New Learning Spaces

by Otto Peters

ARTICLES ON
FLEXIBLE **LEARNING** &
DISTANCEEDUCATION

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»The world is growing digital«
Desmond Keegan (1995, 16)

In the context of learning in the networked digital learning environment we increasingly find the expression »learning spaces« being used. Use of this expression implies the idea that new spaces could be opened up in this extension of our familiar environment, which has been enabled by electronic information and communication technology. But which is basically incomprehensible, and that these new spaces can complement or replace the real and »experienced« learning spaces with which we are familiar. A study will be carried out to see how these new learning spaces differ from traditional learning spaces, and what the consequences for education are. Fundamental preliminary considerations in the field of education can help to sharpen our awareness of these new spaces.
We should not make use of them blindly, without testing them.
And it is also incorrect to interpret and evaluate them using outdated educational ideas.

Introduction

Teaching and learning in the networked digital learning environment begins for those who are unprepared with a surprising, and for some even staggering, experience: learning locations bound by doors and walls, which we have been familiar with it seems for ever, have now disappeared. Students' eyes are now focused on the screens of their PCs. Their attention is focused on this relatively small area. The standard learning location is now restricted to sitting in front of a workstation and looking straight ahead. It appears that this area conceals an unlimited, incomprehensible sphere, which spreads beyond all familiar learning locations and can encompass the world. The strength of this strange impression can be seen in the terms invented by journalists to characterise this sphere. They report on an »immaterial world«, a »fantastic computer world«, the »telecosmos«, »digital new ground«, an »unexplored continent«, »electronic« or »immaterial

reality« (Der Spiegel 1996, 66-67). The expression »Internet galaxies« can also be seen. In the face of this wide sphere the computer even turns into a »flying carpet for the mind« (Kleinschroth 1996, 2)

Experts for computer-supported teaching and learning refer in this context rather more soberly simply to a learning space. For example, this expression is regularly used by the FernUniversität in its announcements of a virtual university. The expression learning space virtual university has become one of the university's slogans.

There is a series of parallel examples for the designation of a sphere which is not defined more closely and in which something is to take »place« or be carried out. In colloquial German the word »Spielraum« (literally »playroom«) is used to mean »scope«, »latitude«. More recently, German has adopted the word cyberspace. »Problem spaces« are also referred to, and there are corresponding terms in scientific language: the computer scientists' information space (Allinson 1992, 287); cognitive space, familiar to learning psychologists, and the transition space of psychoanalysts (Tenbrink 1997, 38). In his book, »Grundlagen hypermedialer Lernsysteme«, Rolf Schulmeister (1997, 24) analysed in detail the multimedia space. Friedrich W. Hesse and Stephan Schwan (1996, 247) use the expression virtual space. In English, the terms teaching space and learning space have become common (Tiffin & Rajasingham 1995, 10). The expression hyperspace is also used on occasion (e.g. Haack 1997, 155).

The term learning space, which is suddenly being heard everywhere, indicates a state of affairs which is new for educationalists. However, these experts will have to concern themselves with structural changes to teaching and learning, which take place in this space. First impressions also make clear that the educational consequences of changes from traditional learning locations to imagined learning spaces are often overlooked, neglected or underestimated in the enthusiasm for the enormous advances in information and communication technologies. This is another reason for taking a closer look at the spatial relationships in computer-supported learning.

Derivations, differences, demarcations, terms

The term learning space has not yet been described more closely, let alone defined. This is in fact difficult, because it remains uncertain what is actually meant by space. In general, we understand this as a three-dimensional

expansion, an area with a length, height and depth in which objects are found whose positions and directions can be altered. The precise meaning of the term expansion remains unclear. For this reason, space is also defined as a »configuration of concrete physical objects« (Hann 1995, 250).

However, our everyday life does not take place in this type of abstract space, but in a naively perceived space. If we attempt to describe it, we refer to objects, which give rise to the impression of a defined space through being on top of and underneath one another, and the distances between them. The people who see this space are important. Because the objects referred to have a different significance for each observer, and this significance is integrated in the individually experienced structure of the space. With traditional forms of teaching and learning we have to assume this form of perceiving space. A lecture room, seminar room or classroom is therefore a »concretely experienced human space« (Bollnow 1984, 16). This will be referred to as a real learning space. The actual space has a completely different structure from the objects, which constitute it. Materially it is fundamentally different from them, because it does not even exist. It is »empty« or »abstract« and, like time, is merely a form of intuition in a Kantian sense.

This reminds us of mathematical space, which is created by generalising and abstracting the space for everyday experience. This space is defined simply through elements, e.g. dots, vectors and co-ordinate systems in which mathematical transformations take place. These spaces can be three-dimensional, but also n-dimensional, and are only imagined as well. They are lacking in all concrete reality.
The enormous expansion of familiar experience space through the networked PC confronts us with a new »space« which is not constituted by real objects but by virtual objects. This leads us to speak of virtual space. While it is difficult to imagine a space as »virtual« which does not exist, but we should not forget the potential space which psychoanalysts create between themselves and their patients to enable them to discuss earlier traumatic experiences (Tenbrink 1997, 41). The virtual space could also be explained with references to merely imagined clearances and distances of the virtual objects from each other, clearances which actually exist and can be measured in the physically real world. As in mathematics, this virtual space is only imagined as well. It may be this special characteristic which causes the developers of digital learning environments to speak of a »learning space« analogous to mathematical space. It appears to be obvious to them above

all if, as electrical engineers or computer scientists, they have learned to conceive this space mathematically.
The question arises regarding which functions this empty space can have for teaching and learning, how it should be occupied and structured from a didactic aspect, and what the educational effects of this would be. In this context, two authors from New Zealand have offered an initial pertinent definition of the term learning space. They see this as »any kind of distributed virtual reality that can be used for learning« (Tiffin & Rajasingham 1995, 10).

Analogous terms

The word »learning space« has not yet found an entry the language of educationists and because of this it cannot be explained using categories from the language of education. But contextual connections to other terms may still be diagnosed which them-selves refer to spatial boundaries for learning, for example learning field, learning location or learning environment. However, these terms are linked with concrete educational perceptions, which are suitable for preparing our comprehension of the circumstances under examination here in an initial approach using comparisons.
The concept of the learning field was created on the basis of theoretical fieldwork by Kurt Lewin. This intensified the consciousness of the interlinking of all its factors and for the global viewpoint. Lewin (1982, 377) described field as »the totality of simultaneous facts which must be understood as being interdependent of each other«. Friedrich Winnefeld (1857, 34) speaks in this context of factor complexes of the educational field, Paul Heiman of a »didactic reference field« in which learning processes are »very dynamic processes of interaction of strictly opposite relatedness«. Even today, the learning field is seen as a »totality of learning-significant facts and the interlinking of its structural and dynamic characteristics« (Kutscha 1986/1995, 532). This interpretation means a turning away from the isolating and restricting observation of what happens in learning and teaching through the teaching theory of behavioural psychology.
The learning location is seen as the spatial precondition which enables teaching and learning in the traditional sense. In tertiary education, this location is mainly the lecture hall and the seminar room, the workplace in the library or the laboratory, in the learning centre or at home. But these spatial preconditions were not always described as learning locations. It was not until students began to leave them, for example to take part in trips, to walk the wards, or take part in practical training and field research that the term extramural learning locations (Rieck & Ritter 1983/1995, 384) began to

be used. In the field of school education learning locations as such were not referred to until efforts were made in the scope of school reforms to »open« them up. And pupils began to make visits to learning locations »outside school«, e.g. the school garden, museums, factories or the post office (Kron 1994, 291). The term is found even more frequently in vocational training, where the idea of the »company as a learning location« (Arnold & Lipsmeier 1995, 18) is claimed for it. According to this, the workplace is to be the learning place. If we assume the physical existence of a learning place with practical appliances, the digital learning environment is also a learning location, albeit in a restricted understanding of the term.
Two criteria are typical for the three examples referred to here. Firstly, people did not become aware of learning locations until teachers and students temporarily left the traditional learning locations and their limited facilities. Up till then, the learning location was completely obvious. Its function and significance were only fully recognised when people deviated from tradition. The new learning locations also caused wide-ranging restructuring of the teaching and learning processes because, for example, the offered new and particularly effective chances for individualising, independent and activating learning, and at the same time invited them. There are analogue developments on the transition from the real leaning space to the virtual learning space. It is in fact digitally imparted learning which makes us aware of the role played by learning spaces in traditional teaching as well. And the transition to the digital learning spaces itself provides opportunities for the development of new forms of learning and teaching.
The concept of the learning environment was created on the basis of the educational paradigm change from empirically founded, target reaching instruction to constructivist learning. Learners are no longer seen as objects but as subjects of the learning process. Their learning no longer consists of receiving and processing offered knowledge, but in active dispute with a learning object they have selected themselves in a defined situative context with simultaneous interaction from other learners in which they themselves develop or alter individual cognitive structures. Teachers no longer concentrate on presenting selected and articulated teaching contents but on »discovering and shaping stimulating learning environments (…) which enable students to create their own constructions« (Schulmeister 1997, 80). Here, too, we are dealing with a particular type of learning space which in many ways enables autonomous learning, invites students to take part in it and supports it.
If this learning environment is digitalised and networked, an immense extension of the educational field takes place in the imagination of the

learners. They are provided with new opportunities and chances, particularly with regard to the educational targets which are characteristic of the real learning environment.

Traditional learning spaces

General characteristics

We will take a look first of all at the concrete rooms conceived, planned and equipped for teaching and learning, e.g. lecture halls, seminar rooms, the laboratory, the classroom. These are all fixed in a permanent location, relatively confined and enclosed, and equipped with practical furnishings and appliances. They constitute those familiar learning environments in which the average European spends about 10,000 hours of his or her life, or even as many as 20,000 hours in the case of continuing education (Flechsig et al. 1983, 4).
What characteristics are relevant in these spaced? According to an analysis by Otto Friedrich Bollnow (1984, 17), the following can be said on this subject:

- There is a central point, namely the person who perceives the space.
- There is a vertical axis which is provided by the person's upright posture.
- The spaces are three-dimensional.
- The objects found in the spaces are real and qualitatively different. Their relations to one another provide the space with a content structure.
- The people acting in the space are at different distances to one another, and this has an effect on the quality of their interactions.
- The space can support or restrict actions that take place in it.
- The space is experienced as an »internal space« which is contrasted with the »external space« (cf. Grossklaus 1997, 103).
- The space is not value neutral. Each place in the experienced space has its meaning for the person. The space does not exist without the person who »experiences« it.

Ecopsychological interpretation

How far are these spaces educationally relevant? To be able to answer this question it is necessary to understand the effects of experienced learning spaces. From a general point of view, this is a special case of the relationships between people and their environment. In relation to teaching and

learning the theory might be supported that learning spaces interact with the activities taking place within them. According to what we know from the psychology of perception and psychophysics, students do in fact absorb the incentives of the real learning spaces, and not only through the eyes, but through all their senses. This induces feelings, associations and attitudes. However, these are not processes, which run in one direction towards learners and teachers; they are in fact interaction processes. They integrate the needs, expectations, interests and experiences of learners and teachers. Perception here is a process, which is interlayered in the interpretation of learning spaces and in actions in them. »Perception of the environment by the individual and his actions in it are insolubly related processes« (Kraft-Dittmar 1987, 8).
If we want to found out more about what real learning spaces can mean for teaching and learning, and what educational processes would lose if they were suddenly lost, it is advisable to study these processes more closely. We can base our studies on the findings of ecological psychology. On the basis of general environmental assumptions, put together by Gabrielle Heidler (1987, 19), the following may be postulated for the special case of the real learning space. This not only creates the preconditions for the interaction between those taking part in the learning process, it can also influence their interactions. It can even influence the contents and forms of these interactions, e.g. by inviting or challenging to a defined behaviour, or deterring it, by affecting the participants aesthetically, and by enriching their experiences. The significance of the space was shown most widely by Karlfried Graf Durckheim (1932, 389): »The concrete space of the developed individual must be taken seriously in the totality of the significances, because in the unique nature of its qualities, divisions and orders it is a form of expression, acid test and realisation of the subject living and experiencing in it and relating to it«. This may all be applied to the traditional concrete learning spaces referred to here.
According to Martin Burckhardt (1994, 8) the »nearest things« in the experienced space also indicate defined times and intervals, they mark the »strata of a history which is far in the past, and still has an effect, even now«. In this context, he even speaks of a »history room«, which he defines as a »thought room«.

Cultural history interpretation

When learning and teaching take place in one of the real teaching spaces referred to, at first this appears to be nothing out of the ordinary, because

it is something we have all experienced. However, if we analyse these circumstances we find certain features which refer back to customs extending back into archaic times, but which very few people are conscious of today. For example, a particular location is provided exclusively for particular actions, which in addition are carried out at particular times and with a certain degree of regularity. At some learning locations a set uniform has to be worn. These characteristics are reminders of rites with have a religious origin in which location, time and action were also linked with one another. Learning and teaching are thus experienced globally and at the same time elevated above the more wide-ranging structures of experience. Learning and teaching may be based on unconscious, but at the same time »deep-seated«, patterns of behaviour, not only of students but also of teachers. Their ritualisation lends solidity and permanence to the actions taking place in the teaching spaces.

Teaching and learning do in fact have sacred origins, and we should bear this in mind. Teaching was originally reserved for shamans and priests, who recite holy texts to their adepts for them to memorise. The sacred character of the contents was matched by the forms in which they were transmitted, which were characterised by the honour paid to the teachers and the ceremonial course of the actions of teaching and learning (cf. Keay 1950, 40). After a long process of secularisation, all that remains of this today is above all the uniform basic space-time structure and the dominance of the teacher. The »lecture« is an impressive example of this. Max Horkheimer (1953, 24) regarded this as an »unsuccessful secularisation of the sermon« and for this reason described academic teaching as a whole as »archaic«.

This recourse is important for the context of our argument, because it makes the function and significance of learning spaces in a traditional interaction structure even clearer. Learning spaces enable the necessary regular interplay with defined persons at set times. Above all they are also the result of a historical development. The educational structure, which is expository teaching and receptive learning, created by the interplay between space, time tradition and subjects acting in learning spaces has been in existence for thousands of years and is found all over the world. It has in fact become a universal cultural model.

Educational analyses are usually concerned only with the processes of teaching and learning which take place in these real spaces, with the actors, contents, methods, media and teaching results, but not with the spaces in which they take place. The question is whether the material »existence«, the quality and the characteristics of the concrete learning spaces and their effect on the learning processes that take place in them, should also be exa-

mined. This aspect becomes more important at the moment we are forced to imagine what actually happens if these learning spaces disappear, as if by magic, and are replaced by virtual spaces.

Uncertainties

The following questions arise from the above with regard to learning in digital learning spaces:

- The sketch of the term learning field has drawn attention to the relationship and interlocking of all factors in the educational field. Does this complex of factors exist in the virtual learning field as well? Is it missing, reduced, halved or only indicated?
- Does the »jump« from the learning location to the virtual learning space lead to a gain or a loss of effective educational factors?
- Are the efforts towards reform of the traditional learning environment continued in the digitalised learning environment? Is it regarded and used as a new field of development and as an acid test for structurally interpreted learning?

Virtual learning spaces

General characteristics

The boundlessness, uncertainty, inconceivability and »emptiness« of the space seen behind the monitor's screen probably makes the greatest impression on the observer. It is associated with thick fog, with an infinite sky, and sometimes with a »black hole«. When attempts were being made to provide metaphors to describe this space, the developers of the Virtual University used pictures of a »desert« (Hoyer 1998a, 4) and »space« (Kaderali 1998, 6). We are now, and this is what these pictures signalise, in a space beyond previous learning locations, and to a certain degree beyond the learning experiences which can be gained at previous learning locations. (..)
On the one hand, the images show the openness and boundlessness of virtual space by indicating a desert landscape or deep space; at the same time, they show the great differences between individual learning spaces.
It is this non-defined space in which educational actions are now to »take place« and in which teaching and learning functions are to be exercised. This creates special virtual learning spaces. Typically, these are limited in

time, because once the learning and teaching functions are completed, the virtual learning space simply disappears. We are dealing here with temporary imaginary images, which can, however, continue to exist in the memory and consciousness of those acting.
These imaginary images are generated above all by visual stimuli on the screen. The virtual learning spaces this creates naturally have other characteristics in many aspects. To demonstrate how they differ from real learning spaces the following may be said parallel to the features, which have been ascertained for them:

- Their locations are not fixed and they can therefore change, sometimes accidentally.
- They are not surrounded by walls but are open and unlimited.
- Because of the fleeting nature of the text, representations and images, the function of the viewer as the central figure in the space is reduced and attenuated.
- There are no vertical axes. The horizontal dominates as a result of the linearity of the relatively large and concentrated texts and images, but above all because of the constant domination of the axis of sight and observation.
- Two-dimensionality takes over from experienced three-dimensionality, with the exception of those cases in which three-dimensionality is simulated for reasons of lucidity.
- The objects and persons which constitute the space are not real, but virtual.
- The distances to the persons who are shown or symbolised are not relatively constant but relatively unstable, variable, fluctuating. They have no effect on the quality and interpretation of their relationships. For example, there are no »preferred places« in virtual spaces.
- »Inside« and »outside« are no longer contrasted.
- Spaces appear more »value-neutral« and therefore do not have any quality of experience comparable with real spaces.

However, pointing to these differences between virtual and real learning spaces only hints at digital learning spaces. More detailed explanations are required to characterise them more precisely.

1. Because of its sweeping significance, their potential unlimitedness must be stressed. The screen itself is associated with infinitely large spaces. Rainer Kuhlen sees the virtual space behind the screen as »a galaxy of thousands and thousands of asteroids«, or as a »universe in permanent flow which does not recognise any precise cosmological lines, or even

the chains of time« (1991, 279). This results in something unprecedented for students. The existence of the Internet and the super information highway enables all terrestrial distances to be overcome in split seconds. Digital learning spaces can in fact span the world, if, for example, participants in a seminar are spread over all the continents (cf., e.g. Berath & Rubin 1998). The great impression this distance makes can be seen above all in the designations used by some experts as synonyms for the »digital learning space«. Robert Kleinschroth (1996, 160, 175) for example uses the expression learning landscape, Franz-Theo Gottwald and K. Peter Sprinkart (1998, 50) refer to the learning world and Rolf Schulmeister (1997, 79, 381) puts this expression into the plural: learning worlds. These designations go beyond conventional concepts of real learning spaces and attempt to put their amazing opening up and unlimited extensions into words.

2. In order to bring out the contrast between real and virtual learning spaces more clearly, the loss of the familiar spatial arrangement or al places and objects is referred to in particular. According to Götz Grossklaus (1997, 112), in the media reality »nothing has 'its place', but everything has 'its time': its short-term presence as a trace of light on the screen. Constellations appear and disappear from view: in this accelerated process of appearance and disappearance … all depth of space and time is done away with…« Consequently, objects, images and symbols, including the writing on a blackboard, have lost their »grip« and have become dynamised. The »letters appear imperturbable, appear out of nowhere and return quietly to where they came from when you command them to do so, and when you delete them, they dissolve« (Kuhlen 1991, 280). The familiar top and bottom, left and right no longer exist. Gravity has been conquered. All representations are »liberated from the constraints of physical reality« (Turkle 1998, 103). This results in unprecedented opportunities for designing these learning spaces. And for the individual a »degree of world comes into existence, which is no longer covered by reality« (Burckhardt 1994, 313).
3. If the screen does not offer any pointers for structuring the learning space, spatial concepts of diffuse indefiniteness (opaqueness) are created. The empty, milky-white screen is associated with spaces of undetermined elongation, with associations of immeasurable deep space, and in particular because both in space and here enormous distances can be bridged in seconds. To return to the metaphors used by Rainer Kuhlen (1991, 280), »the whole is an undersea symphony of soft links and fractures, a galaxial round of autophagous comets…"

The contrast to this is provided by learning spaces in virtual reality. The efforts to occupy the empty and diffuse sphere behind the screen, more precisely, behind the data-viewing screen, are stressed here. Three-dimensional (stereoscopic) rooms can be simulated here, which imitate real rooms in an often-amazing manner. It appears that the limits set by walls, the relationships of objects to one another, and their pro-portions, and the effects of distance and relationships, are reconstructed here. Even more: students do not observe the three-dimensional room, they are immersed in it. They pass through the interface, so to speak, and find themselves within the virtual room. The border between real learning locations in the digital learning environment and virtual space has been overcome as far as consciousness is concerned. Students can now develop a perspective feeling for space, even from different aspects. We can almost believe that the »experienced space« referred to by Otto Friedrich Bollnow has been reconstituted. All the more, because students in this virtual room come into contact with objects and can even carry out actions using them. New opportunities arise if several students have simultaneous access via the Internet to this type of learning space in virtual reality (cf. Alsdorf & Bannwart 1997, 237).

4. The virtuality of persons and objects is of similarly great importance. The dictionary definition of »virtual« is extremely fitting here: »being in essence or effect, but not in fact« (Webster 1953, 2849). An obsolete meaning of the word is even more precise, namely »having the power of invisible efficacy without the agency of a material element« (Webster 1953, 2849). Jürgen Wurster (1997, 2) reduces the circumstances to the bare minimum. For him, virtuality means »real, but not tangible«. At the same time he points to the important part played by digital data in the definition of the virtual learning space.
   Because the »room« in virtual learning spaces is just as empty and abstract as in real rooms, it is in fact these virtual persons and objects with whose help students are able to form spatial structures, which, however, have a different appearance to that in real rooms.
5. The phenomenon of telepresence is in important spatial characteristic. This drastically reduces the distance between students and teachers, and between students themselves, and enables »mental presence with physical absence« (Kleinschroth 1996, 237). Students may sit in their digital learning environments in Cape Town, Wellington or Reykjavik to take part in a virtual seminar, for example. In spite of this, their words, whether written or spoken, unemotional or animated, appear at a distance of about 40 cm. from the eyes of their teachers or fellow students. In their

thoughts they conceive their partners as being and acting at great distances away from them, but at the same time they can take part in discussions with them as if they were sitting opposite. They are closer than if they were in a seminar room or lecture hall. This is a split experience of space and a completely new way of being involved for the teaching-learning process.

6. The choice of the term learning space for the above is significant. It appears obvious that the metaphorical use of this term (cf. Kuhlen 1991, 135) is an effort to come to terms with the disquieting phenomenon of emptiness and lack of structure in which teaching and learning now has to take place. This endeavour is easy to explain. One of our basic needs is for spatial orientation. Perception of space, a »fundamental function of perception, above all of sight« (Städtler 1998, 906), is developed from birth and has become a fixed habit. »Spatial cognition«, in other words the mental representation of spatial relationships, and »spatial memory«, play an important part here. If we leave real rooms and immerse ourselves in the »sphere« in which bits can be transformed into words, drawings, picture or videos, we are unable to do anything other than imagine this sphere spatially as well. The terms Net, Internet and Web are spatial metaphors as well, with which an attempt is made to ward off what is unusual, strange, or even uncanny, about this phenomenon. We imagine our own computer as a node in a net or network, and in this way we gain a certain local orientation. What is interesting here is that we even speak of a network topology (Voss & Raabe 1997, 479), which is understood as different links between nodes. The inherent endeavour to regain ion the screen familiar spatial relationships is seen most strongly in the development of the Virtual Reality Markup Language (VRML), which enables students to navigate in a three-dimensional space. The home page then becomes a home space (cf. Collis 1996, 146).

The digital learning environment

The traditional learning environment has been analysed in its educational and media references by Peter Strittmayer and Dirk Mauel (1995). A look is taken here simply at the digital learning environment, which must be presupposed for the simulation of virtual learning spaces. The question is interesting as to which new learning spaces they in fact enable.

Technical preconditions

The computer

To describe the complexity of the external circumstances of the digital learning environment we must list the devices and appliances which form part of the basic equipment: for some time these were above all the PC, with keyboard, monitor, disk drive and printer. The CD-ROM drive then appeared, with speakers, of course. And at pre-sent experiments are taking place with a small camera fixed to the monitor, which shows the student(s) during discussions. This installation often includes a fax machine.
With the help of this technical unit and the required software the following functions can be carried out inputting, presenting and communicating. Special technologies are required for this, which are shown here in a form borrowed from Anthony Bates (1994):

Input	**Presentation**	**Communication**
Keyboard	Screen	Electronic mail
Mouse	Printer	Telephone
Pen	Sound	Computer, audio or video conferences
Voice		Fax
Gestures		

Multimedia

The most important advance here has been in the field of multimedia publishing (Kaderali ET al. 1996, 271), which has only been possible through the utilisation and integration of new data processing and communication technologies. Electronic publishing integrates graphics, text, pictures, sound and animation, by digitalising them and storing them on the same data carrier. The flexibility and variability of learning in the digital learning environment, which is extremely difficult to grasp, finds a convincing explanation here.

The Internet

A telephone terminal and a modem are required for working in the Internet, and an ISDN terminal and ISDN card for faster connections. These devices provide access to a global network of computers and servers, which consists of a series of national and international, and regional and local subnetworks. The Internet has several services available, which are important for learning: e-mail for exchanging messages, Usenet for setting up newsgroups, Telnet for researching in databases and working through teaching

programs, FTP for requesting data from a server and for storing files there, and WAIS for searching for documents stored in the net, and search engines such as Gopher an VERONICA.

The effect of the computer

The digital learning environment was described at the beginning as a »real learning location«, comparable with working in a library or a laboratory. This was based on its real existence. This environment is part of students' real environment, and this means that the social and institutional context can have an effect. It is namely important whether the digital learning environment is permanently installed at home, in a room in the university, in a learning centre or in a classroom.

At the same time, the digital learning environment is a very special location, hardly comparable with other learning locations. The reason for this is the computer, the central communications medium for teaching and learning. Its effect is incomparable, especially with other inanimate objects. This is because the digital learning environment is only real up to the interface between the person and the computer and the appropriate software. As we have seen, a world can »open up« behind this. If used for educational purposes, the computer changes into a medium for creating virtual learning spaces.

Affective influences

Before the fundamental significance of this opportunity is discussed, the complex relationship between students and the computer will be referred to, because this concerns the man-machine problem, which has been the subject of argument for many years. It is obvious that the computer generates emotions and leads to attitudes, which are integrated in learning in virtual spaces. What can these be?

If students have already experienced computer games as children they can discover the following: computers can react, even speak, they know some things, they are exact and they are also a lot of fun, and can be the cause of amazement, enthusiasm and fascination. The screen becomes a projection room for their fantasy, desires and hopes. In the course of time there is s certain degree of intimacy. The »clever« computer impresses with the speed of its reactions, and disappoints because of its proneness to faults and crashes. Users are »angry« with their computers, shout at them even mistreat them. Thanks to its mystery the computer was sometimes even treated as if it were human (cf. Turkle 1998, 126).

Some of the remains of these experiences may continue to have an effect on young and adult learners, while they continue to gain new experiences, which are not possible in any other learning situation:

- Computers can capture users' minds in learning situations as well because they work with multimedia, hypertext and hypermedia and can bundle and present different modes of presentation.
- Computers impart the feeling to users that they have »mastered« a complicated apparatus, that they are »in control«, that they can start initiate and end processes which have a wide effect, that they have a good and extensive memory, and that in certain fields they can develop unusual cognitive capabilities. Basically it is the feeling that users are extending their own intellects, and in addition their own physical presence (cf. Turkle 1998, 28). Feelings and concepts of power may be wakened and flow into educational actions.
- In the course of time the computer is experienced as an »extension of man« (McLuhan 1964). It becomes an obvious tool with which the user can compensate for certain deficits in his capabilities. When learning, students enter into an apparent symbiotic relationship with the computer. Bernhard Koring (1997, 13) may be right when he regards the use of the computer as an often intuitive process, whereby the abstract-cognitive dimension is curtailed and the concrete-physical, the »corporeal« dimension of the learning process is strengthened. There is the feeling that the user can extend is physical presence.
- The simultaneous access to all stored documents, notes, drafts and elaborations can provide academics, for example, or authors, with the feeling that they have a »somehow enlarged thinking space« available (Turkle 1998, 41). Mutatis mutandis, this feeling can also be ascribed to students.
- The experience value of this relationship can be seen in the feeling of »indispensability« which arises when work must be completed but the computer, with all its information, documentation, text processing and storage capacities, has crashed. There is a feeling similar to having lost a limb.

As a result, a situation arises in the digital learning environment, which is not found elsewhere. It is true that the computer remains a tool for students, but from another aspect it functions as an opposite party, as a »learning partner« so to speak, because it reacts appropriately and helpfully to many of their activities. And there is more: twenty years ago, when evaluating an experiment Joseph Weiznbaum (1976 19) observed with dismay »how quickly and how intensively people can set up an emotional relations-

hip with a computer, and how they ascribe clear human characteristics to it«. In the digital learning environment of our time this will be even more the case.

Learn-theoretical classification concepts

The monitor passes on the appearance of virtual learning spaces, which are constructed by the students inspired by visual and sometime acoustic stimuli. These spaces are created by the view through the monitor's screen. This screen is the inter-face between the real learning space and the virtual learning space. Of course, these abstract and merely imagined learning spaces lack most attributes of real learning spaces. Not even internal spatial relationships can be exactly defined. These are usually two-dimensional and are constructed by means of static surfaces. But there are also learning spaces, which are three-dimensional and even dynamic (in other words, which include the time dimension). In the face of this situation it seems obvious to consider how a virtual space of this kind has to be structured to enable it to be used for teaching and learning.
Speaking generally, this learning space can be subdivided as follows (Rolf Schulmeister 1997, 26):

Presentation space – Semantic space – Occurrence space

In the presentation space students are shown objects which are represented by symbols (writing, graphical characters, pictures). In the semantic space the significance of what has been presented is opened up by means of metaphors. And in the occurrence space students interact with the objects which have been shown, e.g. by navigating or browsing. This interaction is decisive for the link between the presentation space and the semantic space. Here, the »physical interaction becomes a semantic interpretation…« (Schulmeister 1997, 27). The occurrence space proves to be the actual learning space.
Peter Michael Fischer and Heinz Mandl (1990) subdivided the learning space in a similar manner:

Surface structure – Rational and associative structures – Subjective structure

Both suggestions make clear how the three learning spaces must interact in the learning process. And both make certain functions of the students into the basis of a »multimedia architecture«, whereby spatial concepts dominate once again.

The use of spatial metaphors

An obvious reaction to the initially still unfamiliar, unstructured and discontinuous learning space is formed by the attempts to transfer concepts of traditional real learning spaces into the virtual space. These concepts are wakened by spatial metaphors. A spatial metaphor as an »electronic counterpart« (Haack 1997, 15) to a familiar physical space. The virtual space, which is at first still »empty« and opaque, is occupied and structured in part (by islands), and this enables the beginnings of spatial orientation.
This process is by no means new for working with computers. If we look at the operating system we can see, for example, that the metaphor desktop is aimed at giving the impression of an actual desk, and this is joined by wastebin and folder. In this way, the user's workplace in the office or at home is simulated in the digital learning environment. Expressions such as menu bar or user interface bring processes, which come into being separate from each other into a spatial context.

Spatial metaphors are also found with regard to the actual learning process itself. Even the term »learning space« is such a metaphor. Students are led by this metaphor to behave as far as possible as if they were in real learning spaces. In the field of hypertext the metaphors network and node also aim to provide spatial impressions of a presentation. Although the hypertext itself is in reality not visible, and is in fact stored in an encoded form in the smallest possible space on the microchips in the hard disk, or on a CD-ROM, something which is inconceivable for most people.
Even more important are metaphors of real learning spaces, which are used, e.g. when virtual classrooms, seminars or laboratories are referred to, or guided tours through virtual landscapes or cities are carried out. These metaphors create virtual spaces in which students »move«. They are also enabled, at least rudimentarily, to demonstrate a learning behaviour with which they are familiar from corresponding real learning spaces. They then act as if they were in real learning spaces and acquire a certain security through this. In addition, spatial metaphors can even produce a »correlation for the variety of information which makes sense« (Schulmeister 1997, 53).

Friedrich W. Hesse and Stephan Schwan (1996, 243) have pointed out the role played by spatial metaphors (»interface metaphors«) in virtual seminars. They describe first the function of metaphors which designate »larger geographical spaces«, such as the virtual campus, virtual buildings and virtual rooms (lecture rooms, seminar rooms, entrance hall, cafeteria, reading

rooms, etc.). These metaphors are used »to visualise the complex functional structure of computer conferences in terms of already familiar topological features«. They then discuss »small-scale spatial arrangements in specific locations«. In real rooms, they assume, interactions by students are spatially organised and arranged, whereby they orient according to defined features. For example, many discussions take place at round tables. During lectures, a speaker faces listeners, and this also leads to typical fixed arrangements. Spatial togetherness is also significant here for personal and social relationships. When work with corresponding metaphors is carried out at computer conferences, students are provided with starting points with which they are able to imagine spatial togetherness and co-existence. In this way, according to the authors, the appearance of belonging to the learning group is created and those students acting at a distance are made socially present in thought (tele-presence).

Such attempts at imagining real learning spaces, say the authors, can only be successful up to a certain and very limited degree. On the basis of the structural differences referred to here, full correspondence between happenings in real learning spaces and in virtual learning spaces is often simply not given. In my opinion, it will not be achieved by improved software and further interventions. Worlds can lie between a seminar and a computer seminar on the same subject, simply because of the change from oral to literal, and, following this, from synchronicity to asynchronicity of communication.

The transposition from traditional learning and teaching behaviour

If students and teachers are encouraged to imagine real learning spaces in virtual learning spaces as models, it seems obvious for many of them to retain the learning and teaching behaviour familiar from real learning spaces and, as far as possible, to transpose this to the virtual learning space. Apart from the difficulties, which arise here, which must be examined from the aspect of learning psychology, this type of transaction also gives rise to educational doubts. David Hawkridge (1995, 7) drew attention to these doubts by repeating his impression that »old media for good teaching methods, while new media are used for bad old ones«. He arrived at this paradoxical result through a comparison of traditional teaching offered by the Open University in the UK with electronic teaching events. It turned out in fact that traditional distance teaching was designed professionally in accordance with the rules and based on the experience of instructional design, whereas traditional lectures were too often put in CD-ROM and transmitted in the digital learning environment. And traditional face-to-face teaching was used in the scope of a videoconference.

Those who proceed in this way fail to recognise the enormous instructional potential of the digital learning environment and its media and methodical variability, both of which are extremely difficult to conceive. Old instructional models block the view of the richness of their educational forms and their specific possibilities. Often these still have to be developed, by recognising, seeing through, analysing the new technical facilities, and examining them for possible teaching and learning effects. If this were to happen, a fundamental change in educational science could be initiated.
All this of course exceeds our imaginative powers. The situation is similar to that following the discovery of cinematography. At first, people were unable to imagine what might be done with this new and unusual technical opportunity, other than showing the usual scenes from fairs, circuses and variety theatres. It took some time before the new technology was used for film's own dramaturgy (e.g. exterior shots, takes, moving cameras, close-ups, detailed shots, cutting, montages, animation, cartoons, blue box), and before film-makers departed from the traditional pattern of stage representations and arrived at completely new solutions. The enormous difference between a theatrical performance bound by time and place, and a film, which is bound by neither time nor place, took some time to be recognised. There will probably be a similar development in the didactics of the digital learning environment. In a similar way, this may open up new dimensions to a system of teaching and learning liberated from the bonds of place and time. Innovative forms of learning in virtual learning spaces may be a result of this development.
However, before this happens, we must become aware of the crass difference between real and virtual learning spaces.

Technologically founded structuring

The structuring of the virtual learning space through traditional forms of learning and teaching shown here are obvious and at first understandable as well, because we are moving here in a new and previously unknown territory. However, they do not reflect the actual potential of teaching and learning made possible by electronic systems, and in fact hardly touch them. For this reason, I wish to propose a different structuring, which is based essentially on the opportunities provided by information and communication technologies. It is important here to develop the inherent educational possibilities for teaching and learning.
Which are the new and special educational opportunities which can already be detected and which must be used in the digitalised learning environ-

ment? Speaking generally, what must be done here is to interpret and use important working fields in computer science, namely the »compilation and presentation of information«, the »representation of knowledge« and the »management of knowledge« (Kuhlen 1991, 275). In particular, the new opportunities arise from the addition and integration of the three electronic technologies, which have already been sketched here: computer, multimedia and network technology. These technologies are themselves based on special technologies for communication, transmission, display, search, access, analysis, storage, virtual reality and management. Put together, they result in units with different configurations with efficiency never seen before. In virtual space they enable the following new teaching and learning activities:

- The field of the presentation of information: traditionally, learning was conceived of as a consequence of teaching, which had to be offered to students, brought »prescriptively« to them and »imparted« to them, and as a result of this, most teachers see this as being their main task. Offering, presenting, showing and illustrating have all therefore become a basic educational model, which structures and characterises the activities of teaching and learning in a unique manner. The digital learning environment may be regarded as an unusually effective medium, which assumes, exercises and perfects just these functions. The reason for this is in the one hand the possibility of designing the subject-matter for teaching in a micro-didactic, multimodal manner, and on the other hand, an don the other the variety and differentiation of the forms of representation made obvious by multimedia. In particular, it is possible to offer learning programmes in which teaching adapts itself to the prior knowledge, skills and requirements of students (cf. Leutner 1997, 139) Drill and practice programmes can also be integrated simply and effectively into learning.
- The field of procurement of information: with the help of servers and search machines information can be searched for in internal and external databases, on Web pages or sites, in electronic libraries, dictionaries and professional journals, found and used. These sources of information, which are available globally, are easily accessible to students.
- The field of communication: e-mail and video links mean that discussions with teachers and other students, but also with outsiders and strangers, can be sought and maintained at any time ands from any place, and depending on the situation on several levels, from simple chatting to academic discourses.

- The field of collaboration: with the help of the communication referred to here a series of important forms of joint planning, developing and evaluating is possible from any location simultaneously and consecutively, from working in partnerships through project work to collaboration of self-organised teaching and research groups.
- The field of exploration: in hypertext systems, navigating, browsing and surfing lead to exploration learning on the basis if own interests and preferences. This prepares and promotes »autonomous learning«.
- The field of documentation: the unbeatable efficiency of a PC in saving and finding information can relieve the memories of teachers and students alike. The systematic retaining and arranging of thematically relevant information, which is imperative for academic work can be integrated easily into the learning process.
  In the long term, skilful documentation management can be developed an objectivisation of personal knowledge, which constantly changes and can continue to be developed over the period of a lifetime.
- The field of multimedia: with the help of the cumulation, combination and integration of several presentation modes teaching results can be presented and imparted in a particularly convincing manner. Teaching contents can be brought intensively into the group of learners in the same way as in reality. The modes of presentation include: text, two/three-dimensional graphics, pixel images and even video, audio and two/three-dimensional animation.
- The field of electronic word processing: students who are skilled in compiling, entering, transmitting, processing, sorting, saving, linking and outputting information. And in addition, are able to create texts in the interface, to format them and structure them clearly, can draw immeasurable benefits from this for their learning. The link between reading, thinking and writing becomes important. This creates a specific learning behaviour in which activities are concentrated and integrated which are far apart in real learning spaces. In addition, the presentation and distribution of relevant findings are simplified enormously.
- The field of simulation: students can be put into a position in which they can contact simulated (model) reality. This is particularly advantageous if processes are observed or even controlled, for example, management science or macroeconomic trends or scientific experiments or real experiments in a virtual laboratory (Hoyer 1998b). Spaces are also simulated which students have to inspect or visit. Most computer games work with simulations, which enable players to »experience« new spaces. Virtual museums and virtual guided tours work with similar effects.

- The field of virtual reality: students can communicate interactively with three-dimensional objects and persons in the three-dimensionally simulated spaces and landscapes of a virtual reality and even move in these spaces and observe. Through this immersion in virtual space the attention of the students can be drawn to given points, intensified and shielded from diversions from the real world. Their interaction with a learning program is more direct and more intensive, because their actions are converted directly into data, and the consequences of the actions are experienced directly in the three-dimensional learning space. Complex and abstract facts can be made more easily learnable through the senses. The habit of thinking in spaces can be satisfied in a particularly impressive manner here, in that special »knowledge spaces« and »information landscapes« are constructed (Alsdorf & Bannwart 1997, 442). Many learners will find it advantageous above all if they are able to apply, try out and strengthen their knowledge and skills in these spaces in the same way as in the real world, e.g. pilot and train driver training, or learning and practising operation techniques on the human body. Students have learning rooms available to them which only simulate emergencies, and so they tend not be afraid of the consequences of errors.

We can see how different technological foundations lead to specific educational activities with which we have to come to terms with. If we wanted to summarize where the teaching-learning situation in the digital learning environment deviates from traditional teaching and learning, the following six activity fields, which are not found in traditional learning, would be among the first mentioned:

1. Media: the computer is used here as a universal teaching and learning medium, which basically contains all the media, which have previously been used.
2. Media: the computer also includes the field of simulation of dynamic models.
3. Contents: the computer mediates rapid access to distributed information where this is required for learning.
4. Methodology: with suitable learning software the computer can make interaction with the learning programme or learning software into a relevant and even to a dominant elements of the learning process, if the learning situation requires it.
5. Methodology: the computer enables and simplifies communication with spatially distributed partners.

6. Methodology: the computer enables students to compile files containing knowledge they have gathered themselves, and to return to these files again and again.
7. Education: the computer enables and simplifies discovering learning. Learners become the »designers and co-authors of their education« (see Kleinschroth 1996, 173).

These functions are not, however, structurally linked to one another, as in real learning spaces, but are available separately, on request. To remain with this metaphor: digital learning spaces are not found together in a virtual school or university building, but somewhere in a virtual learning cosmos.

If the possibilities for using the technological advances have been recognised tried out and integrated in the arsenal of learning processes available for instructional design. The misuse of computerised communication for presenting traditional lectures (»talking heads«), for holding a conventional lesson with domineering teachers, or with holding a traditional seminar with papers being read and films being shown, is not merely seen as a complete lack of imagination, but also as crass educational misconduct. In the new learning spaces it is not primarily a question of expository teaching and receptive learning, but of completely different things. The great differences between real and virtual learning spaces themselves show that electronically imparted teaching and learning can also be designed to be structurally completely different to traditional methods. The technological innovations, which have been referred to, do in fact enable activities which are greatly desirable in the sense of educational reform. In the foreground we find the chances of the further development and consolidation of self-governing and selfcontrolled learning, as well as for reality-oriented, communicative and collaborative learning.

If these opportunities are used, these activities will of necessity deviate from the conventional forms of teaching and learning, and in some case this deviation will be considerable. This will strike those who adhere to tradition as odd, if it does not shock them. This reform aspect is to be stressed here, because the number of practitioners is not exactly small who, in their enthusiasm for the new technologies, think that with networked computers we have now obtained a powerful medium with which we can in future transport all conventional teaching and learning. The question here, however, is to develop new methods, procedures, rituals and conventions, and to use them to occupy and structure the infinite virtual space at various positions so that a new educational field of operations with its own legitimacy can be created.

The result: ten new learning spaces

The close relationship of the innovative educational activities to their respective technological basis makes it seem obvious to provide different designations for the virtual learning spaces, which they constitute. This is also appropriate because, as we have seen, we are in fact dealing with spaces, which are in essential separate from one another, namely:
Spaces for instruction, information, communication, collaboration, exploration, documentation, multimedia, word processing, presentation and simulation, and with spaces in virtual reality.
Of course, and this must be repeated, these spaces do not actually exist. What is »real« for students is only the digital learning environment with the screen of the monitor as the interface. Virtual spaces are only created, and this has also been said, when the imagined empty space behind the screen is made into an imagined »theatre« for actions, in our case for educational actions. We are not content with objects and symbols on the screen, but we imagine these actions in their spatial dimensions, although their clarity can vary. In this context, there is a difference if students

- Exchange information with fellow students via e-mail or multimedia,
- Search for information required solving a problem from a sea of data,
- Solve a difficult problem in a virtual seminar with several other students and in this way arrive at new knowledge,
- Navigate around an extensive hypertext to find the individual access and path tailored to their learning requirements and aspirations,
- Compile folders and collections of text, sound and photo documents for a subject in a learning project.
- Develop and publish their learning results in the form of graphically demanding presentations
- Study learning contents using professionally multimedia presentations, including animation, simulation an experimental phases,
- Use video programmes stored on CD-ROMs to visit an arrondissement in Paris, for example, or to be inspired by the collections of the Prado in Madrid,
- Use the creation of a virtual reality as architecture students to experience the effects of the rooms in the plans for a house, or as medical students to take a trip through the human body.

In all these cases we are confronted with educationally relevant situations in which a specific learning behaviour is required, because it awakes different spatial perceptions as well. We have internalised how this type of learning behaviour takes place in corresponding scenarios in the real world,

and unconsciously or subconsciously project this in to the virtual learning spaces.

The ten new learning spaces characterised here confront us with the necessity of educational innovation. They offer us a previously unknown plethora of new teaching and learning possibilities. We are faced with the challenge of familiarising ourselves with them, developing them further and using them - with imagination, willingness to experiment and the courage to walk down new roads. However, this will only be successful if we are aware of the special features of the new learning spaces, and know their educational and pedagogical advantages and deficits exactly. However, we will experience the »jump« from real to virtual learning spaces as an abrupt change to another world. We must dare to take this step, above all because of our educational responsibility. All those working in adult education and further education are faced with the task of preparing their students for learning in the information age. And this will take place mainly in the new virtual learning spaces.

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With these working-papers **tbc-Consult** and **DEL** hope to help to develop a better understanding of the profound changes that are taking place in learning today. The old and traditional ways of learning have become irrelevant in methods and also in purposes. We therefore have to create new ways of learning for a changing world. We hope that these papers will help with experience and inspiration.

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