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Brave new world: Mobile phones, museums and learning

- how and why to use Augmented Reality within museums[1]

ANNE KAHR-HØJLAND*

Abstract: *This article deals with mobile technologies as tools for learning within museums. Using the presentation of EGO-TRAP – an exhibition which uses mobile technologies as the technical platform for creating an Augmented Reality – as my point of departure, I will discuss the advantages of using mobiles as tools for learning in museums. EGO-TRAP may be seen as a first modest step into a new museum paradigm. On the basis of a brief outline of the change of paradigms within museums I propose a new paradigm based on interactivity, narration and virtuality embedded in an Augmented Reality with an educational aim. This kind of Augmented Reality, I argue, seems to satisfy the demands of hands-on experiences, narrative structure and individual experiences, which I point out as being crucial for a beneficial learning experience at museums.*
Keywords: Augmented Reality, mobile phones, museum learning, narratives, interactivity, hands-on experience, science centres.

EGO-TRAP – A VIRTUAL EXTENSION OF THE EXPERIMENTARIUM

I will open this article with a description of a concrete example of a mobile facilitated exhibition recently launched at the Experimentarium in Copenhagen, Denmark. By means of an interactive narrative, facilitated by the visitors' own mobile phones, the exhibition entitled "EGO-TRAP – you have no idea" provides a virtual extension of the physical environment at the Experimentarium (cf. http://www.experimentarium.dk/ego-trap)[2]. EGO-TRAP was initially directed at young people from upper secondary high schools in Denmark, though a modified version of the EGO-TRAP is now underway for primary school children. Both versions of the exhibitions have been developed in co-operation with the staff at the Experimentarium and a professional scriptwriter.

If visitors want to try EGO-TRAP, they must bring a mobile phone to the Experimentarium. The mobile phone must be signed up for the mobile Internet (WAP/GPRS) before arriving at the Experimentarium.

Upon arriving at the Experimentarium, the visitors have to register for EGO-TRAP by means of their own mobile phones. A woman's

voice then presents herself as a guide who organizes the exhibition individually for each user. She introduces the exhibition as a personal test, which allows the visitor to gain insight into different aspects of his own skills. From this point, the voice in the phone functions as a personal guide for each visitor through the exhibition at the Experimentarium. What the user does not know is that the description of the exhibition as a personal test is not a full and entire description of the process that follows. For the next one or two hours, the visitor will play the main role in an interactive narrative which changes according to his interactions with the exhibits as well as his response to the voice on the mobile phone. The interactive narrative progresses at the following three levels:

Level 1: testing the visitor's characteristics – and 'getting to know the system'

The visitor is led from one exhibit to another in order to test different skills – e.g. "Can you recognize tones?", "How good is your spatial awareness?", "How fast can you wheel a chair?" etc. At each exhibit, the visitor is urged to set up hypotheses or predictions of his own abilities and characteristics, for example "how long will it take you to put this three-dimensional figure together? (enter your answer on the keypad of the phone)", or: "How much lemonade will you be able to fill in the glass as a result of your work on the wheelchair?" – "How well will you be able to follow the lines in the floor wearing the glasses that trick your brain?". The idea of urging the visitor to make predictions and evaluate his ability to make these predictions is to prompt the reflective processes in relation to each exhibit (Dewey, 1933; Osborne, 2002: 205 ff).

The level ends by the guide preparing a personal profile of the visitor. At this level, the visitor also becomes familiar with the technical system as he grows used to getting information from the woman's voice in his ear and responding to her through the keypad on the phone.

Level 2: the level of co-operation – and arousing suspicion

After receiving his personal profile, the visitor is prompted to contact another (real) visitor who is in the exhibition; according to the woman who guides them the profiles of the two visitors appear to match. This introduces the dimension of cooperation, as both visitors will be asked to cooperate in learning. Level 2 follows the same principles as level 1: both visitors are prompted to predict their own capabilities before using the exhibits and are evaluated by the woman's voice afterward. The themes of the interactive exhibits involved at this level have changed from the (primarily) physical tests of level 1 to exhibits emphasizing the visitors' skills at working together, for example by letting them communicate by whispering to each other in two receiver dishes ("the whispering gallery") or by letting their faces melt together by using the mirrors in the exhibit called "mixing faces".

Also, this level deliberately tries to arouse their suspicion. During their interaction, the visitors will receive a phone call from a hacker who interrupts the sequence and arouses their suspicion of the woman who is guiding them. Who is this woman? Does she have a hidden agenda? The hacker will tell the visitors that they seem to be part of a dangerous experiment being carried out by the woman who is guiding them. The visitors now have to decide; whom should they trust? If the visitors trust the supposed hacker, he will show them a piece of evidence proving that the woman

who has been guiding them is testing them for a cunning and evil purpose. This will lead them to the third and final level. If they don't trust the hacker, of course, the game is over.

Level 3: confrontation and insight - who is really behind the EGO-TRAP?
Guided by the hacker, the visitors will end up in a secret, dark room where they are confronted with an animated rat! This final level is a level of insight: It turns out that the woman who has been guiding the visitors is actually a mutated rat who has taken control over a science lab. This means that in reality the visitors have taken on the role of 'laboratory animals'. The story ends with the rat challenging the visitors to fight for their freedom by means of a computer game (which the visitors are determined to win). After this, the game is over. The aim of this final level is to stimulate the visitors to make critical, ethical reflections about who is providing the information – does such a thing as objective truth exist? How does this relate to their evaluation of the scientific evidence on display?

EGO-TRAP – USHERING IN A NEW ERA

EGO-TRAP is an example of how to use mobile phones in museums. EGO-TRAP is a kind of role play, where the narrative develops according to how the visitor uses and responds to the system. The narrative is formed by the interactive exhibits already existing at the Experimentarium. Therefore, EGO-TRAP can be described as a virtual extension, an Augmented Reality, of the exhibition (cf. Bolter & MacIntyre, 2005; Klopfer & Squire, 2005). This way of using mobiles as augmenting the museum experience is ushering in a new era within museums.

As mobile technologies – especially mobile phones – obviously are a determining factor for this new era, I will discuss the role of the mobile phone as a facilitator of learning within museums in the following.

Mobile technologies – as advantageous facilitators of museum learning
As mentioned initially in this article, the primary target group of EGO-TRAP consists of young people (aged 14 to17). Mobile phones are becoming increasingly popular among young people, but the fact that young people are very familiar with mobiles is not the only reason why mobiles function as advantageous facilitators of learning within museums. Mobiles also contribute to the improvement of the learning potential in semi-formal learning settings, as these new technologies possess the ability to control a narrative or computer game, due to the mobiles' features as computers. Mobile technologies are valuable remedies for creating such an experience of being in an "I-bubble". An I-bubble arouses out of the feeling of having a strictly individual and personal experience, where the world around you seems to recede into the background. In the 1980s Virtual Reality (VR) was very popular. VR offered you a new reality which was created purely by computers. None of the things you could do in VR were tangible and real. Entering such a VR would allow you to get the feeling of being in an I-bubble, which also meant that you would have to leave the real world or at least shut it out. The advantage of the mobile phone is that it offers one a similar feeling of being in an I-bubble without simultaneously requiring one to shut out the real, tangible world.

Another advantage of mobile technologies is that they are *mobile*. They are tiny compu-

ters which can easily be brought into the museums without inhibiting the mobility of the visitor. This, among other things, makes mobile technologies capable of combining the three elements whose I stress the importance in the updated version of the 'learning museum'; namely interactivity, narration and virtuality.

At present, no one doubts the fact that the use of mobiles in semi-formal learning settings may boost attendance to these places, mainly because mobiles appeal very strongly to the young audience (Goodin, 2006: 2). The question is if a mobile phone contributes to more than mere fun and games; can a mobile phone, for example, support reflective learning processes?

Mobile phones are all based on computer technology. Many of us are not particularly aware of how much we use computers in our daily lives. When using a microwave oven, a sewing machine, a camera or a washing machine, very few of us are aware that we are also using a computer because we think of ourselves as the ones doing the task, not the computer embedded in the appliance (Norman, 1989: 185). Similarly, very few of us are aware that the mobile phone in our pocket is a fully functional handheld computer. As Marc Prensky puts it, today's high-tech mobile phones "[…] have the computing power of a mid-1990's PC […] even the simplest voice-only phones have more complex and powerful chips than the 1969 on-board computer that landed a spaceship on the moon" (Prensky, 2005: 1). This feature of the mobile certainly qualifies it an efficient organizer of a narrative – or an Augmented Reality.

Of course, communication is also one of the basic features of the mobile. Actually this was what the mobile was made for – to communicate with others – in the first place. What differentiates the mobile phone from for example the PDA (Portable Digital Assistant) is, among other things, the possibility of receiving and answering phone calls whether the calls come from a server or from another human being. In the example of EGO-TRAP, this feature is utilized in the way the system communicates with the individual, but even more important, the phone is used as a mediator between two visitors. The mobile phone makes it possible to create informal meetings between the visitors. Seen from a socio-cultural learning perspective, these meetings are very important, as it is through our meetings with other people that we negotiate new knowledge, e.g. we construct knowledge from communicating with others (Säljö, 2003; Wertsch, 1998). According to Säljö and Wertch, human understanding is a result of knowledge and patterns of action grounded in interactions unfolded between individuals in society. Knowledge is not a question of biology, as knowledge is created in the interplay between individuals. Säljö and Wertch's theory is influenced by the socio-cultural learning theory presented by Vygotsky. The mediating function of tools is considered crucial in this learning perspective (Säljö, 2003; Werstch, 1998). Learning takes place by means of physical, mental and semiotic tools – in EGO-TRAP another semiotic tool, in the shape of the mobile phone, is introduced as the mediator of scientific information.

EGO-TRAP has been developed to create reflective processes in the exhibition. One of the hypotheses behind the design of EGO-TRAP is that the use of a narrative structure supports the establishment of a 'room for reflection' (Kahr-Højland, 2006). As will be commented on later in this article, narrative

structure has proven to be closely related to human comprehension. To put it briefly, the narrative supports the inner processes of meaning-making by structuring information in a meaningful way, which often leads to tacit knowledge, whereas conversation with other people supports the process of making the tacit knowledge explicit (Avraamdiou & Osborne, 2005). EGO-TRAP is modelled according to the structure of an interactive narrative. At the same time the meeting with another person is a very essential function, as this meeting facilitates the establishment of a room for reflection in a more explicit way than the narrative structure does (Allen, 2002: 260 ff.).

The mobile as a digital showcase

As Bruno Ingemann and Lisa Gjedde claim (Ingemann & Gjedde, 2005: 270), the interactivity as well as the interface of the mobile may possibly steal all of the attention from the exhibit whose information it is supposed to highlight. In the case of EGO-TRAP, a mobile phone is added to an already existing interactive exhibition. One might ask if there is a risk of the mobile 'disturbing' the hands-on experience in such a way that this experience is pushed to the rear; will mobile phones steal all of the attention from existing interactive exhibits and prevent the visitor from interacting with them?

When I propose mobile technology as an 'exhibition tool' that might be fruitful to explore, it is because I believe that among other things a mobile phone will *not* draw visitors' attention away from an the exhibition. Mobiles are most likely here to stay, tools we use without reflection. To use Donald Norman's term, mobiles have turned into a *transparent medium* (Norman, 1989: 185). The mobile has become so familiar to us that we are no longer conscious of our own use of it. This is what Paul Dourish calls the receding of the medium:

> The most successful technologies are those that recede into the background as we use them, becoming an unannounced feature of the world in which we act (Dourish, 2001: 1).

Today, it may seem unlikely that mobiles will recede in this way, but Alison Griffith draws attention to the fact that display cases, when first introduced as a new medium for presenting objects in museums, were exposed to massive criticism. It was said that the display cases stole attention from the objects they were supposed to highlight (Griffith, 2003: 388). The use of the mobile as a facilitator of an Augmented Reality in semi-formal learning settings may be considered a kind of 'digital display case', meaning that initially the mobile will face the same problems as the display case did when it was first introduced. Digital media account for a new way of highlighting information, and the challenge for the mobile is to become as transparent as the – now inconspicuous – display case.

The interactive museum

The opening of the Exploratorium – the world's first science centre – in San Francisco in 1969 marked the beginning of a new paradigm as regards the organization of museums. With interactivity and playfulness at its core, the Exploratorium immediately became a success, at least according to the number of visitors: what was immediately evident was that this type of museum had a strong appeal to the audience.

The concept of *interactive exhibits* means that the visitor has to participate in an active

way during his visit at the science centre. An example of an interactive exhibit could be wheel chairs presented as your personal powerhouse: you are supposed to wheel a chair as fast as you can, and as you wheel the chair lemonade corresponding to the energy you expend will drip into a glass. After wheeling the chair you will be able to regain the energy lost by drinking the lemonade (The wheelchair exhibit is situated at the Experimentarium in Hellerup).

There are many different kinds of interactive exhibits at science centres. Some focus on the use or functions of the human body, some are about conditions concerning chemical, physical or mechanical processes on Earth. Common to all of them is that they all require the visitor to use his hands, and hopefully his mind, and the aim is to communicate science. The hidden agenda behind this kind of exhibits is a learning strategy emphasizing personal activity as a key to personal engagement, which again leads to experience-based learning and which helps the visitor to retain the learning experience (Ansbacher, 2002: 4-7).

What characterizes this kind of interactive exhibit is that it is not meaningful unless a visitor interacts with it, meaning that it is based on a constructivist approach to learning (Hein, 1995: 21-23). Using different kinds of interactive exhibitions, science centres have been able to both attract people and hold them – family visits at science centres often last about five hours (St John, 1993: 59-66; Peacock, 2004: 10; Sørensen, 1996: 1-5). Because science centres have been able to hold the audience so well, the science centre as a museum genre has gained a foothold. Since 1969 numerous science centres have appeared all over the world, establishing the science centre as a sub-genre of museums, a museum communicating scientific and technical topics by means of interactive exhibits. Within a period of thirty years more than 800 science centres have opened their doors all over the world (Martin & Toon, 2005: 407-408).

Actually, the concept of interactivity as it appears at science centres has been so strongly established that it has been affecting more traditional museums, causing the re-mediation of the traditional display cases. For example an art museum in Odense, Denmark, had to employ extra staff for an exhibition which displayed different kinds of installations and technical models, most of which had knobs and strings. Apparently the audience were so familiar with the interactive concept that they automatically started manipulating the exhibited models even if it was actually meant to be a 'hand-off' exhibition, where touching was strictly prohibited (*Installationer*, Brandt Klædefabrik, 2000; http//:www.brandts.dk).

As I have already mentioned, the big difference between science centres and traditional museums is that science centres seek to meet the audience, the focus here being on the person, who is supposed to transform information into knowledge. Therefore I argue that the emergence of science centres based on interactivity marks a paradigm shift within the field of semi-formal learning settings, as the processes of transforming information into knowledge are now considered very important. In this way, what is carried out in practice at science centres is a direct application of the fundamental educational theories formulated by John Dewey, claiming that the process of learning is inseparable from action and experience (Dewey, 1933: 14-29). Dewey (1859-1952), who was a very productive and wide-ranging researcher, worked systematically with, among other things, the concepts of

Boys from upper secondary high schools using bicycles and wheelchairs in EGO-TRAP. Foto: Brøndby Gymnasium.

reflection and experience, and how these phenomena are related to the process of learning. The theoretical work of Dewey has also had great influence on educators outside the formal school system (Wahlgren, 2002: 92-101).

Science centres confronting the positivistic approach to learning

Traditionally speaking, science is associated with a positivistic approach to knowledge and learning whereas the humanities commonly relate to a more interpretive hermeneutical approach to learning (Hiim, 1999: 22; Bruner, 1990: 61 ff.; Bruner, 1996: 94 ff.). It is therefore worth noting that the first efforts to confront the positivistic approach to knowledge within semi-formal learning settings have actually been in the scientific field. Yet while the traditional museum has been criticized for focusing too strongly on the information it provides, science centres are criticized or their insistent focus on the receiver. As far as play is

concerned, I presume that no-one working in the educational field would doubt its importance in relation to the process of learning. But is stimulating playful interactions enough when lasting learning is the ultimate goal?

Critics state that games and entertainment cannot be successfully combined with professional education, as the act of playing and gaming leaves no room for the process of negotiating new knowledge into permanent learning (Wellington, 1990: 247-252). Bo Kampmann Walther (2003) distinguishes between playing and gaming: Playing is characterized as being "an open-ended territory in which make-believe and world-building are crucial factors" whereas gaming is regarded as "something that takes place on a higher level, structurally as well as temporally" (Walther, 2003: 1).

Even if the difference between playing and gaming lies in the degree of complexity, playing and gaming are both peculiar in having their own order and structure. According to Gadamer, the actor who plays the game will automatically be given over to this structure, having as its consequence that once the game is running, it will be the game that plays, while the actor just follows the rules of the game (Wind, 1976: 70). This means that if museum exhibitions encourage gaming, they should seek to "scaffold" their visitors at the same time, cf. Jerome Bruner's interpretation of Vygotsky's work. The idea of "scaffolding" was introduced by Jerome Bruner et. al. in 1976 as a further development of Vygotsky's theory about *zone for proximal* development (Bruner, Wood & Ross, 1976: 89-100; Vygotsky, 1978: 84-91). In his theory of how children learn, Vygotsky distinguished between two competencies, one being what the child is capable of doing on its own, another defined by what the child is able to do with the assistance of a more skilled person (e.g. a teacher or an adult). The latter is regarded as the competence which pushes the progress forward. This means that a mediator between the child and the world the child is trying to perceive is capable of bringing the learning process to a higher level than where it would have been without the mediator. Using Jerome Bruner's terminology, the development of the child is facilitated by the more skilled adult building 'scaffolds' of knowledge for the child (Hallgård Christensen, 1997: 42; Vygotsky, 1978: 86). If museums do not relate their exhibits to some kind of superior context or structure, there is a risk that the visitor might be seduced by the game being played to the detriment of the exhibit. In other words: if the visitor is simply following the structure of gaming or playing unconsciously, it is no longer a semi-formal learning setting – e.g. a place consciously aiming at making its audience learn something. The museum will have become similar to informal learning settings, like trips to the forest and to amusement parks (Kahr-Højland, 2006).

The necessity of structure

So, if we want permanent learning to occur in museums, we will have to "scaffold" the visitor in his use of interactive exhibits so as to activate his reflective processes. This "scaffolding" may consist of some kind of structure within the organization of exhibits, as the addition of a structure may help the visitor feel safe and also automatically allows him to relate the information provided to a superior context; that is, the presence of a structure may boost his reflective processes (Perregaard, 2001: 37; Labov, 1967 (1997)).

Generally speaking, in science centres you will not find any route or guidance as to how to find your way through the exhibition, even

if it is often spread over thousands of square metres and accommodates hundreds of interactive exhibits. Actually this "doing it on your own"-concept is considered to be a very important part of science centres as semi-formal learning settings (cf. Alexander, 2006; Issidorides, 2006). The exhibition at the Experimentarium in Copenhagen before the introduction of EGO-TRAP, @-bristol in Bristol, UK; and the Launch Pad at Science Museum, London, are just a few examples of exhibitions consisting of apparently non-structured interactive exhibits.

Nevertheless, in my opinion, this free choice concept represents a considerable problem as far as learning is concerned. As science centres are generally both huge and chaotic in their construction, they require a considerable amount of independence from their visitors which may seem quite overwhelming to many. Also, studies have shown that there is a tendency to "random button pressing" (Peacock, 2004: 2) and a reluctance to read instructions, both of which inhibit serious interaction (Quistgaard, 2006: 26). Seen from an educational point of view, bringing the learner in a position where he is likely to feel overwhelmed and insufficient is problematic. Therefore in order to prevent the feeling of insufficiency, I argue that some kind of superior structure within the organization of exhibits is needed. A structure may be obtained by combining the exhibits in a mutual relationship, for example a storyline where each single exhibit correlates to a superior meaningful context. As an example of how to structure an exhibition, an exhibition about dinosaurs at the Experimentarium in Copenhagen had offered two different paths to be followed through the exhibition; the "scary path" and the "less dangerous" path. Each path consisted of exhibits about dinosaurs demonstrating different aspects of the dinosaurs (some more bloody than others) both of which ended up by a chicken run containing chickens, the contemporary descendants of the dinosaurs.

The act of adding a narrative structure to an exhibition is not new style of presentation in itself. One often finds a fixed path in a traditional museum. What is new is the combination of a narrative structure and the explorative approach to learning. The challenge thus consists in creating a structure which is closed enough to make the visitor feel comfortable and yet open enough to encourage an explorative approach to the exhibition.

AUGMENTED REALITY WITH AN EDUCATIONAL AIM

Having suggested that the act of playing is not to be regarded as similar to the act of learning, as it is both implicitly and explicitly maintained at interactive science centres all over the world, my point is that a new way of organizing museum exhibitions is needed: In order to encourage learning within museums I propose an organization of exhibits which seeks to combine the three elements *interactivity, narration and virtuality*. These elements may be combined in what I call "Augmented Reality with an educational aim".

What is meant by Augmented Reality may best be explained through an example: In 2005 Stephen Dow, Jay David Bolter and their colleagues implemented a virtual add-on to the Oakland Cemeteries in the US (Dow et. al., 2005: 2-10). When people visited the cemetery, they had the possibility of being guided from one gravestone to the next by means of a PDA with headphones connected to it. During the trip around the cemetery, the

EGO-TRAP: students logging in and playing The Rat Race computer game. Foto: Brøndby Gymnasium.

dead were "brought back to life" through voices of actors who dramatized the lives of the dead. In this way the history of the dead along with the history of the US were revealed to the visitors and an extra dimension was added to the experience. The stories that were told were determined by where the visitor was situated in the cemetery. In other words, the Oakland-experience was determined by both the physical setting and the PDAs. The use of the PDAs and the so-called "spatial narratives" in Oakland Cemeteries creates a virtual add-on to the cemetery: when using the PDA, one experiences a new – virtual – dimension of the cemetery, in this case the stories of the dead, and the history of the US. The PDAs in this way support the creation of a narrative – a narrative which is determined by the place of Oakland cemetery; thus, the setting for the experience heavily influenced the design and

the implementation of the narrative (Bolter & MacIntyre, 2005: 2-4).

The Voices of Oakland is an example of how the combined use of narrative and virtual dimension may provide individualized experiences for the visitor. At Oakland Cemetery the use of PDAs and headphones succeeded in establishing an "I-bubble" for the visitor, meaning that the visitor had a unique experience, as the voices in his ears revealed stories about the people buried there. At the same time the narrative was a principal factor in giving the information presented on each gravestone new relevance, as each piece of information was put into a meaningful context provided by the narrative (Dow, 2005: 6).

Interactivity

In science centres, one finds a strong emphasis on interactivity, as action and experience are considered crucial for the process of meaning making. As already mentioned, the interactive concept has proven to be a success in many ways. There is no doubt that hands-on exhibits are essential for the learning museum (Rennie, 1996: 53-98; Rahm, 2004: 223-225), but to some extent this is incompatible with a high degree of free choice. Following the constructivist approach to learning held by among others Hein, Roberts and Hooper-Greenhill, a widespread use of interactive exhibits within museums should be maintained (Hein, 2006; Hooper-Greenhill, 1999; Roberts, 1997). As I see it, one of the great challenges of museums in 2007 is to combine traditional and interactive paradigms, ie. focusing on both the receiver and the information provided. This is where the narrative enters into this complex of problems, as the narrative has several basic features which make storytelling an advantageous means of presentation.

Storytelling

Bruner has, among others, argued that our consciousness is basically structured in narratives. In his books *The Culture of Education* (1996) and *Acts of Meaning* (1990), Bruner deals with the influence of the narrative on both experiencing and making meaning. Bruner distinguishes between two essential modes of thought in common discourse – narrative and paradigmatic – and he argues that the narrative mode has been given a far too low priority in the educational systems of the Western World. According to Bruner, narratives should be considered the most basic tool possessed by the human being with which to create meaning, organize experiences and understand the world. Bruner claims that we are all born with the narrative form embedded, a form which we can use to organize knowledge, and that this narrative predisposition can also be used successfully to acquire knowledge (Bruner, 1990: 61 ff.; Bruner, 1996: 94 ff). In this way Bruner suggests coherence between the narrative and human cognition, and in this he is supported by cognitive scientist Jean M. Mandler. Mandler concludes that all human beings possess an instinctive understanding of what happens in stories and that from a very early age human beings develop distinct expectations as to the structure and plot of traditional stories (Mandler, 1984: 4).

If the narrative is a key factor of human beings' cognition and learning, it follows that it would be fruitful to use the narrative as a tool in an educational context. The narrative as an educational tool has been investigated by, among others, Avraamdiou, 2005, Norris, 2004, Bostroem, 2002, Bruner, 1996, Bruner, 1990, Davis, 1999, Brier, 2002, Gjedde, 1999, Dow, 2005, Klopfer, and Millar, 1999, all of

whom emphasize how successful using the narrative as an educational tool is.

To briefly sum up some of the conclusions presented by the theorists listed above, the narrative's capacity for presenting ideas is based on the following:

- It can put complex phenomena into a framework that is recognizable to the recipient
- It can be decoded easily by its recipient
- It allows the recipient to identify with the phenomena presented and thereby open to a deeper level of understanding
- It can contain what I call different layers of narration, which makes it possible to communicate with a target group consisting of widely diverse people
- The narrative calls for interpretation rather than explanation, and in this way it invites reflection, which will make a thorough understanding of the phenomena more likely

The narrative is noted for – thanks to the characteristics listed above – its ability to appeal to humans in general. At the same time a story is a tool for structuring information; this function may therefore be used by exhibition developers to influence the actions and the mind of the visitor. The narrative, even in a semi-closed structure, is able to emphasize some pieces of information more than others. Using a narrative structure in an exhibition means that it is no longer solely based on the act of free playing.

Virtuality

As regards the use of the virtual dimension as a means of presentation in semi-formal learning settings, one might argue that the virtual dimension has already been put to use in museums all over the world. In the year 2007, a well-functioning museum without a homepage on the Internet is hard to imagine.

In this case, however, the use of the virtual dimension combined with interactivity and the narrative is more similar to individual computer-based games than to homepages. Through a much more widespread and refined use of mobile technologies than is known today, museums and science centres will be capable of offering their visitors individual experiences. By means of virtual add-on technology, it is possible to create several different virtual add-ons to one and the same physical exhibition or show-room. A more sophisticated use of the virtual dimension provided by the mobile phone will make it possible for the visitor to create his own "I-bubble", that is, his own unique, personal museum and learning experiences. He will experience a personal approach that will allow him to provide feedback by means of the keypads of his own mobile phone. In other words: The virtual dimension supports the feeling of individuality. It supports the idea of meeting all of the visitors individually and where they are, even very different visitors in the same physical setting.

The reason why I am suggesting a new way of planning museum exhibitions with interactivity, narration and virtuality at the core is that these three elements combined support and promote action and experience as well as structure, reflection and unique, personal experiences, all of which facilitate permanent learning.

The table below distinguishes between the three different kinds of exhibitions – the traditional museum, the interactive museum and the interactive/narrative/virtual museum. Please note that whereas paradigm I and II already exist, the third paradigm is a paradigm which is yet to come (ignoring the first modest step being evident in EGO-TRAP). The first paradigm has more or less vanished in its pure shape.

Exhibition Context	Paradigm I Traditional Museum	Paradigm II Science Centre	Paradigm III Interactive/ narrative/virtual (Augmented Reality)
Primary Focus	Information	Audience/receiver	Audience + information Interactions between visitors and media + interactions between visitors
Media	Display case, boards supplemented by movies, tape recordings etc.	Interactive exhibits, hands-on	Interactive exhibits + structure + Mobile technologies
Learning approach	Positivist approach: 'body of knowledge' that exists outside and independently of the audience	Constructivist approach: learning is an individual process occurring in and directed by the individual itself	Constructivist approach + social-cultural learning approach

The table above distinguishes between the different kinds of exhibitions that characterizes the museum paradigms I-III.

MOBILES IN THE MUSEUM - WHY BOTHER?

As outlined above, I believe that museums, as sites for learning, may benefit from combining the focus on information (emphasized in the first museum paradigm) and the focus on the visitor (maintained by the second paradigm). Mobile technologies and especially the mobile phone allows the establishment of a new 'augmented museum' which offers individual experiences, hands-on experiences, narrative structures as well as facilitating social learning processes.

EGO-TRAP, which has served as the example of how to put this new paradigm into practice, is now open to the public at the Experimentarium. At present I am investigating how young students from upper secondary high schools interact in the exhibition by means of video recordings and interviews. It is

Upper Secondary High School Students using EGO-TRAP. Foto: Brøndby Gymnasium.

still too early to present any definite results concerning the visitors' experiences and reflections in the exhibition.

It is possible, however, to point out one of the perspectives of this kind of mobile facilitated interactive narrative in museum communication: The creation of narratives by using the vistors' own mobiles, as in EGO-TRAP, makes a new kind of virtual extension of museums in general possible. In the future perhaps there will be one single exhibition hall with myriads of narratives related to it – narratives directed at children and adults. In other words, it will be possible to experience different kinds of exhibitons and narratives in the same physical setting. When a family visits a museum, the mother will experience one narrative while her husband experiences another and their children yet another – even if they are in the same room and are able to talk to each other during the visit. The technical platform has been put into practice in EGO-TRAP – so now we have the possibility of making myriads of narratives that will fit with the different kinds of exhibitions and visitors in different kinds of museums.

NOTES

1. The article is based on a lecture held at the NODEM 06 Conference in Norway, http://www.tii.se/v4m/nodem/index.htm.

2. The exhibition has been developed as part of my on-going Ph.D.-study, and its aim is to be an educational tool in out-of-school settings, which I refer to as semi-formal learning settings (Kahr-Højland, 2006: 88-90).

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**Anne Kahr-Højland, Ph.D. Student.*
DREAM: Danish Research Centre on Education and Advanced Media Materials.
University of Southern Denmark, Odense,

18 *Campusvej 55, 5230*
Odense M.
For further information please visit:
www.kahr-hojland.dk
www.experimentarium.dk/ego-trap

Address: *DREAM: Danish Research Centre on Education and Advanced Media Materials, University of Southern Denmark Odense. E-mail: akh@dream.dk.*