the University of Duisburg-Essen cover a wide range – from advice to access to work rooms.

7. Linking library and university teaching: SUB Hamburg

Lecturers benefit from flexible trainings at the State- and University Library in Hamburg. Trainings are on offer on everyday problems and pitfalls in the life of academics.[55]

3.6 Recommendations

Learning Spaces will contribute enormously to fostering competence development of students. For this, it is not sufficient to provide infrastructures. There have to be complementary services and agencies in place - services geared to information literacy are one of the essentials.

1. Extend perspectives and topics on information literacy
Information literacy is set in the wider context of key competences and their topics

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[51] http://www.uni-hannover.de/de/studium/elearning/lernmodule/index.php[21.03.2013].

[52] https://ilias.ub.uni-konstanz.de/ilias/ [21.03.2013].

[53] http://www.leuphana.de/bibliothek/service/schulungsangebote/studierwerkstatt.html [26.03.2013].

[54] Universitätsbibliothek Duisburg-Essen. Picture credit p. 57

[55] http://www.sub.uni-hamburg.de/recherche/teaching-library/schulungen.html [21.03.2013].

2. *Increase cooperation*
Shared fields of action in information literacy create a new basis for cooperation. So organizational divisions (e.g. library, computing centre) can be overcome.

3. *Stimulate learning experience by "development instead of transfer"*
Offers on information literacy should support active learning, with increasing flexibility, multi-channel delivery (physically and virtually), and in accordance with social requirements.

4. Types of Workplaces

4.1 Zoning and Differentiation of Work Places

At universities, numerous spaces and workplaces for different functions in student learning and working are typically available – from cafeterias to laboratories. Frequently, students elect the library as their work place, because it stays open for long hours and provides information resources. Because of packed curricula and increasing numbers of students, demand for spaces, where students can work, is continuously on the rise. Universities are responding to this need by reconstructing and building in many places.

The university libraries are dealing with this problem for a number of years already. In 2005, the Hochschul-Informations-System GmbH (HIS)[56] developed a basis für calculating the demand for student workplaces in university libraries. This study defined "user work places" as all "work places which are not used exclusively in formal teaching and research, but instead for preparation and re-working of learning material and for information proessing."[57] From this, HIS developed various methods for measuring and modelling requirements, according to different types of libraries. These calculations, however, do not suffice for calculating the total of requirements throughout a university, at best, they serve as rough indicators for comparative purposes[58]. So, in addition, in 2013 HIS presented a basis for calculations, which allows itemizing requirements for the university as a whole, taking into account requirements from the various disciplines present at a given university.
Analyzing requirements overall includes work places in academic departments (such as computer rooms), informal work places or specialized work places, such as places for processing videos.
As many of the spaces in the departments are not openly accessible, lobbies are regularly used for learning and informal exchange. They are equipped with tables, chairs and power outlets. Students are even allowed to bring food – in contrast to the libraries.

Conceptualizing work places, therefore, needs to take into account fundamental aspects such as zoning and differentiation of spaces. Differentiation means to establish different types of work places, while zoning is about how these types of work places are positioned.

Fig. 8: Example of a consistent concept of differentiation and zoning in one building.[59]
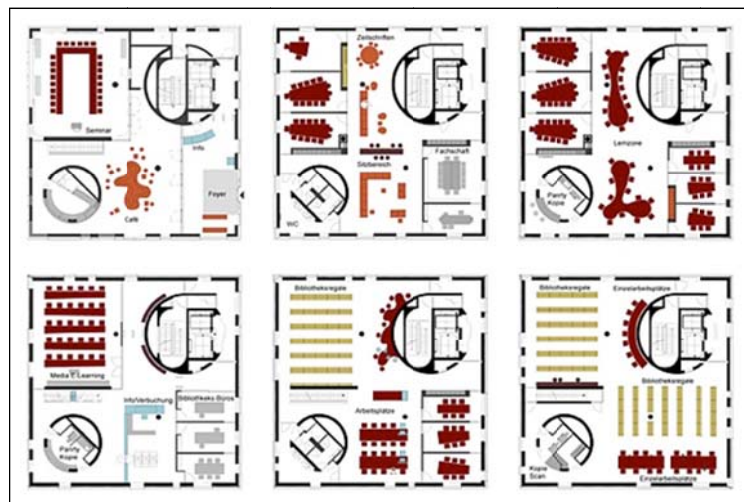
Differentiation of work places according to needs, allows students to seek out spaces suitable for their current learning requirements. At the same time, the university may emphasize particular services, for example, by positioning services supporting self-learning close to individual work places. In doing so, universities are advised to take into account specifics of information behaviour across academic disciplines by including students already at the stage of planning.[60]

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[56] Higher Education Information System, http://www.his.de/english/organisation [19.4.2014]
[57] Vogel/Cordes 2005, p. 88
[58] Vogel/Woisch 2013.
[59] UKW Innenarchitekten. Picture credit p. 57
[60] Refer also to chapter 2 above

To achieve a good system of zoning it is necessary to balance existing spatial layouts and required types of work places to enable quality academic work. This means to take into account available IT infrastructures, how they relate to physical help desks, where passages to other work spaces are desirable and, last not least, differential levels of noise.

Examples

1. Zoning as a central element in an overall concept: Humboldt-University Berlin and O.A.S.E. Düsseldorf

Fig. 9: The socalled "Reading Terraces" of the Grimm-Centre[61]

Fig. 10: Loungezone in the O.A.S.E. Düsseldorf[62]

2. Strict zoning: University Oldenburg

Fig. 11 and 12: A glass door at the Reading Room for Law separates the area for group work at BIS Oldenburg.[63]

At BIS Oldenburg, zoning of the entry area guides attention directly to the information desk. Places for group work, individual work, and work using computers, are placed on the same floor. In contrast, the Reading Room for Law is reserved for "silent work", separated by a sound-absorbing glass-wall from other sections.

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[61] Lutz Stange, HU Berlin. Picture credit p. 57
[62] UKW Innenarchitekten. Picture credit p. 57
[63] Daniel Schmidt. Picture credit p. 57

3. Informal zones: University of Leipzig and Public Library Amsterdam

Fig.13: Corner with sofas, Campus Library Leipzig.[64]

Fig 14: Individual spaces in the public room of the Public Library Amsterdam.[65]

One section of the Campus Library of the University Library in Leipzig is furnished with easy chairs and sofas for relaxation and informal exchange.

The „work pods" in the Public Library of Amsterdam are open to the public, yet they also mark a boundary wihin which individuals can work in a protected atmosphere.

Recommendations

1. *University-wide approach*
In developing work-places and zones, real estate and spatial conditions, perhaps distributed buildings, have to be considered

2. *Enhance accessibility*
Look at opening hours, layout, and access permissions!

3. *Approach learning as a sensual experience*
foster an inspiring work atmosphere

4. *Guide user behaviour through the design of buildings*
Clear zonal distictions between noisy and silent areas prevent conflicts between different learning and working styles of students, and provides a choice between different atmospheric room experiences. In addition to architectural/building designs, flexible zones, separated by shelves or mobile walls, may achieve similar effects. These are essential in "Open-Plan"-buildings[66]. It may also be helpful to signpost floors or areas to indicate levels of social activity.

5. *Focusing to enhance attractivity*
accentuating select areas in buildings adds visibility and directs the user to make choices according to needs or topics.

6. *Continuous Updating*
Stay aware of changed user requirements and update environments accordingly.

In the next section work place types are illustrated by additional examples, mostly from university libraries, which are quite well documented[67]. However, conclusions and recommendations given here are relevant for university-wide planning as well.

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[64] University Library Leipzig. Picture credit, p. 54
[65] Annette Franzkowiak. Picture credit p. 54
[66] Buildings based on Open-Plan – are designed to be adapted to changing usage, except for fixed facilities such as escalators, staircases and bathrooms. Shelves ot partitions are used to separate spaces from one another, see
Krempe 2002, p. 10-11.
[67] In addition, these reflect the experiences of the present authors.

4.2 Individual Work Places

The Report 13 of the DIN (Deutsches Institut für Normung)[68] describes parameter and requirements for individual work places in university libraries, differentiating four types:

1. Individual places for concentrated silent work
2. Individual IT-equipped places
3. Places for information and brief search procedures
4. Carrels und cubicles

To this list should be added places for users with special needs:

Parent-child rooms should be sound-isolated, situated in the vicinity of elevators and bathrooms; they should also have their own water supply. The furniture has to be suitable for children (e.g. height-adjustable, with sufficient space to play on the carpeted floor)[69]. Sharp edges in furniture should be avoided.

Rooms for vision-impaired users: should also be situated near elevators and contain computer workplaces tailored to this user group, i.e. equipped with screenreaders and voice output, magnifiers, scanner and OCR software.

*Multimedia-work plac*es: To accommodate all the necessary equipment – scanner, printer, keyboard and more plus surface space for writing - these places require tables with a minimum surface area of 1,6 m by 0,8 m[70].

The DIN criteria set requirements for individual work places in quantitative terms only – but not in terms of what makes such a work place appealing. Why is individual work in silence interesting for students? Research into how users think and behave frequently points to social aspects, which motivate students to leave their desk at home in favour of public workspaces in the university. For this it is not enough to consider technical requirements. Rather, social conditions just need to be right.
To work by oneself, but not alone at home – this is what many students want.[71] To work quietly, where it is easy to concentrate and yet to be in the company of peers – not only when exams are due, this is what students expect from their university.

> „A problem shared is a problem halved" – one student replied when asked why she came to the library to prepare for her exam

Some students also appreciate "to see and be seen" – to be right in der middle of the university and yet to work quietly. Or, they wish for some measure of social control while learning, and prefer locations, where they can have a look around to see who is coming and going. Tables in rows along railings or atria are popular with these learners.

Tradition vs. modernity: reading rooms and learning cafes in libraries
Classical reading rooms were pronounced dead by many. But in the meantime it has been recognized that there is still much demand for the reading room and its quiet atmosphere of concentration. Reading rooms in the tradition of the 19th century are alive and well, as witnessed by a number of new library buildings. A number of libraries, the SLUB, Dresden among them, even reserve a few rows of desks for absolute silence (i.e. even notebooks are not permitted).

In contrast, in a Learning Café surrounding sounds are noisier, however, this is apparently not perceived as distractive by everyone, but rather as an inspiring factor. Entry areas furnished with comfortable seats are popular meeting places for students. In recent years, libraries increased their

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[68] Deutsches Institut für Normung e. V. 2009, p. 44-50
[69] Minimum size for such rooms is 6,7m², see DIN Fachbericht 13, p. 49.
[70] DIN Fachbericht 13, p. 46.
[71] See Braun 2010 for the following statements.

investments for this type of lounge area – this is possibly the reason why discussion about learning spaces still tends to be reduced to this single feature.

Work – best alone

Well-known studies, such as those of Sommer show, users coming alone also like to sit by themselves[72]. According to Sommer, there is a tendency to choose seats at the end of tables, when tables are arranged in rows. There are "protected chairs", the ones directly next to these or, if visual contact is possible, those opposite. This is observable not only in work places in the library but applies even to complete rooms. Apparently, the first student entering an empty room to sit down and learn "occupies" the whole room. It is therefore possible that a building with places for 800 students is used only by 23 to 50 for their learning outside formal teaching sessions[73]. In rooms with double-tables, all tables are first occupied with one person each, usually the seats by the windows. Only when all tables are occupied with one person, latecomers will accept "secondary" seats.

This behaviour demonstrates that there is a need for privacy and boundaries in public workspaces. This can be taken care of, at least partially, by providing lighting for individual workspaces, book trolleys, screens, or by arrangements of furniture and equipment.

Advanced students, particularly those working on their theses, prefer especially quiet spaces and corners, where they can reflect, write, view their materials without disturbance, and where they even can leave their work overnight. Carrels and cubicles are, therefore, especially popular by Ph.D. and other advanced students. These are usually equipped with a big table (1,2 m x 0,8 m), individually switchable desk lamp, chair, bookshelf, electric and Internet hookup, also WLAN. Quite effective are variants, where the cubicle is not entirely cut off from its environment, but still visually connected, for example, by a glass door. In this way these rooms provide a controlled environment and some measure of safety, but in the framework of fire-technological regulations they are not considered as separate rooms. They are usually made available to students in their final exams. The permission varies between a couple of days and several months. Waiting lists for such carrels can be quite long.

Insight and outlook: Books within easy reach and work places by windows

Nowadays, literature in print is still important as an atmospheric and design element. Depending on the discipline studied, it may be important to be close to the printed literature, if relevant sources are only available in print. Therefore, workplaces situated among book collections, near the shelves are very popular. Books are within easy reach and their presence creates a quiet protected niche for work. In addition, even 'digital natives' appreciate learning surrounded by printed books – providing inspiration and an aura of academic productivity.

Workplaces by windows are very popular. Places with fine views are most certainly among those occupied right away, early in the morning. It is advantageous, when desks are postioned one behind the other and at an angle of 90° towards the windows. In this case, those working there have a view into the distance as well as into the room.

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[72] Sommer 1966.
[73] Stoke 1960

Examples

1. Traditional reading room: Humboldt-University Berlin and SLUB Dresden

Fig. 15   Reading Room of the Erwin Schrödinger-Centre[74]

Fig. 16: Reading Room of SLUB Dresden.[75]

The Reading Room of the Erwin-Schrödinger-Centre in Adlershof is placed in a big hall. Partitions at half-height provide some privacy. Daylight comes in from skylights.

SLUB Dresden is rich in style for enthusiasts of traditional reading rooms. Day light streams in through a glass ceiling. On the balustrade lexica and reference works are within easy reach.

2. Carrels and cubicles: College of West Saxony, Zwickau (WHZ) and Humboldt-University Berlin

Fig. 17: Carrels in der Library of WHZ[76]

Fig. 18: Individual workplace at Grimm-Centre, HU Berlin.[77]

In the new building of the library there are five individual carrels. Their position by the windows allows for concentrated work in daylight.

From the cubicles at the Grimm-Centre of HU Berlin you can look at the learning terraces, work in daylight and be viewed from the outside.

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[74] Lutz Stange, HU Berlin. Picture credit p. 57
[75] Malte Larsen. Picture credit p.57
[76] University Library Zwickau. Picture credit p. 57
[77] Lutz Stange, HU Berlin. Picture credit, p. 57

3. Individual workplaces by windows: University of Hannover and University of Göttingen

Fig. 19: Individual workplaces at the TIB/UB Hannover, Site FBK[78]

Fig. 20: Individual workplaces alongside the window-front at KWZ Göttingen[79]

At the Univeristy of Hannover users of the reading room for Educational Sciences at the Königsworther Platz (FBK) may enjoy viewing the whole city, while working in a high-grade technical environment. Sockets and desk lamps at each desk allow for long hours of learning.

At the Centre for Cultural Studies (KWZ) Göttingen, individual work places are positioned laterally towards the window-front. Thus students can work in daylight without being blinded.

4. Individual places within book collections: University of Duisburg-Essen and Humboldt-University Berlin

Fig. 21 Separated individual workplaces at the Library MNT Essen[80]

Fig. 22 Individual workplaces at the Erwin Schrödinger-Centre of HU Berlin[81]

In the Library for Mathematics, Natural Sciences and Technology (MNT) at the University of Duisburg-Essen, individual workplaces are positioned between the bookshelves, which also provide acoustic protection.

Users of individual workplaces in the reading room of the Erwin Schrödinger-Centre overlook the reading room and have easy access to the book collections.

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[78] Technical Information Library/University Library Hannover. Picture credit p. 57
[79] Simone Baum. Picture credit p. 57
[80] University Library Duisburg-Essen. Picture Credit p. 57
[81] Lutz Stange, HU Berlin. Picture credit, p. 57

5. Rooms for special needs: TH Mittelhessen and Humboldt-University, Berlin

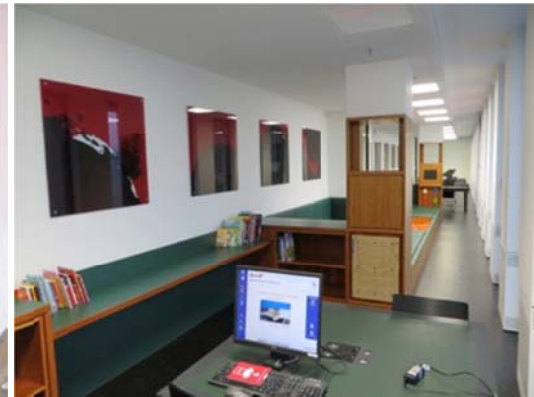
Fig. 23 Parent-Child Room Campus Friedberg[82]

Fig. 24 Nursery at Grimm-Centre, Humoldt University Berlin[83]

The Technical College Mittelhessen offers a Parent-Child room on its Campus Friedberg. Parents can learn using computers while the children can play or rest. In addition, the library provides a small kids' corner.

At the Grimm-Centre of HU Berlin a complete side-wing has been dedicated as a parent-child-learning room: the „Berliner Volksbank Nursery", with 15 individual workplaces for students and 80 m^2 playing area with tables for painting and a media-shelf.

Recommendations

When designing individual workplaces and work areas, libraries should bear in mind student expectations: workplaces for focused silent learning. Distractions and disturbances have to be kept to a minimum.

1. *To cater for a quiet atmosphere*
Individual work places require a quiet ambience. Design and construction need to be geared towards avoiding transit "traffic".

2. *Create privacy*
Individual work places are appealing, because one can work quietly by oneself, but there is contact with the community of learners at the same time. This is helped by spatial concepts and furniture, which enable students to keep boundaries and to have more privacy: for example behind screens or even in carrels.

3. *Provide storage*
Students working on several complex long-time learning projects require learning spaces equipped with storage space for their learning materials. Mobile or fixed containers or lockers have to be provided for, in accordance with the layout of the building.

4.3 Group Workplaces

In recent years, group work is more emphasized in studies as a result of the transition to Bachelor- and Master degrees. An increasing amount of student achievements involves work groups and project work.[84]

Pedagogical constructivism works on the assumption that learners acquire knowledge in a sustainable manner by working actively on the contents of their studies.[85] The learning process is conceived of as a social process. Exchange with fellow learners is integral to making for learning successful.

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[82] University Library TH Mittelhessen. Picture credit p. 57
[83] Lutz Stange, HU Berlin. Picture credit p. 57
[84] See Welbers et al. 2005, p.3

Last not least, group work boosts building key competences for later careers, such as the capacity for team work, structured work-methods, ability to divide, combine and re-combine contents. The Conference of University Rectors (HRK) stated on this issue. ""Good teaching" means to facilitate and support students in their autonomous learning,"[86] and adds the demand to provide additional spaces and resources for this purpose. However, the demand for group work places cannot be filled entirely by the university libraries. Necessary provisions have to be made in the overall building plans of the universities.[87]

Conditions for success in teamwork

Group work requires technical and spatial conditions conducive to cooperative learning. University libraries, the traditional learning spaces for students, are also increasingly used as meeting places for groups. A number of institutions have responded already. When reconstructing workspaces In recent years, libraries have provided for adequate rooms, permitting teamwork and exchange. Two solutions are ususally chosen:

Group tables in somewhat disquiet areas of the library, for example close to the entrance and general information desks

Separate rooms for groups.

In both cases, the following factors need to be taken into account:

1. *Noise insulation*: This can be achieved if zoning is consistently applied to the rooms in question[88] and/or if the rooms for groups are insulated adequately. Because of their level of noise (conversations, transit traffic) these should be located as far as possible from the 'silent' individual workplaces.

2. *Flexible Furniture*: This helps students to fit workplaces to group size. Black- and whiteboards enable teams to visualize their results – they may also be used as room partitions.

3. *Booking systems:* Many universities and university institutions have booking systems in place. Students can book group rooms in advance and plan their teamwork accordingly.

4. *Plan for adequate technology*: Depending on the purpose of group work places, requirements in terms of IT technology and infrastructure may vary in complexity. In each case, they need to be planned carefully.[89] It is understood that technical requirmeents take precedence over flexibility.

A brief mention of informal group workplaces completes the picture. Often universities put some tables and chairs in extended foyers or passages. Equipped with power sockets and WLAN access they can fill some of the immediate needs for workplaces and places for social exchange, depending on their localtion and seating arrangements. Similarly, many libraries are providing lounge areas, where students can meet, sometimes even have a drink and a snack.

Lounge furniture in foyers, cafeterias, roof patios or reading gardens invite students to meet easily for social purposes; coffee and snacks create a relaxed atmosphere conducive to spontaneous conversation shifting between the small talk of a rest period and shop talk.

The capacity for teamwork is an important key skill in the 21st century. Therefore, optimal conditions for making group work successful are important, too. This involves not only adequate technical and spatial condtions, but also their attractive, flexible, modern design. In contrast to individual workplaces, it is necessary to distinguish informal from work-related places when planning for groups.

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[85] See Reich 2012, p. 83-84
[86] Quoted from Hochschulrektorenkonferenz 2008, p. 3.
[87] In the following paragraphs, requirements and examples for group workplaves reflect the view of university libraries.
[88] See Chapter 4.1
[89] See Chapter 4.4 for a more detailed discussion

Examples

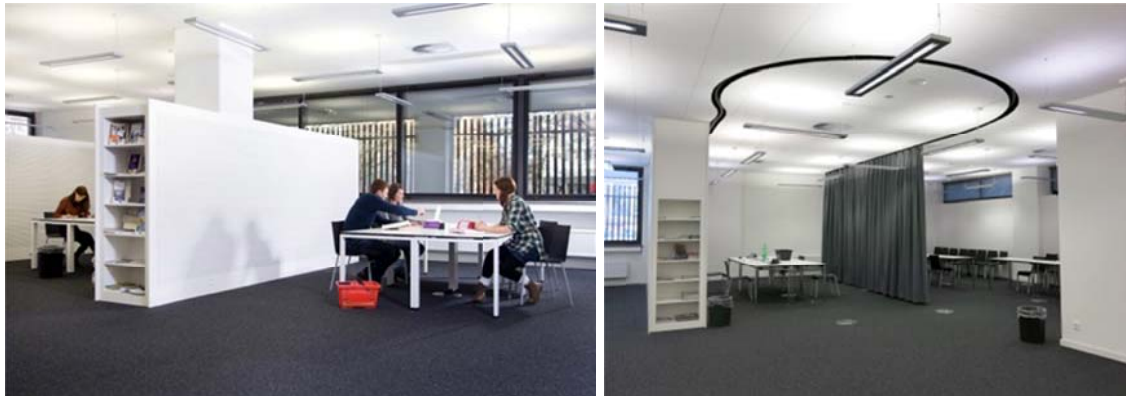**1. Flexible group work places: University of Hannover**

Fig. 25 und 26: Group workplaces in TIB/UB Hannover, FBK.[90]

In their Faculty libraries (Fachbibliotheken) at Königsworther Platz (FBK) the university established open communication spaces. Sound-absorbing elements in the wainscoting of ceilings and in the partitions create conditions for concentrated work within open surroundings. A curtain to create a space for a closed group or a training session can close off one part of the room.

2. Group rooms with quality IT equipment: University of Frankfurt/Main and University of Bielefeld

Fig. 27: Group workroom der UB Frankfurt[91]

Fig. 28: Discussion room with digital whiteboard in Bielefeld[92]

At the University Library Frankfurt students can work in a separate room for group work, having access to a large monitor and a whiteboard.

The University of Bielefeld provides a room for work groups, equipped with a digital whiteboard. Students can access the whiteboard and work on it from their computers.

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[90] Technical Information Library/University Library Hannover, Picture credit, p. 58
[91] Universitity Library , Frankfurt /Main. Picture credit, p. 58
[92] University Library Bielefeld. Picture credit, p. 58

3. Informal areas for groupwork - TH Mittelhessen and Hochschule Hannover

Fig. 29: BibLounge of TH Mittelessen[93]

Fig. 30: Patio of the Central Library, Hannover[94]

On their campus at Friedberg part of the library has been turned into a lounge.

The Central Library of Hochschule Hannover built a patio outdoors. In the summer this is a popular place for students to relax and learn.

4. Protected area: Universität Wuppertal

Fig. 31: In the cupola of the University Library, Wuppertal[95]

Three big columns in the middle of the domed structure dominate the new extension at the University Library Wuppertal. Inside each of the columns is a workspace for groups, the space of their 'roof' has been designed as a cosy meeting place and furnished with beanbags.

Recommendations

1. *Profiling group workspaces*: Planners need to enquire, whether university-wide standards should be followed or introduced, or specifics arising from the departments. In addition they need to consider if the places need to be first of all adaptable to different settings or if a high level of technology is required.

2. *Create informal workplaces for groups*: These should be created university-wide, wherever suitable spaces are available. These can be in busy zones; access to WLAN is imperative, nearby catering a definite plus.

3. *Consider Privacy*: Similarly to students using individual work places, groups also wish for privacy and boundaries. This need can be met, for example, by putting up screens and partitions between group tables.

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[93]   Library TH Mittelhessen. Picture credit, p. 58
[94]   Central Library Hochschule Hannover. Picture credit, p. 58
[95]   University Library Wuppertal. Picture credit, p. 58

5. Training Rooms

Training rooms can be seen as a specific category of workplaces. Historically, they have evolved into a limited, but technically challenging field. In contrast to rooms for group work, training rooms are meant for teacher-centred training of students in IT and communication skills. For this reason "training room" usually equates to "IT-training room". Though requirements for training rooms do change to some extent, according to changes in student habits of learning and working, their core functions and arrangements remain unaltered.

What are IT training rooms?

IT training rooms in universities are separate areas, which may be used for courses, seminars, meetings, exams and other group activities. Depending on discipline, didactical conceptions and topic of the meeting, users may require different pieces of IT equipment for presentation, interaction or communication.

In principle, a great variety of scenarios are possible, for instance:

- Rooms for different-sized user groups
- Rooms for training with or without technical support equipment
- Rooms for seminars using notebooks
- Rooms for training on media
- Rooms for eAssessments
- Rooms for presentation and interaction
- Rooms for vieoconferencing
- Multifunctional rooms.

Functional rooms with no or minimal IT support such as lecture halls, labs etc. remain outside the scope of these considerations.

Why do we need training rooms?

Despite increasing virtualization, e-learning and mobile online access to services, demand for IT training rooms is rising all the time. These are the main reasons:

1. *Penetration of IT support across the board of knowledge domains*: Lately, even students in disciplines somewhat distanced from IT, such as the Humanities and Social Sciences, experience increasingly the benefits of IT support. To get this across is one of the goals of trainings and courses. Therefore appropriate enabling technology is necessary in these rooms.

2. *Demand for additional information channels*: Information sources on any area of knowledge are available on the Internet or intranets and they get integrated through courses and trainings into the educational concept.

3. *Growing demand for IT-trainings*: Mastering academic and academic-managerial tasks on a daily basis is unthinkable today without IT. Therefore the demand for adequate training programmes is one of key requirements.

4. *IT and media for visualizations and simulations*: IT-supported or virtualized laboratory environments are a necessary element in the process of knowledge acquisition. To meet this demand, training rooms have to make available IT and media infrastructures as needed.

5. *Didactic concepts in teaching*: Didactic concepts are geared towards integrating IT-services into teaching and to make use of their many opportunities for interaction and presentation of teaching materials.

5.1 Requirements for IT training rooms

The very basis of running an IT training room consists of robust devices, networking technologies and their connection to the IT infrastructure. In addition, there are a number of specific requirements for operating and using these rooms. Conception and equipment of training rooms have to take care of specific concerns of students, lecturers and operators.

1. *Requirements of students*: In addition to the general stability of the system, it is important for students to find functional applications, acceptable levels of speed in data access and transmission, rescue points in case of failures. Handling the basic functions, such as starting and operating the equipment, needs to be easy, plausible and identical for all users throughout the university. Students get access to this system using their home-account from the university or by specific training log-ins. Online connections to their home-environment is another plus. Otherwise, alternative possibilities for data transfer should be in place.
It goes without saying that disturbances to individual concentration such as noise, bad air, placement, vision, activities of fellow participants should be kept to a minimum.

2. *Requirements of lecturers*: Functionality of hardware, maintenance of software-installations, but no changes during term/semester, availability of user data etc. Easy operability of the system, without need for complex instructions. No requirements of additional staff time to run the operation technically. The same goes for controlling room access. The plan of occupancy needs to be in view by the door, to help participants to find the right room at the right time, or to indicate when the room can be used freely.
Lecturers expect availability and usability of all the services, applications and technology necessary for their course. They must have the ability to make available to participants data and materials prepared in advance. Also, lecturers should be able to start videoconferencing, in order to make the lecture accessible to distant students.
It is also important to put up information on contacting help from the service provider in case of problems.

3. *Requirements of operators*: The main task of the operator is to fulfil the requirements of users and lecturers at the lowest cost possible. The key here is the reliable availability of back up and restore mechanisms to pre-empt user operating errors. This includes limiting user access to the functional minimum, to run safety applications and to enable resetting the system to a defined status quo ante. Work on maintenance and preparation of sessions have to be kept to the minimum. Using terminal server services, virtualization of computers and applications, and imaging of hard drives are helpful for this.

Virtual PCs and virtual environments are particularly effective: operators can store materials on a file server and release them at the date of the event at the push of a button or automatically. At the workstation, access has to be set to this service – which then runs practically in "set and forget"-mode.
Logon of participants has to be assured – according to their status in the underlying system of roles and rights. Access rights based on defined user profiles are very helpful for this. Enough lines for access to the IT infrastructure, stable supplies of electricity and features limiting risks, e. g. excessive heating, electric shock – such as protective circuits and switches to disconnect devices from the network - are imperative.

There may be periods of time, when these rooms are not used for training. In these cases they should be open to be utilized for other purposes, for instance as a computer workroom, for group work or even as a campaign area. But this requires additional measures to protect the physical and technical infrastructure - for example, by regulating access - and to ensure security through surveillance or security services.

5.2 What do training rooms look like?

IT-training rooms accommodate the requirements of modern teaching-learning scenarios and also the specific conditions for IT training. For this purpose furniture and devices are arranged in a way

conducive to interaction and communication. They are fitted with technology, which is easily mastered, handled intuitively and well documented.

The challenges to be met subdivide into the two categories "space" and "IT".

Space

1. *Architecture:* Already in selecting appropriate rooms some of the basic conditions have to be considered to add appeal to the future space. Generous dimensions – 4 sq. m. minimum per work place (including circulation areas) and adequate ceiling heights create a pleasant relaxed atmosphere. Another 20 sq. m. should be factored in for contemporary moderation and communication tools (flipchart, pinboard etc.)

Rectangular rooms with similar side lengths have found to be optimal. Windows should be oriented towards the North to avoid direct sunlight. Proximity to bathrooms, service-points, libraries and cafeterias add appeal to the training room. To facilitate concentrated work acoustic shielding should close off the room from noisy areas of the university.

2. *Furniture:* Students often spend long periods of time in training rooms. Therefore, selection and arrangement of furniture have to meet ergonomic regulations such as the Directives on Work Places or the relevant DIN-norms.[96] Additional small shelves or lockers may be provided for bags and coats to keep the room tidy. This has positive effects on the general atmosphere, but also helps to prevent accidents. If the room is used for e-assessments, lecturers can safely shut away critical or personal documents.

3. *Arrangement:* Unhindered sight on the lecturer, the blackboard or the projection surface helps students to focus and to remain attentive. Depending on the style of teaching various arrangements are useful:
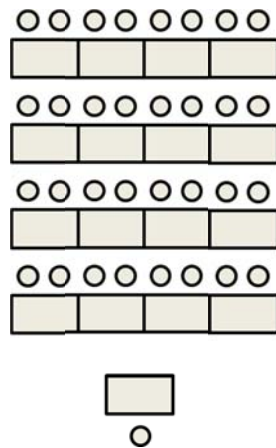
Frontal Seating   U-shaped Seating
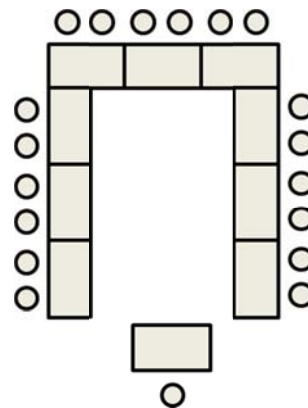
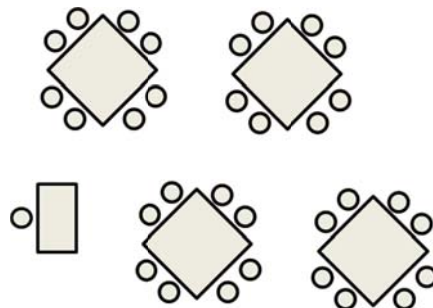Learning Bays

Fig. 32: Models or ordering tables and chairs in a training room.

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[96] See for example, „Verordnung über Sicherheit und Gesundheitsschutz bei Arbeit an Bildschirmgeräten" (Ordinance on occupational safety and health protection during work with visual displays) or the DIN EN ISO 9241 (especially part 5 insbesondereTeil 5: „ Workstation layout and postural requirements ").

IT

In rooms dedicated to learning, technology should never be employed for its own sake. Its sole purpose is to support users unobtrusively in their work and to allow them to handle the equipment intuitively.

The basic equipment of an up-to-date training room consists of:
- Projector (including anti-theft device and mount)
- University-wide coordinated, centrally managed media controls with terminal panel and lighting control
- Board (if possible, digital whiteboard including short distance video projector)
- PC-work places.

If required, these might be added:
- (Digital) overhead projector
- Didactic ring (device for organizing digial communication between lecturer and students)
- Facility for videoconferencing
- Audiovisual equipment for recording lectures and seminars.

Heating and ventilation also have to be adapted to create a pleasant indoor climate and to offset thermal discharge from computers and monitors (about additional 100 watt per work place)

Finally, it is recommended to reduce reflections of light. Indirect and dimmable lighting combined with efficient darkening mechanisms is, so far, the best solution. It reduces lighting as well as heat.

How are training rooms run and further developed?

1. *Organisation:* Lecturers have a number of expectations concerning the technology in training rooms. They want support for contemporary teaching-learning scenarios, consistentency in look and feel to increase acceptance. Active monitoring guarantees a high degree of availability and reliability.

To meet these complex requirements right across campus efficiently, those responsible for operating training rooms need to be identified clearly. If tasks are divided optimally, the number of points of intersection between organisations involved may be cut down (e.g. computing centre, department of operations etc.).

In close coordination with all actors, including the users – there should be a body responsible for ongoing conceptual development of training rooms in the university. A representative of the university directorate should be part of this body, preferably the prorector or vice president responsible for teaching, to prevent strategic misdirections and to enable access to central resources.

2. *Operation:* No matter which request they have, users should be able to turn to a „Single Point of Contact", personally available throughout opening times and accessible via phone and e-mail, too. Constant monitoring of the technology, timely local support and remote access through media control systems increase customer satisfaction and permit high capacity utilization of training rooms. Complex technologies are best supported by trainings regularly on offer. This helps to engage lecturers' interest for modern media. At the same time, support requests are reduced. Also, simple, up-to-date printed documentation – at best bilingual - should be on site and online for easy reference.

5.3 E-Assessment Rooms

If training rooms are also used for e-assessment, additional specific requirements have to be met. These include:

1. *Security of the installations*: Operators need to hook up additional special services to be accessed from the computer workplaces (e. g. the exam form and permitted tools) and de-activate others (e. g. access to the Internet or to home disks)

2. *Ensuring exam conditions*: This is applies especially to the security of access to the room, i.e. access has to be restricted to students participating in the e-assessment. Furthermore any exchange between participants or participants and outsiders need to be prevented. This has to be part of the room-design and the regulation of the exam.

3. *Consider the number of participants*: In some disciplines attending groups become quite large and designated training rooms are overcowded. In this case additional, PC-equipped rooms have to be reserved and additional passageways should be opened.

4. *Ensuring support*: e-assessments require a high degree of support. Those responsible for the exams (lecturers, operator of rooms and IT) have to coordinate to reach optimal solutions.

5.4 Examples

1. Media training rooms: IKMZ Cottbus and University of Regensburg

Fig. 33: IKMZ of BTU Cottbus[97]

Fig. 34: Training room for groups at the computing centre of the University Regensburg.[98]

In the media training room at IKMZ Cottbus students can sit written exams in larger groups, even outside opening hours of the library.

University of Regensburg: Displays in the training room of the computing centre can be hidden by a folding mechanism, when IT devices are not needed in a course.

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[97] IKMZ Cottbus. Picture credit p. 58
[98] Computing Centre University Regensburg. Picture credit p. 58

2. Training rooms equipped for e-assessments: University of Duisburg-Essen and University of Bremen

Fig. 35: PC-Hall University Duisburg-Essen[99]

Fig. 36:Testcentre University Bremen[100]

The „PC-Hall" is the largest computer workspace at the University of Duisburg-Essen. Designed as an e-assessment room it accommodates 196 computer work places for users and 2 for supervisors.

The Testcenter of the University of Bremen is a computer room available for all lecturers of the university to offer e-assessments ranging from placement tests to exams.

5.5 Recommendations

In contrast to unspecific work places and spaces, IT plays a key role in training rooms, in addition to pedagogical considerations. Training rooms cater for highly demanded IT trainings – this is their core function.

1. *Define clearly their intended use* – Intended use and target group are important reference points in design and operation of training rooms. If these are defined, equipment and mode of operation of the room can be implemented in an optimal way. All-purpose rooms should be discouraged – usually they are not up to the more specific requirements and/or the amount of maintenance is prohibitive.

2. *Less is more* – The diversity of devices, applications, and user demands etc. often results in providing IT training rooms across the board with wide selections of hard- and software. This is not only uneconomical, but also tends to undermine the existing IT infrastructure. A better approach is to define a core-portfolio and to guarantee it is available reliably and securely.

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[99]   University Duisburg-Essen. Picture credit, p.58
[100]   Jens Bücking, ZMML Bremen. Picture credit p. 58

6. BYOD Work Places[101]

According to Gartner[102] the number of WLAN-enabled devices will grow worldwide from 2 billion in 2010 to more than 3 billion by 2015. A considerable portion of these devices is used in universities.
By now, it is no longer a question for universities if and which of the 'consumerization'[103] devices they are willing to allow. Rather students expect to find compatible environments and interfaces for their devices in the university. In the near future a sizable segment of students is expected to bring two or three mobile devices on campus. Most likely, the whole spectrum of systems and manufacturers will be represented. From this follows: BYOD work places are becoming an important component in viable conceptions of learning spaces.

Added value of BYOD for studies and teaching

To respond to these developments adequately is certainly one of the technical and infrastructural challenges faced by universities. But it also brings definite added values for student learning, which should be taken up by universities.

- Mobile devices support new forms of teaching and learning technique by:
- Discovery of new locations for learning (Example: students of landscape architecture learn in the field and systematize their results collaboratively and in real time on tablets);
- Support for innovative leanng sceöllllnrios, such as Flipped Classrooms[104];
- Support for complex communication scenarios, for example, synchronous collaboration[105].

At the same time, mobile devices bridge learning spaces on and off campus by technology[106]. Using Unified Communication[107] students are able to make use of all communication services –write e-mails, check mailbox, record lecture etc. - no matter which device is used

However, students not only bring their personal devices into the learning processes, but also their social contacts and networks. These are built in various social media environments mixing personal and study-related contacts. Students as „Digital Natives" take these technologies for granted. They expect to access their data in all areas of their lives – including their university.

BYOD demands new communication strategies of Universities

Universities have to keep in contact with their students and this implies using their communication channels, i.e. it is advisable for universities to be present in social networks.
This does not necessarily mean to use external platforms, but to build their own platforms for learning and research. But then universities should make sure these structures are conducive to communication and cooperation. In addition, it is necessary to remove barriers to make the platform accessible everwhere, i.e. accessible from all mobile devices with contents being displayed in a good quality.

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[101] Bring Your Own Device" means to access the IT-infrastructure of an organization from external (private) devices

[102] Gartner is a US marketing research institute specializing on information technology.

[103] Consumerization means, there is no central unit of provisions specifying which devices can be used, but users themselves choose what to get.

[104] Flipped Classroom is a method of integrating learning: learning takes place at home; the course in the university is used for clarifying questions and applying what has been learnt in practice. See Handke/Sperl 2012.

[105] Synchronous collaboration: learners collaborate on a common task using real-time electronic communication, see Hinze 2008, p.243.

[106] This type of linking internal and external learning spaces is also termed „Hybrid Classes", see http://distance.uh.edu/class_formats/hybrid.html [25.03.2013].

[107] See Koepsell 2007, p 2-5

6.1 Terminal Device Classes at BYOD-Work Places

In relation to BYOD work places two types of devices have to be distinguished from one another:

1. *Smartphones and Tablet-PCs*: These usually run on the operating systems Google Android, Apple iOS and the mobile versions of Windows. As a rule, it is not possible to run standard PC-applications on these devices; they are replaced by apps developed for their specific platform. Some apps add true value for studies and academic work. Others may pose security risks when the mobile device is hooked up to the data network of the university. This type of device is mostly used for passive retrieval of information, current messages, communication and collaboration, access of portals and e-learning platforms. On account of missing interfaces and a merely virtual keyboard, these devices are not suitable for academic writing.

2. *Notebooks*: These are fullfledged computers with the usual range of interfaces and programming abilities. Because of their flexibility and performance class as well as their simple connectivity to the networks, they pose risks to security and require the installation of security measures, at the very minimum, effective anti-virus applications. At this point a thorny question arises: how can a device get accepted into an IT network, though it is in violation of basic network principles, for example when it brings in software applications from outside the approved portfolio? It is possible to test every single BYOD-device, for example by passing it through network quarantines.

BYOD and IT requirements of the university

To hook up BYO devices to the IT-infrastructure of the university users authentificate themselves with the user account and password provided by the institution. This opens access to services specific to the university, for example, eduroam or Shibboleth.

Even if universities do not have specific applications for systematic integration of BYOD-devices: students demand this kind of infrastructure for quite some time.
The level of IT certainly is not a primary criterium in choosing a university for one's studies. Yet, increasingly, it does impact on the satisfaction of students with the services of their university. Universities definitely have to respond by providing BYOD work spaces on campus, which meet three basic criterias:

- Internet-connectivity (usually via WLAN) with seamless roaming, application integrity[108] and appriate data transmission rate,
- Comfortable seating and work conditions
- Power supply nearby.

Students usually give clear feedback on what is most important to them in terms of infrastructure: first of all, internet-connectivity, followed by design of work-places and availability of power. In planning BYOD-work-spaces, the university should take care of all three criteria. If institutions are not able to provide WLAN access everywhere on campus, the next hotspots should be sign-posted.

6.2 Integration of BYOD work spaces in the university

BYOD work places are easy to create – all free areas on campus are suitable, if security and fire safety are assured. Particularly the foyers are a good choice as they are used by students as informal meeting places. BYOD thus opens up new possibilities – areas can be used in addition to separate rooms.
Still, universities should also consider existing rooms for BYOD.

In principle, there are two kinds of public rooms in a university - rooms for teaching and social rooms.
1. *Rooms for teaching* include lecture halls, seminar rooms, laboratories etc.
2. *Social rooms* are, for instance, canteens and cafeterias.

Usually, rooms for teaching or dedicated to narrowly defined purposes – lecture halls, for example, are meant to be used for lectures and exams only. Equipped for BYOD, their usability is immediately

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[108] Access on applications such as Microsoft Office via "Software as a Service (SAAS) and specific ports in the network.

extended. The hall might quite easily be used for videoconferencing. A major problem is controlling access; if for example, a few hundred people want to use the same service.

BYOD enabled social rooms are very appealing for students. The technical challenge here is access to power. Serious investment is required to put up modern campus-wide power supplies. Also, additional operating costs have to be taken into account when planning this type of infrastructure.

Recharging batteries for their devices is an important service for students. This may be offered in connection with other services, for example, at the general service point for a minimal fee.

6.3 Examples
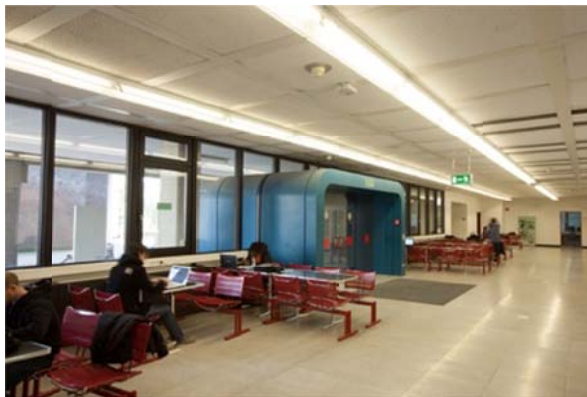
University of Düsseldorf and University of Paderborn

Fig. 37 Lobby of Centre for Information and Media Technology (ZIM), HHU Düsseldorf.[109]

Fig. 38: Notebook-Café at the University of Paderborn.[110]

WLAN is available throughout the entry area of the ZIM at the University of Düsseldorf. Work places at the windows are fitted with power sockets.

The Notebook-Café of the University of Paderborn provides BYOD infrastructure and additional services, such as recharging batteries and advice on IT issues.

6.4 Recommendations

1. *Make use of free spaces*
BYOD zones in free areas provide added value for students. Additional furniture is not necessarily required.

2. *Take user requests for BYOD seriously*
BYOD is a challenge for universities, especially their computing centres, because of the IT security issues involved. Nevertheless, this issue has to remain on the agenda because of clear user demands. Computing centres definitely should face up to this challenge and come up with solutions in terms of security technology and constructional considerations.

3. *Achieve attractivity with small steps*
For BYOD even small steps can create tangible added value for students: BYOD enhances the appeal of the rooms, buildings, campuses, where it is available, and boosts the impression of a living learning space.

4. *Create a starting point for additional service*
Students are very interested to use infrastructure and services of their university on their own devices. These services need not be restricted to access on the learning management system and a full-text database. Rather, BYOD makes it possible to adapt and makes available more services of the university

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[109] Centre for Information and Media Technologies, University Düsseldorf. Picture credit, p. 58
[110] Julius Kolossa. Picture credit, p. 58

on student devices. On the other hand, physical student services might be placed into the proximity of BYOD areas, which are also very much student meeting places.

7. Virtual Learning Spaces

7.1 Virtual Learning Spaces – A Wide Spectrum

Multimedia offerings labelled „virtual learning space" differ over a wide spectrum. They can be ordered roughly according to goal, connection with other systems, degree of reality etc. Wessner summarizes their common features in his definition of virtual spaces:

[Virtual spaces are] „computer representations of logical places, a number of people, a number of objects, to be operated upon by people in virtual space, but also a number of opportunities of action, by which people can manipulate objects, communicate with each other, coordinate and collaborate."[111]

This reference to opportunities of action shows clearly the limits of a purely technical understanding of virtual leaning spaces. Rather, it is necessary to create pedagogical scenarios, oriented towards users and needs, to demonstrate the functions of virtual learning spaces. Usually, this involves making available material and human resources to ensure their smooth operation, for example through IT specialists maintaining servers.

Virtual learning spaces differ according to their capacity to represent real worlds in images, language or process. This can be illustrated by the example of visual metaphers. Schwan and Bruder distinguish four different kind of visualization:

1. Pictorially true illustration (high degree of accuracy and realism, e.g. photos)
2. Schematizing illustration (low degree of realism, reduced to the relevant content (e. g. cross-sections of the brain with blood vessels emphasized)
3. Concretizing illustration (low level of realism, pictorial illustration of abstract phenomena, e.g. electrical fields).
4. Metaphorical illustration (low level of realism, illustration by means of allegories, e.g. karies bacteria symbolised by interacting human figures).[112]

Depending on which type of illustration is used, users can benefit in a variety of ways.

7.2 Basic Requirements of Virtual Learning Spaces

Depending on the scale of realism virtual learning spaces make different demands on the user:

1. *Adaptablity and usability*
Virtual learning spaces providing a high level of realism offer familiar types of guidance. They enable easy access to IT and digital communication and facilitate participation in online study activities. In consequence, the most important requirement for virtual learning rooms is to be adaptable to user groups on different levels of experience and media competence. This is achieved, when usability criteria have been observed and suitable pedagogic-didactic conceptions are followed. Increasingly, universities offer part-time and second-degree courses. In the context of life-long learning and demographic change, this issue becomes relevant to universities, in addition to providing virtual learning spaces for the curricula of undergraduates. The new "adult" target groups may be confronted with virtual learning spaces, self learning and cooperative learning only at their return to the university, and definitely need to master the necessary IT and communication skills.

2. *Accessibilty*
In virtual leaning spaces students with disabilities, e.g. vision-impairment, can retrieve information, interact socially and learn. For this it is necessary to provide the functionality to the machine to read out learning materials stored in the virtual learning space. In this way, virtual rooms can contribute to the integration of students with a disability into university life and the community of students.

3. *Interlinking real and virtual offerings*
The preceding example showed already what is needed generally: to interlink virtual and real learning

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[111] Quoted fromWessner 2005, p. 19.
[112] See Schwan and Bruder 2006, p. 2-7.

spaces and learning. Students with disabilities can work through lectures in virtual space and at the same time interact with their fellow students in real time instead of working though a skript all by themselves. To build these links is an important task of universities. Frequently it is the case, that real offerings (e.g. face-to-face meeting of a learning group) are preferred over a virtual variant (e. g. virtual learning communities).

Chapter 7.4 describes possibilities of interlinking virtual and real learning rooms. To maintain or even enhance the practical value of virtual learning rooms to the actors in the university they have to be kept updated and as far as possible linked to the university systems and other virtual services. This requires the implementation of interface-plug-ins, routines of synchronization etc. To be able to do this, software applications need to be transparent and adaptable. The university has to make sure of permissions.

4. *Taking into account social processes* – Apart from technical concerns, virtual learning rooms need to cater adequately to the social character of learning. Concepts like „Social Embeddedness"[113] and „Awareness"[114] describe from different perspectives how to interlink learning processes and social processes in virtual learning spaces.

Many universities want to implement Web 2.0-technologies across the board, in order to offer a diverse selection of digital products and services. They are required, therefore, to implement general guidelines or to commission their service units to take care of the technical infrastructure.

The universities have to open up to innovations. To formulate an official university-wide strategy may give clear orientation to departments, institutes and professors.

7.3 Multiple Functions of Virtual Learning Spaces

Universities usually choose one of the Learning Management Systems, such as Moodle of ILIAS to accommodate virtual learning rooms. These systems are designed to provide functions for a wide variety of users, learning goals and needs. Their all-purpose character permits to bring together all virtual services of an institution as a "single sign-on portal". In this way, these systems act as a virtual presence of their institution. However, virtual spaces can also be used in learning more specifically.

From the requirements mentioned above the following core functions of virtual learning rooms may be summarized[115]:

1. Virtual learning rooms to assist orientation
These include virtual tours, online databases, and information services by chat, QR-codes etc. – Services helping users to grasp facts and circumstances quickly. One the one hand they make possible learning in virtual space (tour, database etc.), on the other they transfer of knowledge, if the purpose of virtual learning is to help find one's way in the real physical space, for example, through audio tours or QR-Codes.

2. Virtual learning rooms as accessible extension of teaching
Part-time students, students on parent leave and people with disabilities specifically benefit from virtual learning rooms, giving them the opportunity to retrieve course information flexibly any time, anywhere or to use asynchronous functions for exchange, such as discussion forums in learning platforms, to communicate across various barriers. In this way, the virtual learning supports new forms of teaching, going beyond media-technologial enrichment of traditional university teaching and learning.

3. Virtual learning spaces as social locations
Virtual learning spaces encourage social interactions between diverse actors. Just as in formal learning settings, like seminars, lecturers and students or students among themselves can get into contact with one another. Virtual spaces also support communication in informal learning settings, for instance when students 'meet' in discussion forums or exchange material. Informal settings in virtual learning rooms have another advantage: Sometimes users raise question or voice opinions, which they would

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[113] Social Embeddedness: Learners' actions are very much determined by their social relations, see Granovetter 1985, p. 490. It follows, that acceptance of learning programmes can be improved by embedding them into wider social activities.
[114] Awareness refers to the knowledge of users of a learning platform about "who is where within the shared virtual space at a certain point of time and ready to be contacted", see Hampel 2001, p. 116.
[115] Additional functions of virtual learning spaces are discussed in detail by Kannenberg, 2011, p. 14

hold back in a formal setting for reasons of feeling ashamed, isolated or afraid to be seen as lacking in knowledge.

4. *Virtual learning rooms - access to integrated services*
Also, virtual learning rooms can provide efficient access to user-oriented information. In the framework of so-called Personal Learning Environments (PLEs) information from a wide variety of sources are made available. Through personalization information can be filtered according to interests. PLEs serve as a more flexible and open structure for active and self-paced teaching-learning processes. Students are able to collect topics and materials according to their interests, and to work on them directly on the learning platform. So far, most PLE systems in universities permit access to select stand-alone services, such as specialized databases, link collections, etc.

5. *Virtual learning space – location of new forms of action and services*
Virtual learning spaces can be very open in terms of audiences addressed and opportunities of action, to lend themselves to further development and test of new forms of utilization. For example, so-called „Massive Open Online Courses" (MOOCs) represent a form of virtual learning space, in which course providers offer their contents in a set way („xMOOCs"). At the same time, they invite users to add their own contents relevant to the course. This kind of interdependence is expected to enhance the engagement of users with course contents. Because contents are open, they can be re-used as a basis of knowledge for new innovative course concepts. In this manner MOOCs break up traditional settings for learning and service provision: They fling course contents out of the ownership of institutions over into the swarm intelligence.

6. *Virtual learning spaces – location for developing specialized competences*
Virtual learning spaces are not necessarily open. To train specific competences they are usually designed as closed. Classic examples are flight or driving simulators, where learners train for specific competences and strategies on how to deal with critical situations. Such environments are already fairly common in vocational training. On the level of universities they have been taken up in medicine and health care because of their focus on a limited area of competences. As a rule, these are broken down into a series of pre-defined technically supported learning actions. This kind of specialised application is usually very complex and costly.

7.4 Connecting virtual and real learning spaces

There is a great demand to link virtual and physical learning intelligently. So far, there are no practical and empirical findings on implementing this successfully. In practice it often turns out: virtual learning spaces cannot stand alone, they are associated with physical sites, even if users do not perceive them as a learning space. Gläser (2012) underlines that virtual learning per se takes place in physical rooms. A student in a virtual learning room is at the same time in a physical room – a café, at home at his desk.[116] But there is a fundamental difference between learning at home and learning at the university: the physical room at the university is designed with didactics in mind, the place at home is outside this system. From this follow two trains of thought:

1. If the physical learning space cannot be adapted to learning, this has to be taken into account in the virtual learning space. In it learning resources, tools and communication functions have to be arranged in such a way to make work possible independent of a physical learning space.
2. If both the virtual and the physical learning spaces are designed didactically, it is possible to find complementary arrangements between the two spheres.

Taking the second variant as a point of departure, possibilities are shown in the following sections for interlinking virtual and physical learning spaces.

We propose to design the central features of the learning space in a unitary manner in the virtual dimension as on the physical level.

1. *Learning activities* – learning activities can be implemented virtually as well as physically. They can be designed in reference to one another and to complement one another.

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[116] Gläser 2012, p. 5.

2. *Learning resources* – learning resources are accessible in the virtual as in the physical learning space or they complement one another. In the virtual space they are available in digital form for downloading, as online tutorial etc.

3. *Support* – Support plays a key role in both cases. Virtual support adds the ability to offer support anytime, anywhere – it can be provided by people or even avatars.

4. *Design* – Virtual and physical work places share central design elements to show their connection.

5. *Offerings and services* – Offerings and services for supporting learners should be geared to virtual and physical rooms equally. For example, consultation hours should be offered face to face and digitally.

6. *Contents* – Physical as well as virtual offerings and services have to meet two requirements in terms of content: Both rooms have to be contain contents appealing to prospective users. At the launch of a learning programme, contents appealing to potential users have to in place. To appeal, they need to reflect a high level of quality, actuality, attractiveness) to keep up users' interest.

To match virtual and physical learning rooms is quite challenging – not least because ineraction can easily flip into competition, if one side is used preferentially. This happens when learners choose one, maybe because it is very prominently advertised, while others are ignored.

Or, utilization looks one-sided, because there are no sufficient records for different variants. To give an example: A blog has a lot of visitors, but hardly anyone uses comments. If this is analyzed only superficially, a pedagogic scenario relying on this blog may pass by its target group. Programmes and facilities – physical or virtual – have to enable users to make adaptations, according to their individual preference and situation. This includes, to be able to decide at any time which type of support is needed for which teaching-learning scenario.

Progressive technological developments raise anticipations of future mergers between virtual and physical learning spaces. Learners will be able to interact with physical objects in virtual spaces. But at present universities hardly follow this direction. This topic is, therefore, concluded here with a reference to a paper by Reiterer et al. (2010), who developed such a scenario for a library[117].

7.5 Examples

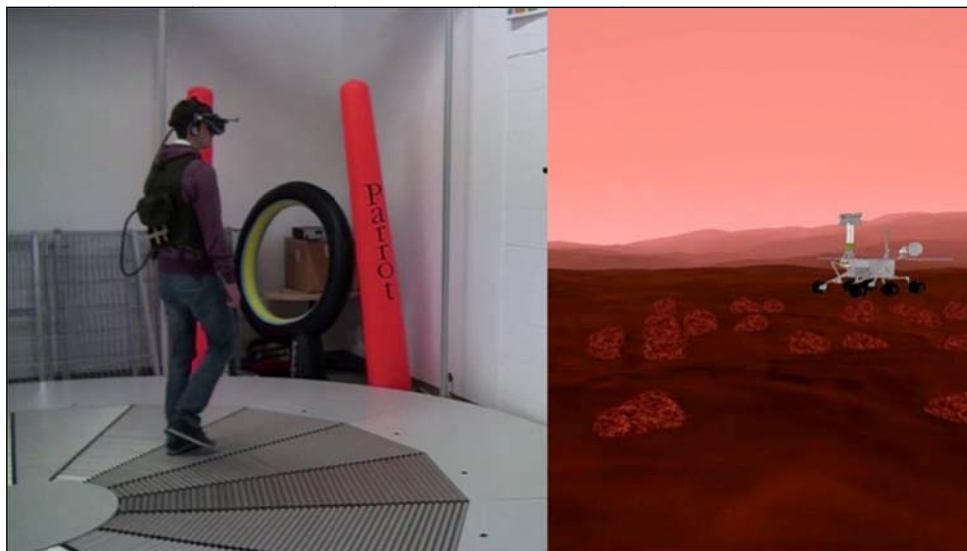### 1. RWTH Aachen and TU Dortmund, Campus RWTH Aachen: Virtual-Reality-Lab/Virtual Theatre[118]

Fig.: 39: Exploration of the Martian surface in the Holodeck of RWTH Aachen/TU Dortmund.[119]

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[117] Reiterer et al. 2010, p. 90-97
[118] http://www.ima-zlw-ifu.rwth-aachen.de/dienstleistungen/virtual_theatre.html [21.02.2013].
[119] IMA/ZLW & IfU, RWTH Aachen. Picture credit, p. 58

The Virtual-Reality-Lab and the Virtual Theatre allow students to work on special engineering contents locally in a physical room. The Virtual-Reality-Lab provides a laboratory environment, in which students produce and test 3D-applications. From the holodeck, an extension of the Virtual Reality-Lab, they project the 3D-animation to a physical room, which can be entered by students to manipulate or interact with the virtual objects.

Didactic-methodical aspects, namely encouraging experiments, construction and testing, guide this. The holodecks help students to work in areas, which are hard to access or risky (such as engineering in nuclear plants).

This practical example shows: Virtual learning works also in physical rooms, but in principle, a Virtual-Realiy-Lab is about virtual learning in virtual space.

2. University Library St. Gallen: 3D-library portal of electronic resources

The University Library St. Gallen offers an alternative tool for orientation, additionally to its website, which includes a spatial orientation system and the user catalogue. The "3-D Tour" is a realistic graphical representation of a bookshelf. Users can grab e-journals and –books from this virtual shelf. Elements from this tour are linked to pages from the website. Consistently implemented, this might lead to a complete presentation of all electronic resources, such as databases, in a much more appealing and user-friendly manner than usual. Especially users with reservations towards technology might be attracted to this kind of intuitive low-threshold access.
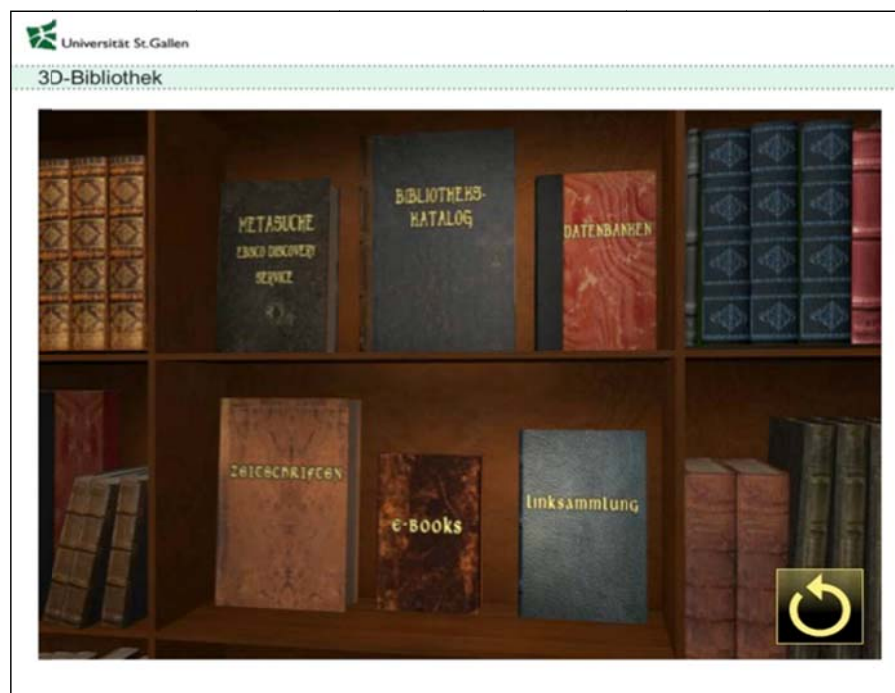

Fig. 40: 3D-Library Portal of the Library St. Gallen[120].

3. Orientation on campus: University of Portsmouth[121]

The University of Portsmouth offers a virtual tour depicting the whole campus. Using filters such as living space, sports sites, student life etc. it is possible to select orientation points on campus. All images of university buildings include mouse-overs displaying concise information on their infrastructure and specific services. Bookmarks, printing and a planner facilitate transfer of the virtual presentation into physical reality.

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[120] University St.Gallen (HSG), Hannes Thamann. Picture credit, p. 58
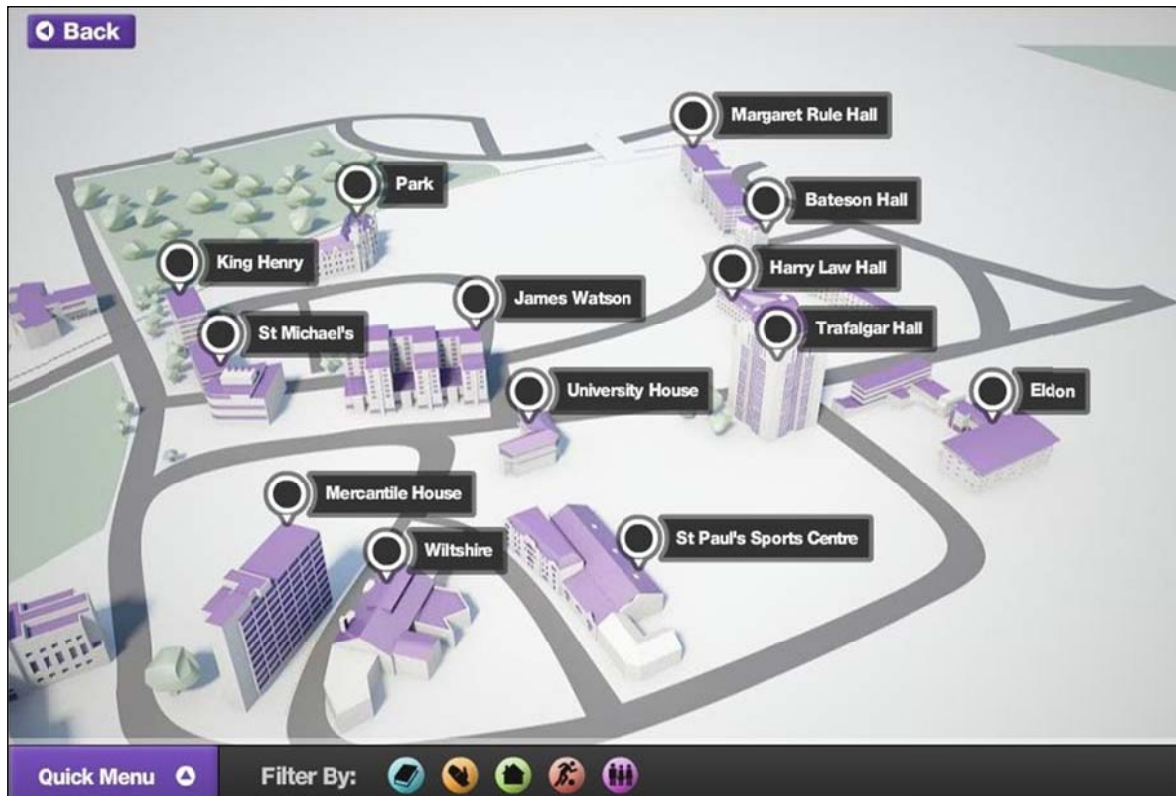[121] Additional information: http://www.port.ac.uk/virtualtour/?hvt

Fig. 41: Virtual Tour University of Portsmouth.[122]

4. Accessible university online: DisabledGo/, University of Portsmouth[123]

The University of Portsmouth made all buildings and services completely accessible. Detailed information on any building is available on the portal „Disabled Go": location, access, services for disabled persons, accessible infrastructure etc. Symbols show students possibile ways of utilization. For services requiring booking, contact persons and their coordinates are added, too. The university is using virtual learning spaces consistently to make the entire university accessible for students and visitors with disabilities.

[122] Press Office, University of Portsmouth. Picture credit p. 58
[123] Additional information: http://www.disabledgo.com/en/org/university-of-portsmouth.

Fig. 42: Description of Anglesea Buildings, University of Portsmouth.[124]

5. University Library Duisburg-Essen: Moodle Library Certificate[125]

Since 2009, the University Library (UB) of Duisburg-Essen offers the „Library Certificate" – an online course to acquire basic subject-specific information competences. Partly, this course takes place in class, partly in a course room on Moodle.[126] The whole programme consists of three parts. Part I (Introduction to the Library) and Part II (Literature Research and Inter-Library Loan Services) can be completed either in class or online, Part III (Subject-specific Literature Research) is studied mainly in class. Since 2013 the Library Certificate in English Studies is available. In this course, students develop their competence for academic work, working flexibly time- and location-wise. Their certicate is shown in the course room as soon as they have passed the test online. This is printed out and taken to the information desk at the library to get official approval.

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[124] DisabledGo. Picture credit p. 58
[125] More information on the library certificate of the University Library Duisburg-Essen: http://www.uni-due.de/ub/abisz/schein.shtml [26.04.2013]
[126] Petschenka/Engert 2011, p. 19f.

Fig. 43: Library Certificate Moodle, University Library Duisburg-Essen.[127]

6. Medical College Hannover: Disciplinary linking of virtual and physical rooms[128]

Medical College Hannover provides an App for mobile devices, which supports students in diagnosing rare skin diseases. The Augmented-Reality-App „mARble" projects altered states or injuries on a photo of a healthy arm, for example. In this way students recognize, how the disease appears in real life and they can practice diagnosing realistically.

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[127] University Library, Duisburg-Essen. Picture credit p. 58
[128] Weitere Informationen zu mARble: http://www.marble-app.com

Fig. 44: The mARble-App of the Medical College Hannover projects symptoms onto its photos, facilitating der MHH realistic learning.[129]

The App brings up additional information on symptoms of the disease; users can compare their diagnosis with this information. Learning processes from first views to making the diagnosis and feedback is extremely speedy and effective.

7.6 Recommendations

1. *Orientation on target groups and needs*
Virtual learning spaces at universities become more important in the context of Web 2.0. Institutions should not view this issue as an exclusively technical problem. Rather it is necessary to take into account pedagogical-didactic teaching-learning scenarios for different target groups and the specifics of learning, teaching and research.

2. *Link physical and virtual learning spaces*
First of all, universities should analyze requirements and desired functions of virtual learning spaces, and then include services as a result into their own service portfolio. Universties should emphasize their solutions of linking physical and virtual learning spaces, and how these are part of their overall concepts in their discussions and their public promotions.

3. *Tap didactic and technical potentials fully*
Virtual learning spaces and particularly their link to physical spaces, offer a wide variety of opportunities and usage scenarios. Given enough will and daring to experiment, universities can break new ground for innovative services as well as dialogue with their target group, students, on many levels.

The good practice examples presented here demonstrate a wide range of innovations already put into practice. They are offered here as a pool of ideas to encourage other universities to take up similar innovative approaches.

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[129] PLRI MedAppLab, Medical College Hannover. Picture Credit p. 58

8. Results

Discussions and examples developed here so far show clearly the versatility and complexity of learning spaces. Universities not only have to adapt their building and technical infrastrutures, but they have to gear their own credo towards the quality of student learning and its support.

In the following paragraphs we summarize core recommentations from the preceding chapters:

1. Learning Space as a Strategic and Management Task of Universitities

1. Research into student learning, suggesting budget lines
It is essential to research systematically student learning and the requirements resulting from it. Funding agencies have to to re-align their budget lines towards supporting the development of learning spaces in universities adequately. Universities need empirical studies on student learning and incentives to work on the development of learning spaces. Existing programmes supporting "Quality of Teaching" can be extended to include such projects.

2. Develop local profiles
To turn learning spaces into an asset adding edge to the profile of the university, its concept has to be built from local conditions and specifics.

3. Embed conception and central controlling
Integration of all projects into one conception is the sine qua non to achieve their most effective coordination. Therefore, the conception has to be embedded into the strategy of the university to secure long-term success for the learning spaces initiative. This has to be complemented with a fully transparent process involving all actors.

4. Initiate staff- and organisation development
Learning spaces have to be considered as a crosscutting issue, which means to draw in many actors from different sectors to enable them to proceed towards joint projects. This needs to be taken on board from the very beginning on the level of overall staff and organisation development. In cooperations and mergers the teamplay of the actors has to be encouraged, especially when instutional boundaries are to be crossed. Standards for communication and quality have to be worked out jointly by these actors.

5. Secure resources longterm
Sustainable learning spaces cannot be operated on one-time investments, but need continuous funding. Essential resources to run Learning Spaces have to be provided and secured centrally; this applies to rooms, staff (coordination, planning, service and support, maintenance) and Equipment (initial and maintenance).

2. Information Literacy

1. Extend perspectives and topics on information literacy
Information literacy is set in the wider context of key competences and their topics

2. Increase cooperation
Shared fields of action in information literacy create a new basis for cooperation. So organisational divisions (e.g. library, computing centre) can be overcome.

3. Stimulate learning experience by "development instead of transfer"
Offers on information literacy should support active learning, with increasing flexibility, multi-channel delivery (physically and virtually), and in accordance with social requirements.

3. Types of Workplaces

1. University-wide approach
In developing workplaces and zones, real estate and spatial conditions, perhaps distributed buildings have to be considered

2. Enhance accessibility
Look at opening hours, layout, access permissions!

3. Aprroach learning as a sensual experience
Foster an inspiring work atmosphere

4. Guide user behaviour through the design of buildings
Clear zonal distictions between noisy and silent areas prevent conflicts between different learning and working styles of students, and provides a choice between different atmospheric room experiences. In addition to architectural/building designs, flexible zones, separated by shelves or mobile walls, may achieve similar effects. These are essential in "Open-Plan"-buildings[130]. It may also be helpful to signpost floors or areas to indicate levels of social activity.

5. Focusing to enhance attractivity
Accentuating select areas in buildings adds visibility and directs the user to make choices according to needs or topics.

6. Continuous Updating
Stay aware of changed user requirements and update environments accordingly.

4. Training Rooms

1. Define clearly their intended use
Intended use and target group are important reference points in design and operation of training rooms. If these are defined, equipment and mode of operation of the room can be implemented in an optimal way. All-purpose rooms should be discouraged – usually they are not up to the more specidic requirements and/or the amount of maintenance is prohibitive.

2. Less is more
The diversity of devices, applications, and user demands etc. often results in providing IT training rooms across the board with wide selections of hard- and software. This is not only uneconomical, but also tends to undermine the existing IT infrastructure. A better approach is to define a core-portfolio and to guarantee it is available reliably and securely.

5. BYOD-Workplaces

1. Make use of free spaces
BYOD zones in free areas provide added value for students. Additional furniture is not necessarily required.

2. Take user requests for BYOD seriously
BYOD is a challenge for universities, especially their computing centres, because of the IT security issues involved. Nevertheless, this issue has to remain on the agenda because of clear demands on the part of users. Computing centres definitely should face up to this challenge and come up with solutions in terms of security technology and constructional considerations.

3. Achieve attractivity with small steps
For BYOD even small steps can create tangible added value for students: BYOD enhances the appeal of the rooms, buildings, campuses where it is available, and boosts the impression of a living learning space.

*4. Create a starting point for additional service*s
Students are very interested to use infrastructure and services of their university on their own devices. These services need not be restricted to access on the learning management system and a full-text database. Rather, BYOD makes it possible to adapt and makes available more services of the university on student devices. On the other hand, physical student services might be placed into the proximity of BYOD areas, which are also very much student meeting places.

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[130] Buildings based on Open-Plan – are designed to be adapted to changing usage, except for fixed facilities such as escalators, staircases and bathrooms. Shelves ot partitions are used to separate spaces from one another, see
Krempe 2002, S. 10-11.

6. Virtual Learning Spaces

1. *Orientation on target groups and needs*
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[131] If no source is given for the photo, it is a personal photo of the author.

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Photo: UB Duisbrg-Essen

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