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KNOWLEDGE SPACES – EXPERIENCE BASED LEARNING AND CULTURAL EDUCATION IN THE MEDIA AGE

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Abstract

Research into the opportunities offered by electronic media as regards finding and acquiring knowledge, together with the development of new teaching and learning methods for the field of art and culture is the focus of the work being carried out by the Media Arts & Research Studies (MARS) research group at the Fraunhofer Institute for Media Communication. This paper illustrates the requirements on electronic and digital media concepts in the context of e-learning, using the very latest developments and experience in this sector as examples.

In the broadest sense, the aim is to visualise information and create networked ‘knowledge spaces’ which are accessible to users as new forms of teaching and learning through play. Experimental methods, tools and interfaces that support communication between the digital and physical spaces and investigate new forms of knowledge retrieval are being developed and tested.

Keywords : e-learning in art and culture – information visualization – knowledge spaces – explorative learning – experimental methods – digital and physical spaces – Mixed Reality – tangible interfaces

Introduction: MEDIA-BASED TEACHING AND LEARNING CONCEPTS

How do people learn? By asking questions and seeking answers, by finding opportunities and making decisions, by processing information and establishing contexts. As in many other sectors, digital media also bring new opportunities for basic and advanced training in the field of art and culture. In contrast to many other sectors, however, the abilities of expression, experimentation and reception are important, since they support the growth of artistic and cultural orientation and the ability to deal with such concepts (Panzini 1999).

Digital media, information and network technologies have profound implications on the opportunities for communicating and building knowledge, online study and e-learning. For some, the main advantage of online learning is the ability to communicate instructions via the Internet wherever you are, as can be witnessed in numerous popular e-training programs. Others regard the Internet as little more than a wild, untamed data archive. Neither of these groups is making the most of the opportunities available, since the constantly growing 'network of networks' offers far more than just that. It creates a space in which learners and teachers can work together to create and depict new forms of knowledge from a universal archive, regardless of the time or place they occupy.

In this sense, the Internet is both an 'archive' and a 'cultural memory'. It is becoming a space for telematic presence and is fulfilling a 'globalisation role' that can create a feeling of cultural togetherness – regardless of geographical location (de Kerckhove 1990).

Because of the lack of suitable methods and tools that provide access to this 'complex new world of knowledge', many contemporary e-learning concepts transfer mostly linear, traditional learning and training methods to new, digital media without really exploiting their full potential (Kritzenberger & Herzceg 2001).

The challenge must be to create constructive and logical frameworks that provide as informative a picture as possible of the extensive collection of data material. In order to be able to understand a large amount of information quickly, this information must first be visualised and contextualised appropriately (Wilson 2002, 761f). In addition to the appropriation of cultural technology for digital media, a 'sensory training' is a basic requirement for perception, recognition and learning in order to acquire knowledge (cf. Weibel 2002). At the same time, the perception of the physical world needs to be included into media-based teaching and learning concepts. Of equal importance are the skills required for social interaction and collaboration, which should not be restricted to a 'screen presence'.

The MARS Exploratory Media Lab is pursuing the idea of creating networked 'knowledge spaces' – telepresent Mixed Reality spaces that are created by overlapping the physical and electronic domains. These are networked places, spaces and tools that are accessed via experimental interfaces, which link the real and virtual environment.

FOUR LEVELS OF THE KNOWLEDGE SPACE

Four interferential layers of knowledge spaces had been identified by the authors. They build on current research and development work for new forms of teaching and learning at the MARS Exploratory Media Lab and from which the concept of ‘knowledge spaces’ derives.

- The “information space” is primarily where the infrastructural network of a data archive is created. The Internet platform netzspannung.org is introduced.
- The “explorative space” offers knowledge tools that support the intuitive discovery of data. The Semantic map as an explorative browser is introduced.
- The “participation space” is where tangible objects and invisible interfaces provide experimental access to enterable knowledge spaces. The notion of Mixed reality is introduced.
- The “mediation space” ultimately focuses on the significance of the social context. A workshop format is introduced.

Information Space: ‘netzspannung.org’

The Internet platform ‘netzspannung.org’ provided the basis for the design and development of the technical and structural elements required for a database-backed knowledge platform which supports the homogenous networking of different types of reference sources derived from existing online archives. Of particular significance in this context is the description of data objects (metadata), i.e. the categorised information that makes it possible to locate an object in a database.

Where they are accessible online at all, the main body of existing media culture archives use highly-specialised and proprietary processing systems. To date, these archives have no uniform standard for indexing archive objects with metadata.

In principle, media art - with its specialist needs - requires its own descriptive language, a so-called “media art markup language”.

These specific requirements from media art ultimately lead to the model of a ‘data body’, which occupies the digital knowledge space (Fig 1). This data body links itself to all relevant data and maps it, associating itself also with the context of the author or project.

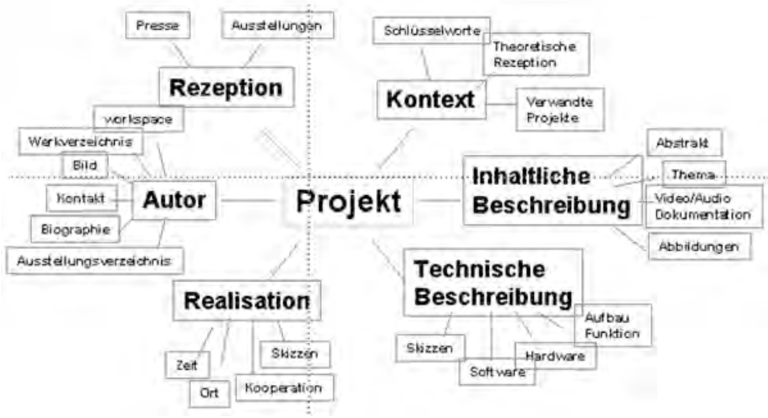

Fig 1 : Semantic structure of a ‘data body’, e.g. artist’s data-body or project data-body

The multimedia online archive ‘netzspannung.org’ locates media art at the intersection of art, science, technology and communication. Topics such as production, distribution, connectivity, collaboration, communication, theory formation, publication, education, archiving and public visibility form the electronic arts community’s basic requirements on an Internet platform for media art. These topics had been addressed as the 10 most important issues for the production of media art in the CAT - Communication, Art & Technology – feasibility study of 1998 through an email-poll (http://netzspannung.org/journal/issue0/cat-history/en). Individual, curated modules of the ‘netzspannung.org’ platform form the basis for growing data resources and content.

The annual competition to promote new ideas, ‘digital sparks’, is one of the modules that generate high-quality content through a peer review process. The series of “Tele-Lectures” uses broadband streaming and archiving of key lectures to create a temporarily extended auditorium and a sustained cultural memory. Conferences and workshops are further sources of salient contributions and up-to-date information. For the community, the platform ultimately offers open publication channels, primarily for presentations and discussion. ‘netzspannung.org’ therefore provides its users with an infrastructure for publishing their own work and also generates its own, curated content. It therefore represents a constantly-growing, high-quality pool of information belonging to one specific community and is aimed at an audience of professionals and university academics.

After nearly two years of existence (10/2001 – 07/2003), the bilingual platform contains more than 600 projects in the form of media files, texts, images, videos and some 130 hours of recorded talks known as ‘Tele-Lectures’. Over the same period, a community has sprung up of around 2,400 registered users of the ‘netzspannung.org’ data pool. Over the last three months, some 23,000 visits were recorded on the site.

The three-layer model of Figure 2 visualizes the architecture of ‘netzspannung.org’ as a distributed community platform. It shows the open, documented interfaces that allow users to implement their projects. The architecture can be understood as a "network operating system". The base is an "internet hard-disk" that allows the storing of standard formats like XML but also self-defined data models. The base has an interface that connects to an "application layer". On top of the application layer is an "interface layer" for creating individual skins. The architecture supports various protocols like CORBA, SOAP and HTTP, making it very flexible and offering different layers of complexity or simplicity. Thus, the architecture is attractive for beginners as well as for experienced users.

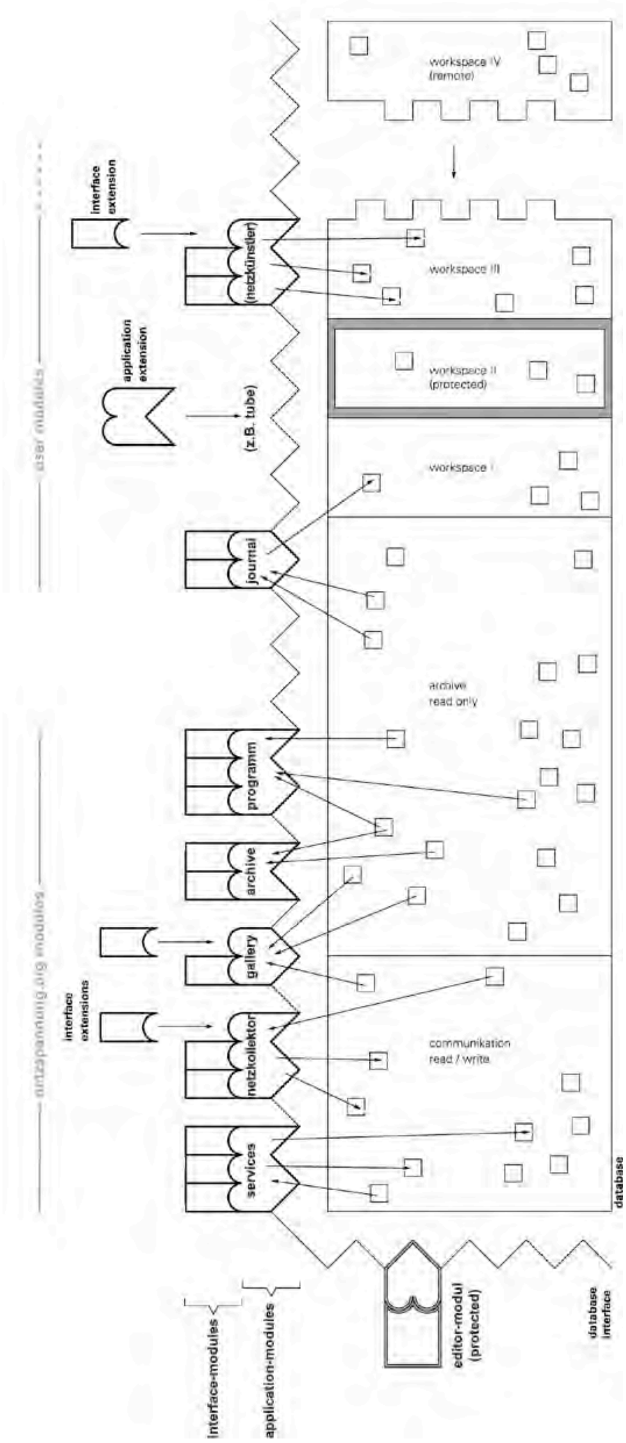

Fig 2 : Sketch of ‘netzspannung.org’ platform architecture

The aim of future developments is to network ‘netzspannung.org’ with other archives. To achieve this goal from a technical point of view, interfaces will be defined as web services and a “dynamic archive adapter” will be developed. In this context, semantic web technologies can be of particular benefit, since they automatically establish a metastructure at semantic level between heterogeneous content and the systematics of different archives.

'netzspannung.org' then facilitates central access with an interface to a decentral network of various archives and becomes, in the true sense of the word, a portal.

Explorative Space: Knowledge Discovery Tools

Just as large telescopes help astronomers to see the stars, digital cultures need new instruments to be able to see, survey and evaluate the rapidly-growing volumes of data.

The 'Semantic Map Interface' from 'netzspannung.org' represents a "telescope for viewing and evaluating the data cosmos", as astronomer Roger Malina put it at ARTMEDIA 8, held in Paris in October 2002.

'Knowledge discovery tools' – one of which is the 'Semantic Map' – are special tools which permit a 'bird's eye' view of large volumes of heterogeneous data and facilitate the visualisation of data resources as contextualised information spaces. Because they also support active structuring, preparation and communication, they are also recognition tools.<0}

According to the context in which they are used, three different interfaces have been implemented so far.

- The 'Semantic Map' compiles content into clusters and facilitates an explorative navigation of interdisciplinary relationships based on semantic interrelations.
- The 'Timeline Interface' arranges content in parallel into various categories and time (x-, y-grid) in order to identify chronological relationships between different fields of content.
- The 'Knowledge Explorer' is a more complex tool for communities of experts. Experts can use it to structure data pools, but also create personal knowledge maps and share them with other members of the community who can then tap into uncharted pools of information.

In the next stage of development, the tools will be personalised and made available for use online. The members of 'netzspannung.org' can then use these to create personal knowledge maps based on their own content and an information pool they have selected themselves (Novak et al, 2002).

Below, the 'Semantic Map' will be described in more detail as an example of knowledge discovery tools.

The 'Semantic Map' is an interface, which evaluates and visualises semantic links between individual documents in the 'netzspannung.org' database. Interactive visualisation provides an overview of the contexts and relationships between the data. It also gives access to individual documents that are then displayed in separate windows. For the conference entitled "cast01/living in mixed realities" (http://netzspannung.org/cast01) organised by MARS, the 'Semantic Map' serves as an overview of the conference contributions that can be used for research purposes. The following illustration (Fig 3) depicts the map's structure:

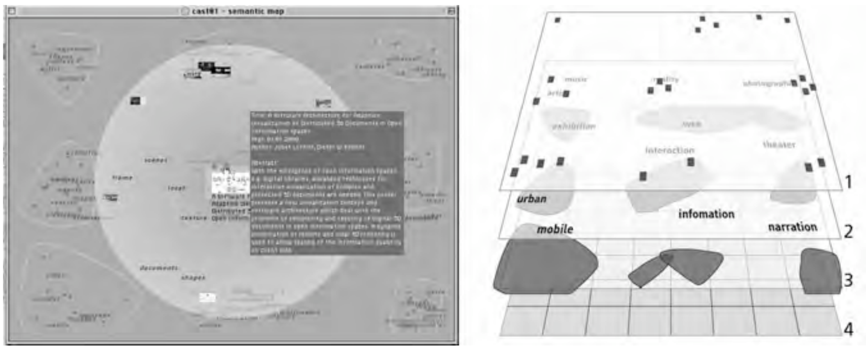

Fig 3 : 'Semantic Map' interface- layers of information and data processing

1. Each document is represented by a small blue square on the map.
2. Keywords provide information on the content of a cluster.
3. Documents with a greater number of content links are grouped in clusters.
4. The visualisation process is based on the Kohonen Map procedure: It connects all the documents to each other and arranges them in a two-dimensional grid according to their content links (cf. Kohonen 2001).

Participation Space

The knowledge communication abilities of conventional desktop computers with their GUI interfaces following the WIMP paradigm (Windows, Icons, Menu, Pointing) are extremely limited, since they only take limited account of the person's inherent spatial sense of orientation and are largely unsuitable for collaborative learning on site.

The question of how online archives can be implemented on both metaphoric-virtual and physical-real levels as enterable and tangible knowledge spaces is answered by the Mixed Reality methods developed by MARS for penetrating and overlayering physical and electronic spaces. The 'electronic Multi-User Stage Environment' (eMUSE) describes a mixed-reality space continuum in which an enterable audio archive, as an interactive sound space for multiple users, can create the impression of a concert room. The space appears as a room furnished with data (Strauss et al, 1999) (Fig 4).

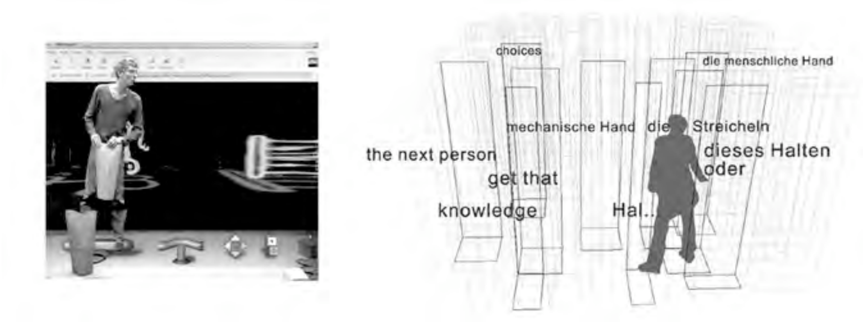

Fig 4 : Imagine a room furnished with data

Mixed Reality Installations

Mixed Reality offers the opportunity of converting 2D information structures into 3D ones. The notion of Mixed Reality was mentioned for the first time in 1994 by Paul Milgram and Fumio Kishino in their paper on Mixed Reality visual displays aiming to enhance the limited research field of Virtual Reality (Milgram & Kishino 1994). In contrast to classical, two-dimensional interfaces, users of mixed-reality installations are drawn into the centre of the proceedings. They are not transported into an alien world and morphed into a cyborg with data visors and data gloves, but instead move in a familiar action space with extended electronic functions.

With the performance installation “Murmuring Fields”, MARS developed a Mixed Reality audio archive. Data spaces and action spaces are linked via an intuitive interface. In the interactive sound space known as "Murmuring Fields", participants can experience the sound of the virtual space through movement. They experience a space that they ‘play’ with their bodies, as they would an instrument (Fleischmann et al, 2000) (Fig 5).

Fig 5 : Layers of a Mixed Reality-Stage Installation

Based on the eMUSE technology developed in this project, MARS is adapting knowledge tools for the physical space under the title “the enterable knowledge space”. In the initial studies, the recipients move over a ‘Semantic Map’ covering the floor, and this now becomes a ‘life-sized’, enterable orientation landscape by virtue of the on-screen display (see Fig 6). The data space – now a three-dimensional archive – can be explored by moving through the space and making appropriate gestures. In an interactive, dynamic interchange, content (text, image, video, sound) is selected and depicted in the space.

Fig. 6: Enterable 'Semantic Map' and gesture based 'Timeline' interface control

Tangible Media Learning Objects

The term 'Tangible Media' (Ishii & Ulmer 1997) describes the linking of physical objects and digital processes. Projects such as 'Triangle' (Gorbet et al, 1998) show how computer applications that can only be displayed in a very abstract way on the screen can, when transferred to Tangible Interfaces, approximate more to human behaviour and an intuitive understanding of things, thereby making these applications much more useful.

For learning in the pre-literal human development phase, educationalists from Pestalozzi to Montessori encourage learning objects that communicate facts on a concrete, material level. With developments of the MIT such as 'Digital Manipulatives' and computer-enhanced building bricks, etc., pre-school children can learn procedures that previously were regarded as too complex for this age group (Resnick et al, 1998). For the handling, classification and recall of media archive objects such as sound, image and video files, physical representations – i.e. reference objects that make contexts 'tangible' in the physical space – can be extremely useful.

In 2002, 'Soundgarten', a tangible media learning object that used play and easy-to-understand methods for managing media on a database was created at MARS. 'Soundgarten' is a toy for explorative and formative learning using sound (Fig 7). It enables children to create their own sound environments by manipulating physical play objects. Mushroom-shaped objects represent the individual sounds. Small leaf-shaped and flower-shaped attributes can be attached to these, which then function as filters to change the sound. In the "flowerbed" – or more technically, the base station – the collected sound sequences can be arranged and played through (Wolf 2002).

As a type of 'Lego for sound', it facilitates an explorative game with sounds. By enabling children to design personal sound spaces from variable elements, this promotes their motor, receptive and cognitive skills.

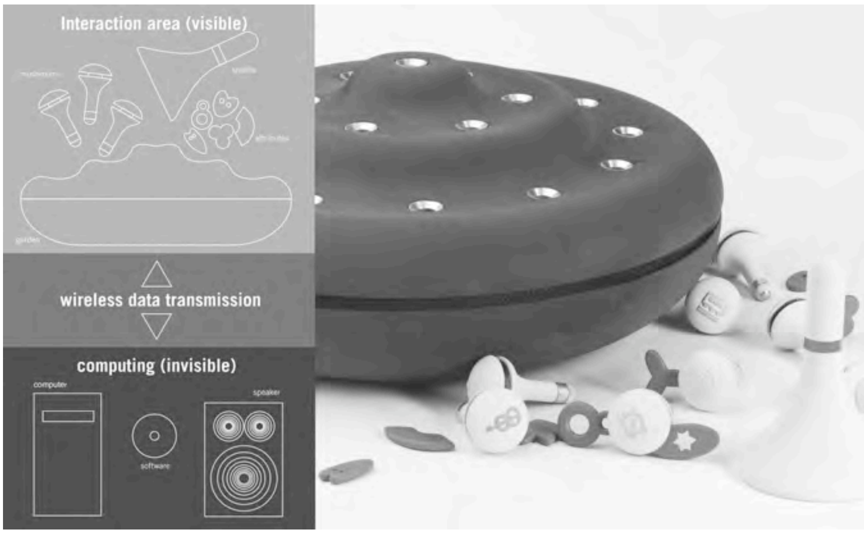

Fig. 7: Elements of 'Soundgarten'

Mediation Space

The process of discovering and developing concepts for knowledge communication in digital cultures must extend beyond simply integrating new technical concepts, and must also investigate the social contexts of teaching and learning. MARS initiates experimental teaching events that examine classical teaching situations. The experiments discussed below using two examples contain cross-university, interdisciplinary and project/action-focused approaches in media culture education. In the classical education system, young people are still being educated using mostly verbally-fixed thought and analysis methods. Even though this efficient teaching and learning method continues to be of fundamental significance, current developments in education are showing how important a knowledge of individual skills is in graphic-associative or kinaesthetic thinking in order to be able to exist in the media reality of our society (Svanaes 1997).

Workshop entitled "I see what you hear"

The MARS workshop entitled "I see what you hear" is an example of experimental, project-focused learning in heterogeneous workgroups (Fig 8). The participants at the teaching event comprised young people aged between 10 and 15 years, plus art and art therapy students. Working together as equal partners, they developed concepts for kinetic objects. Using the technical principles of the Theremin (http://www.thereminworld.com/) a series of small, interactive exhibition pieces were developed in the workshop. The workshop leaders were chiefly there for moderation purposes. The first stage for the total of eighteen participants involved only the students, who were introduced to the topic over workshops lasting seven days. Then came working groups made up of one young person and one student in the practical part of the workshop. At the end, the results of their work were presented in a public exhibition (http://imk.gmd.de/ich-sehe-was-du-hoerst/reflection_english.html).

The link between practical work and reflection led to a playful and sensory workshop that gave the participants the opportunity to play an active part in designing the workshop content. The various methods of approach used by the groups, whose age and knowledge differed, and the interdisciplinary approach of integrating state-of-the-art information technology into an artistic and playful context gave rise to extremely productive potential for both sides. The bee flies over the flowery meadow which is humming with the sounds of summer and a mouse runs squeaking among the legs of the visitors. The workshop participants share the experience of independently creating the theremin circuit on a circuit board they have soldered themselves – along the lines "Think first, then solder".

Fig. 8: Workshop activities: I see what you hear

Tele-Lectures

Universities are increasingly being faced with tighter budget restrictions. This makes it more difficult to cover interesting topics and bring eminent lecturers on board. The concept of a decentral network of auditoria from different universities is one attempt to address this problem - with ‘Tele-Lectures’, MARS is linking the auditoria of several media and art colleges and universities via broadband Internet streaming to form a single telematic space. A lecture being given in one location is transferred to the auditoria of the other participating universities and moderated there. Discussions then follow. All lectures are also recorded and archived on ‘netzspannung.org’. In contrast to conventional Internet TV broadcasters, the focus of the ‘Tele-Lectures’ lies on the shared experience of live transmissions on the spot and the embedding of content in the context of university teaching.

The further development of the ‘Tele-Lectures’ format focuses on the creation of a feedback channel which facilitates communication between the lecturer and the audience listening at the various locations. In future, all auditoria will need to have the basic equipment for incoming and outgoing live transmissions. This infrastructure should facilitate an audio-visual exchange between universities that requires as little maintenance as possible and is easy to use. The ‘Mobile Unit’ (Fig 9) of the MARS Lab functions as a mobile multimedia streaming laboratory prototype for the mobile classroom (Pfuhl & Peranovic 2002).

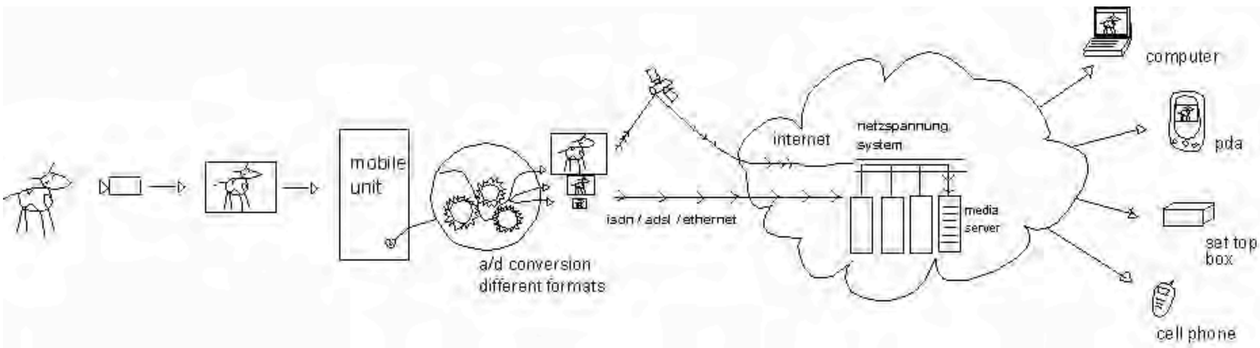

Fig. 9: Mobile Unit: web-cast production tool for real-time workflow, transformation, capturing of media data.

OUTLOOK: MIXED-REALITY LEARNING ENVIRONMENTS

On its current projects, the MARS Exploratory Media Lab is planning to link the layers described in this paper (information space, explorative space, participation space and mediation space) to form a single knowledge space for media culture education which bridges the digital and physical spaces.

'Mixed Reality Learning Environments' feature a high level of integration where the familiar physical environments and their everyday artefacts are extended by the possibilities of digital information and communication technologies. Concepts such as the 'affordances' ("properties of the world that are compatible with and relevant for people's interactions") can be used in order to make electronic functions comprehensible and tangible, and to establish a 'direct link between perception and action' (Gaver 1991). The material and tangible environment with which we are familiar is used in order to facilitate access and interaction on both a cognitive and an emotional level. The structures and behavioural patterns that are linked to the space and the objects that surround us are adopted and expanded.

Alongside technical expertise, there is particular focus in these environments on architects' and product designers' expertise relating to the communication process. Various projects such as the "Designers' Outpost" at the University of Berkeley, to cite a recent example, have focused on these approaches for working environments. Designers' Outpost supports the structuring work of web designers who plan site maps with paper Post-Its, extends these Post-Its electronically and "combines the affordances of paper and a large physical workspace with the advantages of electronic media to support collaborative information design for the web" (Klemmer & Landay 2001).

For learning environments, the comprehensive integration of different, heterogeneous media and media formats is as essential as the tactile, comprehensible and material environment. Live streams of audio and video files must also be supported, along with slide-based lectures. The environment must also actively support the creative work of learning groups (cf. e.g. Streitz et al, 1998).

The interactive Internet TV platform "I2TV" developed by MARS is designed as the technical basis for 'Mixed Reality Learning Environments' (Fig 10). This platform's system architecture supports connections between different input and output media on-site and on-line. The I2TV System enables the combination of different levels of content representation, interaction and communication channels based on the situations on-site and on-line, and depending on bandwidth, input and display devices of individual users using a multi-layered system architecture (Novak et al, 2001).

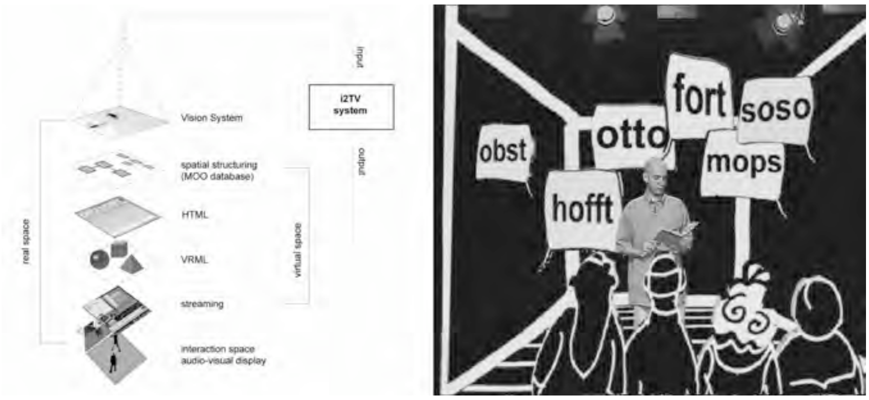

Fig. 10: The I2TV-System featuring a distributed speech-play based on the poem „Otto's Mops" by Ernst Jandl.

'Mixed Reality Learning Environments' especially support playful and experimental learning and communicate media expertise as self-referencing content. Different scenarios that are aimed at different age groups are currently being checked out for their feasibility.

Kids' Playground

'Kids' Playground' provides a vehicle for creating and investigating innovative, networked infrastructures for playing, learning and therapeutic purposes. A Mixed Reality playground should offer children participatory and active learning through practical media experience (Fig 11). In workshops, children, students and professionals work together to design new games, mechanisms for supporting play, and interactive playthings. The locomotor system and gestures serve as a basis for interface concepts. The tangible media learning objects serve as ways of trying out new communication and play scenarios and, from the perspective of interactivity and cooperative action, to promote social competence, personal creativity and media expertise (cf. Bobick et al, 1999).

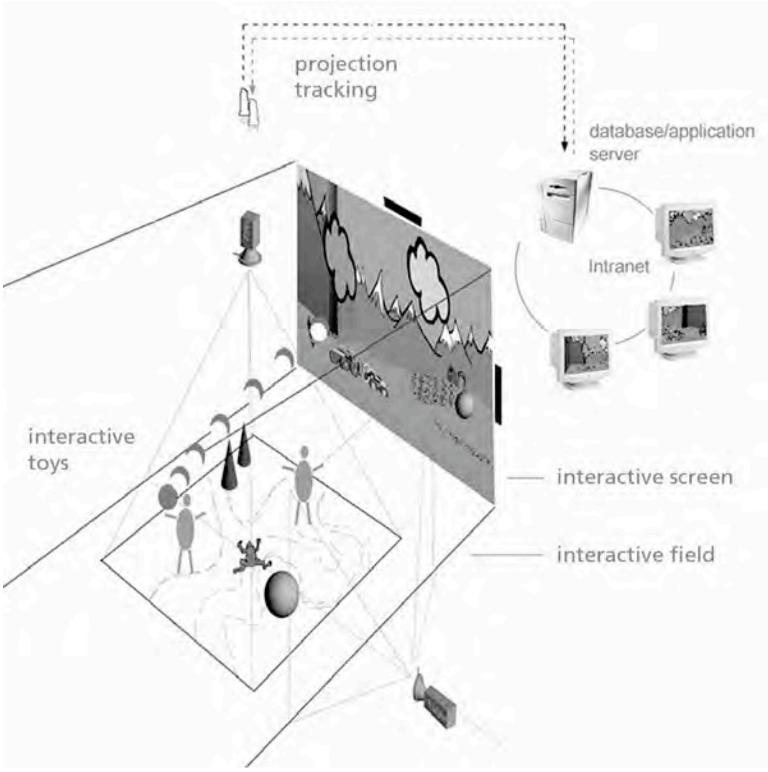

Fig. 11: Example of a Mixed Reality playground

Mixed Reality Classroom

The concept of the 'Mixed Reality Classroom' gives online and onsite learners and teachers the opportunity to meet at a specific time at a specific location and to generate knowledge in a collaborative way.

The centre of the room is a large board, which is written on with conventional chalk. The content is recorded, digitised and published live on the Internet (cf. Stafford-Fraser & Robinson 1996, Abowd et al, 1996, Moran et al, 1999, Rojas et al, 2000). Superimposed projections on the board facilitate ad hoc interactions such as annotations, comments and remote publishing. Other projections on the floor or on tables, e.g. those of a personalised 'Semantic Map', enable lecturers to navigate through their personal knowledge space in parallel to their lectures and obtain access to personal work spaces. The classroom functions as a central communication interface. Individual users or groups in different locations can come together and participate. Knowledge maps can be created jointly and exchanged. The ‘Mixed Reality Classroom’ is ideal for linking up multiple universities in shared ‘Tele-Lectures’ (Fig 12).

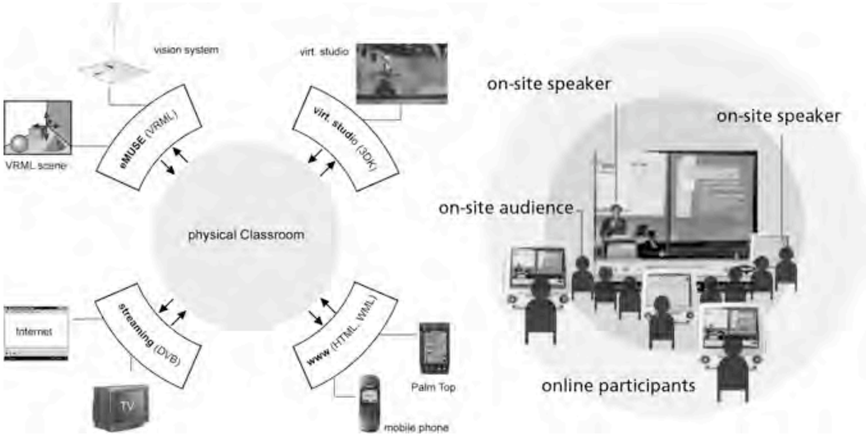

Fig.12: ‚Mixed Reality Classroom’ scenarios

Online/Onsite–Campus

The ‘Online/Onsite Campus’ is aimed at creating a coherent unit of infrastructure and infostructure at universities. Extending beyond the concept of the ‘Mixed Reality Classroom’ (and on a larger scale), the various and extremely heterogeneous aspects of the infrastructure found at a university are linked together. The possibilities include networking stationary kiosk systems and mobile personal devices, publicly accessible archives and private data resources, collectively-used video beamers and personal workstations, in line with the information and action needs of the students and teachers (Fig 13).

Fig. 13: Distribution and accessibility of media objects (Digital Assets), e.g. the ‘Tele-Lectures’: Wim Wenders on Campus

A network that spans multiple universities and departments in this manner would also facilitate the interdisciplinary use of resources. It will also be possible to jointly develop approaches and communication concepts for interdisciplinary and media culture content (cf. Carrard & Engeli 2001, Griswold et al, 2002).

Conclusion

The concept of the networked knowledge space is the central theme of this paper, which presents the work and experiences to date of the MARS research group at the Fraunhofer Institute for Media Communication. Using the example of the Internet platform ‘netzspannung.org’, a host of infrastructural measures was presented that offer a vehicle for activities in the field of e-learning and media culture education.

The ‘Knowledge Discovery Tools’, with their opportunities for visualising information, the explorative investigation of large volumes of data and the creation of personal knowledge maps, represent a key navigation tool and method for sifting through and visualising the data space.

The limits of two-dimensional user interfaces are increasingly emerging as inadequate. The space that surrounds us and the objects around us can however, when given digital capacities, become an extended space – a Mixed Reality environment. The authors believe that the transition to the surrounding space, which becomes an interface, represents a key step towards giving humans the most intuitive access possible to information technologies.

Finally, reference is made to the significance of social contexts for communication concepts, without which learning and teaching is barely possible, even when prefixed with an 'e-'.

The outlook bundles together the concept of the knowledge space and introduces scenarios for 'Mixed Reality Learning Environments' which pick up on all the tendencies mentioned previously - infrastructural measures, smart tools for delivering overviews, the extension of the space that surrounds us (Mixed Reality), and the significance of direct social interaction in groups.

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