ArtAbilitation®: An Interactive Installation for the Study of Action and Stillness Cycles in Responsive Environments

Eva Petersson; PhD, Aalborg University Esbjerg
Anthony Brooks; Associate Professor, Aalborg University Esbjerg

Abstract
The paper presents an exploratory investigation that features computer technology use where non-formal learning is targeted through action and stillness cycles. Six workshops designed for accessible participation attracted 91 attendees; including 61 from special care institutes, of which 39 had profound disability; and 30 who were from music teacher higher education. Stillness issues were addressed in a hall size interactive installation designed to enquire two questions; (a) whether, and how, a private space could be optimised for participant personalised interactive expression through progressive temporal intuitive understanding that originated from a stillness confrontation with multimedia, and (b) how a specific graphical interface could be created as an element in a public space and used to questioned participant recognized associations and subsequent choices in respect of scalar and axial dimensions. Participant perceptual abilities and associated learning curve when confronted with control of an interactive environment was in focus for the research. Evaluations of user experience were based on triangulated qualitative methodologies, including interviews, questionnaires, and observations. Results from the analysis of use showed the power of the participants' increased ability to express themselves as well as problems according to the experience of stillness. Furthermore the results indicated associations with minimal learning curve.

Keywords
Responsive environments; non-formal learning; interactive experience; learning experience and outcome; action and stillness cycles; creative expression.

1. Introduction

New technology has gained increasing importance within different sectors of the society, including that of people with different forms of disabilities. Individuals with disabilities enjoy interaction as much as the next person. Designing responsive environments for learning implies interactive experiences, which concern active participation in activities (meaning making), leading to knowledge or skill (Rogoff, 1990). These experiences of meaning making and interaction encourage engagement in the activity out of interest and curiosity (intrinsic) rather than an activity introduced by someone else (extrinsic). In this sense, design is a way to configure learning resources and interaction (Kress & van Leeuwen, 2001).

In this paper, designing for learning is to emphasise action- and stillness cycles as intertwined aspects of *non-formal learning* processes. In doing so, we have transcended beyond mere *use* of the responsive environment towards *exploration* and *transformation*, which means that we consider every *action and stillness cycle* as new creations. Bruner (1973) states that patterns of action that emerge through exercise become constituents for new patterns of action directed at more complex tasks. Exploration goes along with play, but is not the same as play. Bruner (1972) describes how play involving manipulation of tools, requires a degree of competence, which is achieved through a learning process starting with exploration of the characteristics of the tools. The absence of negative consequences encourages the exploration, which in turn, can result in the development of unemployed skill (Beach, 1942). By this, the focus is on both the attributes of the responsive environment and the learning process/outcome (Petersson, 2006). This offers a new approach to learning and rehabilitation by emphasising user's creation of meaning and production of expressions.

Our approach does not take any aspect of the learning process and outcome for granted neither being coerced, but rather strategised into play and creative activities that are inherent to e.g. games and art making (Bloom, 1968; Krentz, 1998). By this, play and creativity at the user level conceal the embedded learning and training available from the designed interactions with the feedback media. In this sense, learning is at a 'subliminal' level for the user as he or she is engaged in the responsive environment. Thus, motivation is suggested as optimised through action and stillness cycles where the user iteratively is exploring and transforming the feedback media. This process contains choices and decisions that indicate learning, e.g. in the form of increased repertoire of expressions, changes of skills, new patterns of social interaction.

Previous research (Brooks et al., 2002) has shown how certain individuals prefer to explore, play and create without any others being present. The chain of exploration-play-creation began with a curiosity that evolved out of the privacy and initial stillness that was first encountered within the interactive space. Thereby, stillness became part of the action and vice versa. Furthermore, Brooks and Petersson (2005a; 2005b) state that interactive play, which offer choices between interaction and rest in a silent space, create a sense of control. In other words, the responsive environment should not be configured to generate multimedia without participant intervention.

The action and stillness cycles, which consist of iterative loops of exploring and transforming, constitute one part of a theoretical map for the purposes of analysing critical incidents in a non-formal learning process. These cycles are related to the user's *learning experience*. The other part of the theoretical map concerns design issues in the form of use qualities relative to the user's *interactive experience*; transparency, social-action space, user control/autonomy, pliability, playability and seductivity. The Figure 1 illustrates the map of learning and design aspects involved in the evaluation of the use of responsive environments.

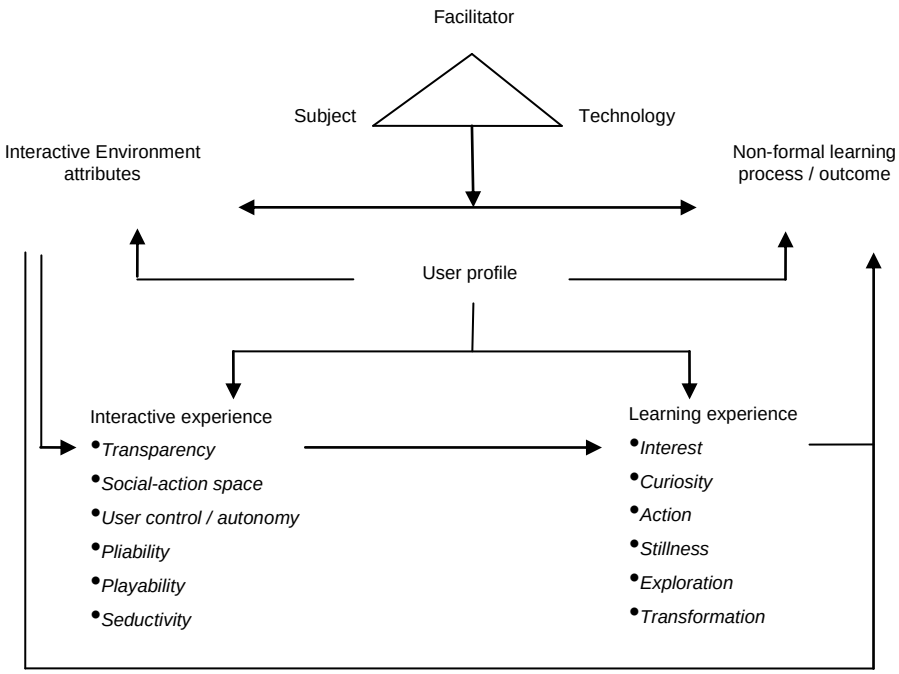

Figure 1: Model of non-formal learning attributes within a interactive environment ©

During the whole cycle of action and stillness, *facilitators* make interventions and have the possibility to reflect upon the indications of learning that occur during the process. The *user profile influences* the facilitator's decisions on how to set up the attributes of the responsive environments

relative to the desired learning process and the expected outcome of that process. Once these prerequisites are set, the user is expected to experience as a result of the interaction as well as from the learning.

Hence, the aim of this paper is to investigate the user's performance in using responsive environments designed so as to experience learning through action and stillness cycles. A sub-question concerns the ability of perception and the associated learning curve of the attendees with cognitive disabilities to be able to easily correlate across dimensions of scale and plane – a matter which influences the participant's interactive as well as learning experience.

2. The design of the interactive installation

In April 2007 a week of performances, installations and workshops under the theme 'Music, Technology and Disability' took place in Casa da Música (figure 2), Oporto, Portugal. Six research workshops (interactive installations) were hosted.

Photo with permission Casa da Musica, Oporto, Portugal

Figure 2: Casa Da Musica, Oporto, Portugal, venue of the ArtAbilitation workshops

The workshops were created in a room 238 square meters floor area and approximately 20 meters high.

In order to address the research questions *stillness attributes* (nul content areas) were designed in a *public space* and a *private space* within a responsive environment.

The stillness attributes within the public space were designed by assigning digitally reproduced musical tones to unencumbered movement data sourced via a camera-based interface. Drawn active data zones representing floor areas were presented to the user groups on a vertical large screen. Outside of these zones was stillness, i.e. no sounds. A second large screen gave a visual manipulated feedback based upon the interaction within the active floor area. Portuguese national football team stars images were also used as an element of the installation. The programming of the image located it behind a solid colour masking that was uncovered through participant movement (walking, crawling or rolling) in the public space. Other strategies with abstract imaging were also used including an interactive body painting algorithm (Brooks and Hasselblad, 2004; Camurri et al., 2003).

In a private space a participant experienced stillness with no sound and a muted projected image that evoked attention and exploration. A participant positioned between the camera and screen abstractly affected the feedback loop (appendix). Upon the participant exiting the private space

again returned to stillness.

Figure 3 illustrates the location ’Sala de Ensaio 1’.

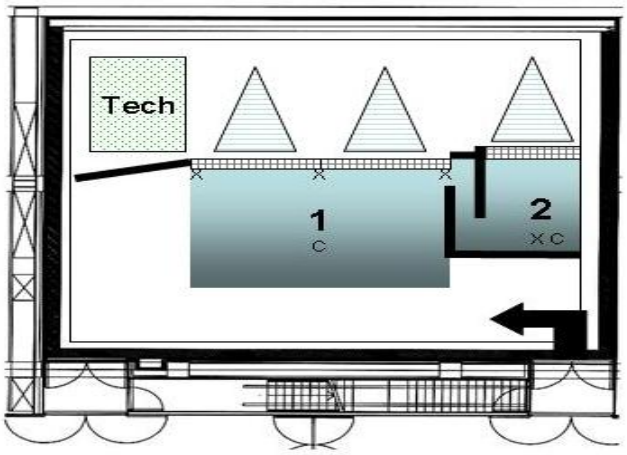

Figure 3: Sala de Ensaio 1 in Casa da Música, Oporto, Portugal

Area 1 in figure 3 designates what was referred to as the public space floor area. 3 microphones were installed at approximately 1.8m from the floor on the screens (marked as X in the figure). An infrared surveillance camera was set up central to the floor area (marked as C in the figure) so as to track the participants from above.

The private space (area 2) had a large back projection screen with a microphone (X) set up at around 1 meter high on a ‘magic arm’ that permitted immediate repositioning according to participant preference. This microphone was routed to the Max/MSP graphical programming environment. The algorithm generated an echoing sound effect that related to the image effect confronted by the participant. The algorithm also changed the screen backlighting sequentially between the primary colours of red, blue and green according to utterance amplitude. A video camera was set up adjacent to the microphone pointing at the screen so as to establish a video feedback loop (C). The technique of creating a video feedback loop is illustrated in figure 4. The interaction opportunity occurs for the participant in video feedback when a body interferes between the camera and the screen (figure 4).

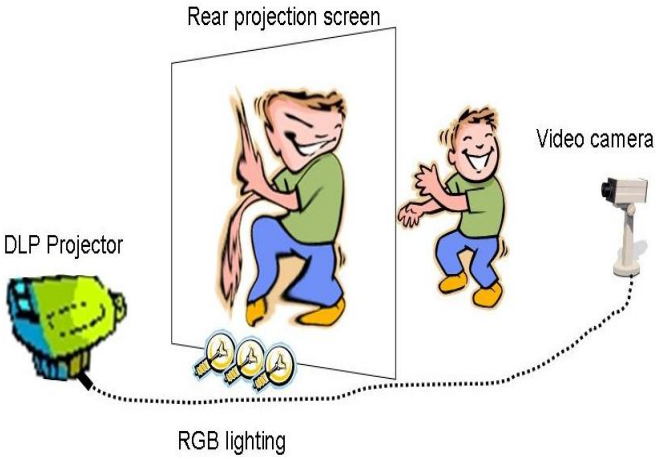

Figure 4: Video feedback loop is where a video camera ‘sees’ or receives the same image as it is transmitting – in other words the camera output is routed directly into a projector that presents the same image to the camera as it is outputting. Defocusing, zoom and camera angle are used in combination. RGB lighting is controlled from voice utterance

3. Method

A total of 91 attendees participated in the interactive installations; including 61 from special care institutes and 30 in music teacher higher education. The 61 from special care institutes consisted of 39 participants with profound disability and 25 special teachers/carers. Age range of the people with disabilities was from 10-37 years-of age. The music students were between 21-35 years-of-age. The range of disabilities covered a wide spectrum including: Autism, Down syndrome, Angelman's syndrome, Cerebral palsy, Microcefaly, and other developmental disabilities.

3.1. Procedure

The study was explorative and conducted during six different workshops with an average of 15 participants per workshop. The duration of the respective workshop was one hour. The nature of the workshop was such that the participants were free to act or interact – alone, together with staff/family members or peers – for as long as they wanted up to an hour within the responsive environment. Data from the performance was collected through video recording and manually through observations by two researchers.

After the session the participants were asked to fill out a questionnaire with questions regarding the psychosocial impact of the interactive experience including a user profiling part so as to be able to have knowledge of the user's daily living (home or institution) and diagnosis. It was also noted if the participant was filling out the questionnaire or required any help. Finally, three participants within each workshop were interviewed (totally 18 participants) about his or her experience (if the participant had no speech he or she was interviewed together with the facilitator/family member). By this, we targeted a triangulation of the data collection. A designated professional translator assisted and ethical issues were covered through signed permissions by users or those responsible for them.

4. Preliminary observations from the study

Although the study has not been completed, a number of interesting observations have been made and can be reported at this stage. In the public space it was observed that in respect of both scalar and axial dimensional and user's perception correlation most of the participants were at ease with associating the 8m x 4m horizontal floor area to the 4m x 4m vertical screen. The stillness interface with seven boxes representing the sonic hotspots was facilitating playful interactions evident throughout each session.

4.1. The power of being able to

The participant's possibility to experience a sense of control and autonomy within the responsive environment was an important aspect that was emphasised by the participants as well as by the facilitators. For example, the 'ability to freely express' was highly emphasised in the questionnaires. Furthermore, some of the participants asked to be taken out of their wheelchairs and positioned on the floor where they reported an experience of "a passionate sense of freedom and autonomy". Progressively, the participants became aware of the empowerment of the control, either through digital techniques as in the public space or through analogue means as in the private space with video feedback. A high degree of concentration was observed, which also was supported by the results of the questionnaires where the experience factor 'concentration' was stated as being increased by all the participants.

Another interesting factor that was observed was the speed of association and comfort with the graphical interface overlay in the public space. The various graphic animations all engaged the participants equally and the recognition of the animations being made with surprising little information. It was in this session that two female participants with profound physical disability and

no verbal competence, on different occasions, requested their helper the opportunity to interact without their wheelchair and they proceeded to roll around on the floor to ‘unmask’ the image (see figure 5).

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Figure 5 (a – left) A single usually wheelchair bound female participant was tracked (see upper left cross-hairs) rolling around the floor uncovering the image mask hiding an image of the soccer star Fig. 5 (b – right) The right screen shows the body painting algorithm result as multiple participants interact between themselves and the feedback. The left screen illustrates the seven active zones (rectangles) that are a visual vertical reference to be associated to the horizontal active locations that are mapped to sound (and secondary image change) and the surrounding stillness zone.

The simplicity and flexibility of the system supported the participants’ exploration and they developed a fine-grained control of the situation. This resulted in personal achievements, which is a rare commodity for these participants. The overall meaning of being ‘able to participate’ was stated with an increased value by all the participants and the carers.

The participants consciously used the stillness attributes of the responsive environment, especially in the private space, where it was observed how the ability to choose between action and stillness facilitated the sense of being in control. Related to this, the participants’ experiences of being able to explore and their eagerness to try new things were highly emphasised in the questionnaires.

The direct and immediate feedback from the system, which created action-to-stillness-loops, enhanced the sense of ‘being able to’, which was shown through the questionnaires where the experience factors of ‘curiosity’ and ‘capacity’ were all stated as being increased. One of the

facilitators expressed the significance of the participants' increased capacity as follows:

"It made me feel really small compared to their abilities, wondering what was going on inside their heads as I could see they were really enjoying that space of their own … difficult to put into words…makes you think about the whole world and the way our society is organised".

The participants showed engagement in every workshop through an observed concentration and consciousness of intent, which was especially notable in the private space. The results from the questionnaires stated that the experience factors of 'enjoyment' and 'engagement' was marked as highly increased by all participants. The translator, who took part in all the workshops, stated that:

"The feeling was the same – freedom and fun. Some of them were really tired but that did not stop them from exploring the space with the same enthusiasm."

All in all, these results points towards the participants' awareness and enjoyment of the situation.

One of the facilitators stated that people with disabilities generally cannot explore and enjoy installations or exhibitions like this as much as others do:

"It was amazing to see them on the floor, trying so hard to move and accomplishing. It is very good because we do get the idea that this installation and what they are exploring elevates their self-esteem. Very beautiful!"

The private space was reported as being good for participants as it enhanced concentration and they became less tensed, and more relaxed and concentrated.

4.2. The problem of experiencing stillness in the public space

An important finding from the study thus far has been the difficulty the participants had to identify the stillness attributes in the public space. One of the facilitators expressed this problem as follows:

"But there were too many people in the room and the general idea was that it was a bit complicated because some were playing and there was little time to everyone to explore the space and its potentials."

By this, the social action that supposedly was inherent in the environment instead was experienced as confusing by several of the participants, especially those with the diagnosis downs syndrome and autism. For example, a male participant with downs syndrome entered the public space and walked back and forth crossing the active and the stillness zones. From start he was not aware of the visual feedback on the big screens. He was more aware of the sounds and his body in the space as he was exploring and enjoying the changes from action to stillness. He noticed that when he stepped out of the active area the sound stopped. He paused for a while in the stillness space and after that he walked back into the active space where the sound started again. Later on he came back to these zones and repeated his previous actions; he walked back and forth through the active and stillness zones and stopped so as to notice the changes between action and stillness. But, at that time a lot of participants were actively exploring the space as well and, consequently, when he stopped different sounds came from all over the public space. The moment of the participant's curiosity, special awareness and perception disappeared and the participant did not continue to explore these features. This fact could be one of the reasons to why some of the participants experienced the responsive environment as not so private and neither not so self-guided.

Accordingly, the action-stillness cycles were positively explored and experienced by the

participants within the private space. It was also observed that when other participants entered the space the sole 'performer' in the majority of cases continued. Caregivers were also instrumental in introducing and encouraging the participants to perform. On occasions interaction of image and sound were achieved. Once the microphones were located and they heard that their utterances were amplified they became more active and laughing, sometimes even making sound screams for effect. The assumption is that in the private space, the directness of the feedback in the form of sounds (echoes of the participant's own voice) and visuals was much more transparent through the privacy (one-to-one scenario). This situation could be one of the reasons to why some of the participants experienced well-being and a decreased frustration.

Appendix 1, 2 and 3 show sequential images from one participant who became deeply engaged in the private space interactions with the video feedback.

5. Conclusion

The exploratory study highlighted adequacies and inadequacies of the learning from action and stillness cycles. The results gained from the research articulated that in order to achieve adequate learning, all system attributes need to be in harmony so as to correctly address the participant where the challenge presented matches the ability of the participant. The public space illustrated an inadequate action space, whereas the private space emerged to be more flexible for the participant.

Findings were that the responsive environment contributed to curiosity and highly involved processes of explorations where the loop between perception and action was quick and physical. Through the action-stillness-cycles the participants experienced and played with the sensation offered by the interactive attributes. Initially the exploration was not goal-directed but developed into play. This exploration-to-play process facilitated the discovery of interesting and surprising content. The interface was flexible enough to facilitate the participants' unanticipated desires.

The masked images (e.g. the Portuguese national football team stars) that was uncovered by the participants' different movements clearly showed that the elements of surprise and control were inter-related. Thus, by uncovering the masked image via the participant's control evoked his or her interest and motivation. The action-stillness-cycles inherent in e.g. uncovering the images, created a process of enticement by attracting the participant's attention, the ability to make progress and experiencing fulfilment by ending the experience in a positive way. In this way, the quality of seductivity (Lövgren & Stolterman, 2004) extended the understanding of the system's playability; offering surprise and the creation of emotional responses through the visual and auditive interactional qualities – the interactional beauty.

It was important to note that the participant's actions were not merely ancillary, but central features of the learning. The movements and gestures had a communicative and narrative function as well, connecting the gestures to the feedback (visuals and sounds). Thereby, the action and stillness cycles were main, rather than subordinate, status in the interactive experience and as such crucial ingredients in the learning activity. All in all, the learning was indicated especially in the form of increased repertoires of the participants' expressions.

Conscious use of stillness attributes in the design of the responsive environments enhanced the experience contributing to the interactional beauty (seductivity and playability). The balance between challenge and skills targeting aesthetic resonance supported fun experiences through which the user extends his or her actions to new limits of achieved skills. This can be equated to open-ended play and how experience develops into play (Bruner, 1973).

Both symmetry and asymmetry were witnessed as important factors in the interaction between the

user and the facilitator as it created a foundation for the facilitator's adjustments of the balance between challenges and skills.

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Biographical Notes

Dr. Eva Petersson is an assistant professor; coordinating/managing the Medialogy Bachelor and Master Education Program (see http://www.aaue.dk/medialogy/uk/index.php); and vice chancellor at Aalborg University Esbjerg in Denmark. She is member of the research group SensoramaLab (see http://sensoramalab.aaue.dk). She has a background in Education Science and her PhD is focused on ludic engagement (playfulness as a foundation for engagement) within virtual environments and the potentials in associated non-formal learning (see http://dspace.mah.se:8080/dspace/handle/2043/2963). Petersson has been coordinating research projects in inclusive and participatory design, storytelling, and creativity and learning processes through the use of new technology in education and rehabilitation contexts. She has been leading projects on physical and virtual toys, the design of toys for children with disabilities, and the use of computer games (interactive environments) in educational and rehabilitation contexts involving flexible methods of delivery for local, national and international users. Petersson is member of the International Toy Research Association (ITRA) and the Toys for Tomorrow Forum. Furthermore, she is a board member of the Pan-European Game Information (PEGI) and expert member of the Interactive Software Federation of Europe (ISFE). She was one of the founders of International Toy Research Conference recently organised by the International Toy Research Association (ITRA).

Associate Professor Tony Brooks has a background in performance art, and was born into a family with disability. He has advocated the use of digital technologies in intervention for people with a disability and founded Handi-MIDI in 1987 which later became SoundScapes non profit organisation. He is on the management team of the Medialogy education and is director of the SensoramaLab at Aalborg University where he leads a team of post-doc assistant professors. He was awarded the European Eureka prize for SoundScapes in 1999 and the Danish research prize in 2006. There are approximately 50 publications associated to the concept including achieved international degrees citing the work. As founded of SoundScapes he has realised the annual ArtAbilitation international conference and undertakes international workshops where he is invited to work with local artists and research students. SoundScapes has been featured at for example, the cultural Olympic/Paralympic events 1996 and 2000; the European Culture Capital of Europe 1996 and 2000; the Danish NeWave, New York 1999; the UNI/NGO World Summit 1995; and has been a featured exhibitor at leading Museums for Modern Art. SoundScapes has been responsible for published patents and national and international research funding.

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Appendix 1. Video feedback in the ArtAbilitation® workshop private space.

Photo Credits Augusto Brázio with permission Casa da Musica, Oporto, Portugal

Appendix 2. Video feedback in the ArtAbilitation® workshop private space.

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Appendix 3. Video feedback in the ArtAbilitation® workshop private space.
This series of images illustrate the intense engagement with the visual feedback loop from the workshop private space. Upon entering the space the participant encounters no sound and no change in the visuals. The options are to use the microphone to change colour of the RGB lighting behind the screen; to play with the camera hardware to create various effects, e.g. focus, zoom and direction; to manipulate the feedback via movement immediately in front of the camera lens or closer to the screen (as in this figure). The video feedback loop creates a phenomenon of image change relative to change of body position.