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Investigating the Computer as a Medium in Creative Processes –an Interdiciplinary Approach

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Abstract

Although the technical skills of pupils are quite high, the current approach to gain computational literacy still focusses on updating software applying skills, rather than exploring the potential for learning and the nature of digital media as programmed entities. Though multimedia computers are becoming widespread in the consumer market, only little research has been undertaken into the computer as a shapable medium based on a mutual understanding of computational modeling in the context of aesthetics. The key dicipline in the context of digitalisation, that is, computer science, is not reflected in media education. Further, most research was focused on the computer simply as a tool or a ressourse, rather than investigating medium specific potentials. Accordingly informatic modeling is not an issue addressed in media education. The paper looks at a new interdisciplinary approach to explore the computer as a shapable medium in project-oriented art and computer education. It discusses the impact of self-created Mixed Reality learning spaces to establish a multidimensional media literacy involving different human senses, aesthetic objects and artefacts. By linking physical and virtual spaces, new technologies and its potential for learning are scrutinised, such as software to create 3D-worlds and virtual identities (avatars) delivered and experienced through the Internet as well as sensor technologies (such as image and gesture recognition software) in combination with iconic programing tools.

Introduction

The paper looks at hybrid aesthetic learning spaces developed by the learners themselves. It aims to advance ideas for multi-layered media education scenarios as an alternative to common practice to be found at school. The latter reduced the computer to the tool metaphor. The use of computers in education we perceive limited in terms of the learning approach and pedagogical methods, the reduction of paradigms using the computer as well as in terms of the overall learning environment: Most media education infrastructure is characterised by using single work place systems reducing the humans' activities to mouse click, keyboard activities in front of the screen. The computer is reflected mainly as a tool or resource, rather than a shapable medium. In both education and educational research, there is less didactical interest to be noticed towards the understanding of the nature of digital media as programmed entities. Furthermore, most computer infrastructure implemented at school was based on the idea of transferring traditional teaching models (such as lectures) to media education. Accordingly single work place systems were introduced in centralized computer classrooms coined by a static and inflexible infrastructure. However, the structure of socially isolated work places with computers was common and also applied in the context of art education. Internet access still is strongly limited at schools for control purposes.[1] Furthermore, the hype of high-end technologies was absorbed by educators as being a compulsory approach to media education. Taking all these grievances into account, we introduce alternative multi-layered learning spaces. The approach is based on the idea of experiencing digital media by selfactingly designing. The scenarios were realised using low-budget tools available on the consumer market or for free. Developing scenarios affordable for schools, low-budget was not only a response to the economical reality, but applied as an overall conception to focus on the character of aesthetic concepts rather than on the technology as the dominating issue.

[1] Access to network technologies for knowledge creation, such as mobile phones and Local Area Networks are even excluded from the education process.

Shaping aesthetic Mixed Reality learning spaces

The concept of Mixed Reality[2] allows for addressing the different human senses. In the context of practices and procedures of contemporary media artists, the notion of Mixed Reality refers to hybrid constellations of artistic practices, objects, events and systems linking high- and low-tech artefacts, applications and communicative processes by using a variety of aesthetic materials of digital and non-digital nature, such as images, bodies, technologies, language, sounds and codes. Such art works allow for linking physical reality with the digital spaces by addressing different human senses. The experimental approach towards the different media is characteristic for work methods to be found in media art and it is defined by the term of artistic constellations [13] (Seelinger, 2001). Hybrid media art projects are often coined by a multidimensional and interdisciplinary approach to arts, crossing the borders between the disciplines such as arts, design, engineering, science, information and communication technologies, philosophy, literature as well as dramatic narratives and performance. However, most collaboration in such interdisciplinary projects is based on the idea of the division of labour, rather than on the idea of a mutual and reciprocal understanding of the other disciplines' approaches. Although the open concept and the variety of different work methods is opening up important impulses for learning, educational research seems to have missed scrutinizing the concept of Mixed-Reality for education purposes.

Fig. 1 The concept of Tangible Media, that is, the interface getting embedded in the objects of the physical world, is reflected in our approach to Mixed-Reality as an augmentation of the physical world.

Creating interactive environments with Tangible Media

The computer extends the physical space for communication and acting by adding the digital dimension. Mixed-Reality environments can be perceived as systems of augmented reality. Virtual Reality can be considered being an extension, rather than a replacement of the physical world (as implied in the term of Augmented Reality.)

The concept of Tangible Media allows for implementing the computer into the objects of the physical world, that is, computers is integrated into the very scenario and location where learning takes place. As touching things is a means towards investigating and understanding the world, pupils are encouraged to learn about media by means of graspable objects, rather than reducing their activity to mouse click and key board activities. Tangible media support the interface to get activated in the very situation where learning takes place. A more natural way of interacting with the computer, such as those activated by using hand gestures, motion and body stance of any kind. The combination of sensor technology and iconic programming facilitate a more human centred human-machine interaction. By making transparent the invisible inside of computer in order to facilitate an overall understanding of algorithms and computational modelling. At the same time it allows for the machine as a visible box to disappear in the context of the overall scenario to the benefit of multi-layered communicative experiences and aesthetic phenomena the learners are confronted with. The latter constitute the overall learning space.

Hard- and software tools are available on the consumer market, such as image and gesture recognition software. Interestingly enough, only little research has been undertaken in exploring micro computers, robots, robotic toys and sensor technologies for learning such as the works by Druin and Hendler [4] (San Diego, CA, 2000), or the works with tangible interfaces by Ishii, Patten and Griffith, [8] (The Hague, the Netherlands, 2000) who introduced the research field of Tangible Media. From an education point of view, sensor technologies and icon based programming allow for crossing the barriers of curricula by facilitating subject-crossing and project-oriented learning.

Current technologies, such as sensor technologies, image and gesture recognition software, allow for linking the digital spaces to the physical communication and acting environments of the pupils by providing interfaces to integrate 3-D-scans and self-created media files. Furthermore, such technologies come along with software tools based on iconic programming, that is, visualizing the lines of code programmed self-actingly by the user. Pupils are encouraged to self-actingly programming the computer and test the self-made programme in the physical environment. By experiencing the computer as a shapeable medium, they become active, creative designers of digital and non-digital artefacts. We believe a long term computational literacy can only be supported on the

[2] The term of Mixed Reality was firstly introduced in the area of computer science by Milgram in 1994. It is defined as an overarching concept linking the two established concepts of Augmented Reality (AR), which refers to "augmenting the real or physical world with electronically synthesized data" and Augmented Virtuality (AV), referring to "augmenting or enhancing the virtual world produced by a computer with raw data from the real world." (cp. Ohata, Tamura, p. 2)

bases of an understanding of algorithms by using the computer as a shapeable, and manipulable medium. Pupils learn that programming is a creative and communicative process.
The work processes are coined by collaboratively developing concepts and aesthetic objects which are brought together in the overall hybrid learning space. Pupils learn to instruct micro computers and test the programmes developed. A variety of sensors such as those responding to temperature, haptic click or light have been given to the pupils to experiment with. The pupils themselves develop the overall environments, installations and stories using event-driven programme features. Controlling motion of artifacts which allows for moving static objects in physical space, is realised by means of icon based programming. Micro computers and sensors are represented as icons on the desktop which are connected by pieces of physical string to the micro computer. The learners themselves instruct micro computers by testing self-actingly created programmes in the context of interactive environments. The computer, which is present for the kids in terms of transparency, dissapears in the context of the overall education scenario to the benefit of multi-layered aesthetic phenomena. The latter is characterised as being multi-dimensional, that is, such phenomena address the different human senses during the diverse phases of the development process. The rich learning environment is coined by a variety of dimensions such as those addressing haptic and auditive communication channels. The arrangement of artefacts, aesthetic objects and communicative processes constitute the overall learning space which is stimulating discourse and social interaction.

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Fig. 2 Interactive hybrid learning spaces realised with sensor technologies and iconic programming on primary school level as wel as on academic secondary level

Extending the Synchronous Communication Space of the Internet using 3D-Worlds and Avatars

Synchronous communication spaces are strongly limited to either text based chat and Videoconferencing. However, the development software for 3D-worlds delivered through the Internet has become affordable for school kids. From an education point of view, a variety of challenges and opportunities is opening up using such tools in creative and collaborative learning processes. Pupils are enabled to design their own spaces for communication and collaborative experiences to be made in self-created environments. Software tools allow for integrating images, and objects of the physical environment of the pupils, that is, delivering an interface to the physical world. The latter is a general characteristic for Mixed-Reality-environments developed. We consider it of increasing importance in the context of embedding the computer into creative and multidimensional education processes, as it links the basic element for the human being – the physical space – with the digital spaces of the computer. The main challenge offered by virtual spaces is in terms of experiences which differ from such made in the physical environment. The limits and borders with linked to gravity are abrogated in virtuality. The latter can be seen as a medium specific opportunity. Furthermore, pupils are challenged by the immersive effect of virtuality. The awareness about medium specific opportunities for artistic expression we perceive of increasing importance in the context of media literacy to be developed on the long run. [3]

The software tools used come along with a construction tool mediating different approaches to three-dimensional imagination of the pupils, such as player-, top-, side- and isometric view of construction level. The self-created world can be tested and experienced collaboratively using the software's player (viewer) modus. After the construction phase the collaborative navigation of the three-dimensional Internet-world representing the opening of an online-event, such as an exhibition. The latter can be put on stage in the context of an online-meeting or online event such as an online exhibition. Data projection allows for linking back to the physical environment reflecting Mixed-Reality as an extension of reality as shown in figure 3.

Synchronous communication traditionally is represented simply as text based chat, which supports a rather poor level of communication, given the fact that communication is a complex, dynamic phenomenon involving different human senses, gestures, bodies as well as appearances. The introduction of avatars (as well as bots or agents[4]) add a new dimension to synchronous communication spaces. Avatars constitute digital representations of one's identity in online communication. The term originally is derived from the Hindi and refers to the ability of certain gods to take any form at will. [1] (Altstatt, 2001, pp 7). They can be created self-actingly, e.g. by using portraits which can be integrated in the development software.[5] Furthermore, they can exist as independent

[3] E.g. a perspective drawing can be transferred and therefore navigated as a three-dimensional virtual model.
[4] Apart from avatars, other forms of continuing basic entities exist, such as embodied conversational agents (e.g. "Rea" by Justine Cassel). Those agents will be of increasing importance in future education scenarios.
[5] E.g. using Avatar lab software

entities as part of a virtual environment. In the latter they are representing a range of programmed motion and interaction looped in a particular context. Avatars allow for representing oneself in digital space by means of a chosen or constructed appearance and support a more visualized communication delivered through the Internet. Extending the idea of text-based chat, avatars may be instructed to behave in a particular way by the user. A wide range of hand gestures and body movements linked to human conversations coined by expressions of anger, joy, flirt and the like can be simulated. That is, the user programming the self-created avatar's behaviour himself.

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Fig.3 Projection of an Internet world as a part of a Mixed Reality learning space developed by 8th graders of a comprehensive school (left); Pupils of 8th grade communicating online as avatars by using hand gestures and body stance

Furthermore, avatars are defined as "embodiments of a person, a concept or philosophy, as concrete manifestations as of a principle attitude, way of life, or the like." [14] (Vesna, 2001). The concept of avatars implies a multidimensional approach to the issue of identity formation. Identity represented by an avatar can be anonymous or changed. Different forms of embodiments exist, such as two-dimensional, static ones as well as dynamic avatars which are able to move and communicate by using gestures, voice and the like. The latter we see of importance because they open up a variety of opportunities for collaborative education processes. The identity chosen can be created (or selected) and be developed further self-actingly by using special development tools for creating dynamic avatars.[6] Those allow for integrating scanned objects or photos of real people. The new opportunities are also referring to a variety of contents for education processes, such as the earlier mentioned complex and intercultural topic of identity and identity formation.

The worlds and identities created have different interfaces linking to the physical space. The software support the integration of photos and scans, sounds and the like which allow for individual creations.

Conclusion

As the evaluation has shown the concept of applying computational modeling in the context of art in Mixed Reality learning spaces were proved being an exellent means to stimulate creative processes at the different age levels. The skills gained by the pupils consist of a wide range of experiences and competences linked to aesthetic and computational modeling. Learners become constructers of conceptions, artefacts, competences and models. The construct objects and extend such by programming a particular behaviour.

Furthermore, communication and collaboration have been supported not only by the pedagogical approach of team based learning, It can be an integrated part of a particular networked software which might underpin the concept of social networks. The hypothesis promoting the shaping process - e.g. by self-actingly programming - being an excellent means to get the pupils emotionally involved in the learning content was proved right. The hybrid aesthetic learning spaces realised consist of a variety of stimulations in terms of aesthetic, social processes and interaction between the learners. It goes beyond the idea of the learning arrangement which is defined as a combination of different media in a learning environment. The hybrid learning space is located in the very situation where learning is considered best to take place, be it a studio or the like. Such a rich variety of stimulations are hamperd by the rather unflexibel learning environments to be found at school in the common central computer class room.

On the long run, the updating of technical skills can not be perceived as the main educational goal. The projects realised have shown the necessity of the introduction of broader concept of media literacy based on the key competences such as designing and computational modeling. According to our research, the computer needs to get embedded into new forms of project oriented and interdisciplinary learning, rather than simply being a tool for data processing and applying software. Media education is challenged by the idea of integrating the computer as a shapeable medium. It requires for a new culture of learning, which needs has to be established on the long run. The latter includes a new ground-breaking models for the creative use of digital media in education which allow for crossing the barriers of curricula by facilitating subject-crossing and project-oriented learning.

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