Reflecting on Co-creating a Smart Learning Ecosystem for Adolescents with Congenital Brain Damage

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Abstract. Special needs education is focusing on a complex interplay of cognitive (knowledge), physical (motor rehabilitation), and social (interaction) learning. There is a strong discrepancy between the institutional spaces in which learning takes place and the need for scaffolding these levels of learning. In this paper, we present a first part of an ongoing collaboration with a special needs education facility for adolescents with congenital and acquired brain damage, that is interested in exploring the transformation of the institutional space into a smart learning ecosystem. We exemplify our research approach with a case study of a corridor in the institution that serves as a testbed for the involvement of all parties, i.e. residents, staff, management, in this transformation process.

Keywords: Smart learning ecosystem · Social practice · Co-creation · Brain damage

1 Introduction

One crucial aspect of smart learning ecosystems (SLEs) is their perspective change in terms of where education or learning takes place. The concept of SLEs allows for rethinking traditional learning institutions tasks, creating room for informal and experiential learning and by doing so changing/modifying/adapting traditional learning approaches as well as the actual layout and design for the built environment. While this can be beneficial for all learners, we claim that it will be especially beneficial for learners that are challenged by the traditional educational system.

In this paper, we present a case study that investigates potentials for out-of-class learning for adolescents with congenital brain damage[1]. This study was done in the context of a long-term collaboration with a residency and rehabilitation center for adolescents (age 16–20) with moderate to serious brain injuries, both acquired and congenital. During their stay, adolescents participate in a three- to four-year educational program that is tailored to individual challenges and abilities and aims at improving

[1] The term *congenital brain injury* bundles various 'disorders' bound to a damage to the brain before, while of briefly after birth (Clemmensen-Madsen 2004).

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cognitive, physical and social abilities. Thus, any attempt at transforming the institutional space into a smart learning ecosystem must tailor to at least one of these objectives, i.e. either contribute to cognitive development (e.g. conveying knowledge or reasoning skills), physical development (e.g. training motoric skills like moving an arm), or social skills (e.g. scaffolding social interaction or collaborative tasks).

In the center, each resident has its own apartment and is supported by an interdisciplinary team (therapists, pedagogues, social and health care workers). In discussions with staff and management a specific part of the building, a corridor, emerged as a space that seems to serve as an informal meeting place but does not encourage any interaction between residents. The decision to investigate this corridor also decided the potential group of users as the corridor is in the section for adolescents with congenital brain damage. All but one of the adolescents we observed were using a wheel chair, some of them could use it alone while others needed assistance. Some of the adolescents can talk, others use sounds, gestures, communication books or technologies steered with their hands or eyes for communication.

2 Related Work

We have argued above that SLEs might be especially beneficial for challenged learners and the realization of SLEs in traditional learning institutions might benefit this group. Schreiber-Barsch (2017) analyzes the role of space in relation to lifelong learning on the background of the UN Convention on the Rights of Persons with Disabilities and highlights the importance of the built environment for in- or excluding citizens from learning opportunities. This is also evident within disability studies that discuss the physical design of space as a crucial aspect of excluding, marginalizing and oppressing people with disabilities (Titchkosky 2011; Freund 2010; Imrie and Kumar 1998; Kitchin 1998; Hahn 1986). A prominent example for this organization is the segregation of people with disabilities to certain locations like schools or centers often outside or at the margins of the urban environment (which is also true for our collaboration partner).

Most studies touching on aspects of smart learning environments are though concerned with school or university class rooms, presumably due to intimate knowledge of the involved researchers with this context. The study presented by Jayasainan and Rekhraj (2015) reports on the potentials of scaffolding social engagement, informal learning, dialogue, and group work. The main advantage is seen in enabling learners to become stakeholders in their own learning process and thus assuming responsibility for their learning success. Of course, changing the space, itself is not automatically creating collaboration between learners, but it creates a place that encourages and supports a change in learning/pedagogical strategies (Divaharan et al. 2017). Divaharan and colleagues make it clear that such a change must be supported by the people engaged in the social practice of learning at the institution, i.e. teachers, learners and management alike.

Grigsby (2015) as well as Bilandzic and Foth (2014) analyze how a different traditional learning institution, i.e. the library, can change to become a smart learning environment as a hub of social learning and collaborative exploration of knowledge by

embracing current technological trends, re-thinking the role of libraries, and re-designing the built environment of the library to cater to this development. On a more fundamental level shows Brooks (2011) the positive effect of technology-enhanced learning environments on learning outcome, highlighting the importance of the technical layer of smart learning environments.

In respect to the further transformation of the institution into a smart learning environment, Benze and Walter (2017) argue that involving citizens (in their case children and young people) into the planning activities of a given urban space will not only further learning about this space but has the chance to understand and take part in the intricate network of stakeholders involved in negotiating the future development of a space. This opens an interesting avenue of exploration for the overall process of transforming the whole institution into a smart learning environment. This also opens the question on who is going to conceptualize the space and its possibilities. Jornet and Jahreie (2013) describe that research usually focuses on analyzing user experience post-factum, i.e. when the design process has already resulted in a product. Instead they argue that it is worth looking at how the conceptualization of the space is negotiated in the design process, and by whom. With the example from designing a hybrid learning space for a museum, they show how the use of prototypes can become powerful tools for discussing the potentials of the space. Although they embrace the idea of analyzing the design process, they do not consider user involvement in this process.

As a side note, we are well aware of the discussion about the difference between space and place (e.g. Dourish 2006; Knox and Fincher 2013) but refrain from getting into this discussion here. Our concern is mainly with transforming the space inside the institution to enable user to engage in meaningful (learning) interactions, which will turn this space into places for the individual users. But those subjective interpretations of the space are not our concern.

3 Research Approach

Our research approach is in line with the approach described in depth in Rehm et al. (2016) for the specific case of developing social robots for institutional care settings.[2] In principle, we are an interdisciplinary team that is driven by the idea of developing technology together with users and stakeholders. We are specifically not user-centered but aim a co-creation of technology. We like to stress this point, because we have the feeling that current reports on user-centered design are often only marginally involving users. Thus, we embrace the idea of co-creation instead, where we rely on our specific users throughout the whole process. Because we work in institutional settings this means we cannot engage with single individuals but have to engage with a network of persons with diverse perspectives, from residents and their relatives over care personnel to management. Our goal is to identify social practices where the introduction of technology could make sense in the specific case, e.g. by increasing independence of residents or by freeing up time of staff, allowing them to concentrate on their core

[2] See also http://si.ehci.dk for an overview of projects and project partners.

competences. To this end, we build on a mix of methods from social sciences, humanities, and engineering allowing for gaining on the one hand a deep insight into the social practices surrounding the life of the residents in the institution and on the other hand a similar insight into the institutional rationales that will play a crucial part when introducing new technologies. Based on these insights we can develop targeted technological interventions that are based on real challenges residents and staff face in their daily life.

4 Analyzing Practices of Corridor Use

As mentioned in the introduction, we decided to work with the main corridor in one of the buildings. Figure 1 is a schematic drawing of the corridor highlighting the length as well as the different functions of the rooms that are located in this corridor, ranging from apartments over offices to therapy rooms. Figure 2 shows some impressions from the corridor, the left image taken at the entrance (corresponding to the left-most point of the drawing in Fig. 1, the middle one taken at the other end just in front of the common room, and the right one depicting an area for social interaction. This corridor was described by management and staff as unappealing and unwelcoming. At the same time, they called it a market place or pedestrian zone, clarifying that the corridor is not only a zone of transit but also a place for social interaction (Lu et al. 2011).

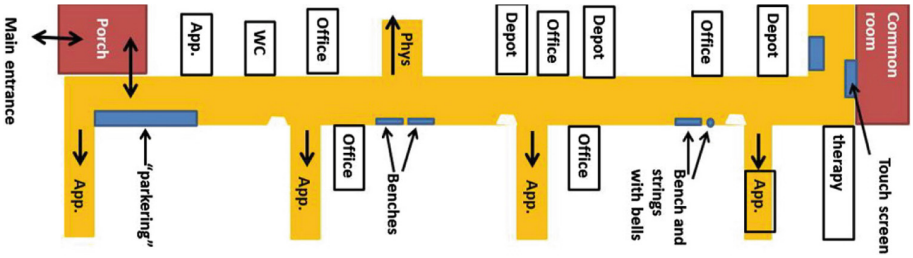

Fig. 1. Layout of the corridor

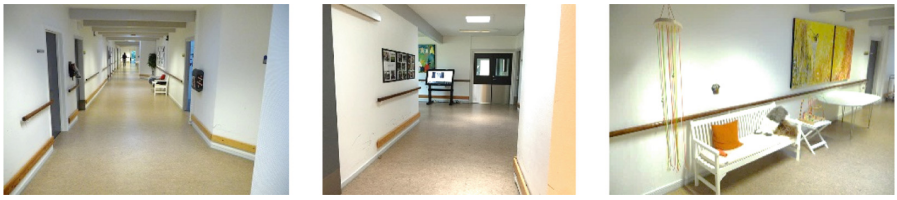

Fig. 2. Impressions from the corridor.

In order to get an insight into the use of the corridor we initiated a series of ethnographic observations to understand (i) the corridor, how it is used and what it affords, (ii) the users and their abilities as well as (iii) materials, activities and other actors on the corridor. Unlike traditional ethnography, our observations were clearly design-related, i.e. very focused with a clear goal, were done by several researchers, and had

to be reached in a limited period of time (e.g. Crabtree 2012; Miller 2000; Hughes et al. 1994). Hughes and colleagues (1994) identify four different ways of adapting traditional ethnography to the need of design processes especially that of time pressure, relatively small scale of research focus and the non-interventionist role of the ethnographer. In our approach, we focus on what they call "concurrent ethnography", where the ethnographic study is taking place at the same time as the design process. This includes a close cooperation between ethnographer and designer informing each other during the process of fieldwork, debriefing, system design and prototype interaction, accompanied by ethnographic fieldwork which are repeated several times. These circles are combined with workshops and meetings with the target users, e.g. staff and residents, which also feed back into the development process.

Over the time of two months, 10 days were spent collecting data, either through observations, through design workshops or through in-situ interviews. In all activities, residents and staff participated. On the one hand, this allowed us to capture different perspectives, on the other hand this is often necessary because staff has to serve as interpreters between researchers and residents.

The observations in the corridor revealed that the corridor is indeed not only used as a space for transition but represents a space that is used for social interaction between resident. Summarizing from the observations, three distinct roles could be established that residents assume frequently on the corridor.

1. Looking for social contact: Residents use the corridor to get in contact with other residents or staff and seem to have a strong social awareness of others. This sometimes results in a kind of hunt to find an employee that has time to engage in short social interactions. At the same time, it became obvious that many have difficulties to initiate and/or maintain social interactions, esp. with other residents (see also Petry et al. 2005; Whitehouse et al. 2001; McWilliam and Bailey 1995).
2. Engaging in focused activities: The corridor has already been equipped with some technology that can be used for free-time activities like an area where strings with bells hang from the ceiling for sensual stimulation or a touch screen, where residents can listen to music. Mostly, these activities were done alone, but we observed one occasion where two adolescents were using the screen together and another occasion where two adolescents were dancing together on the floor. In the latter examples, it remains unclear whether these activities were joint activities or done side by side. Were the persons using the touch screen together, or was one person just watching the other using it? The employees reported that the adolescents in general had difficulties in engaging and undertaking joint activities with each other, which confirms our general impression.
3. Being a ratified bystander: Whereas in the above two categories, residents actively engage in either social interaction or focused interaction with objects, we could also observe residents that were seeking the vicinity of others but clearly did not wish to actively participate in the ongoing activities. The adolescents in this case claim the status of a "ratified bystander" (Goffman 1981) and employees (and other residents) readily accept their hybrid participation status as being close enough to be part of the group but not taking actively part in the joint activity. The employees described

these adolescents as spectators and compared the corridor to a pedestrian street in which people observe others.

5 From Institutional Space to Smart Learning Ecosystem

The observations were complemented with five workshops with residents and staff members and additional in-situ interviews with both residents and staff members.

At the first workshop, we discussed our observations with staff members to understand their perspective on the adolescents' practices on the corridor and to elicit aspects that should be considered for the design of the technology. Staff members wrote their comments and ideas on post-its which we took up for further discussion. In a second workshop, we engaged in a mutual understanding process with the adolescents. We presented a 3D-model of the corridor to engage a discussion of their understanding of the corridor with the possibility to enact certain scenarios. The third and fourth workshop were directed to initiate a creative process of developing concrete ideas of possible interactive technologies in the corridor and where to place them. The final event of this part of the project was a common lunch meeting with residents, staff, and management, where we concluded from the observations and workshops and pitched some first design ideas to the whole group. This resulted in lively discussions about the potential venues of the project. Especially the pedagogues and teachers, which had not been part of the workshops in this first part of the project could instantly see the potential of transforming the corridor into an (informal) learning environment and opted strongly for the possibility of dynamically relating the content to the curriculum, stressing again the three levels of learning identified earlier.

1. The design must consider different participation roles in a focused activity, as e.g. the ability to become a passive bystander observing activities from a close distance and allowing multiple users to use a technology at one time.
2. The design must ensure to keep the marketplace atmosphere, that is the possibilities of seeing, meeting and approaching people and activities.
3. The design must open up to multimodal ways of communication offering various ways of interacting with the content.
4. The design should take the three levels of cognitive, physical, and social learning into account.
5. The design should be considered as one building block in a smart learning ecosystem that encompasses the whole institution.

Based on these considerations, we initiated the next iteration of this project, where we are currently concentrating on developing several prototype installations together with residents and staff that will allow for more focused discussions on the technical possibilities.

6 Future Work

In this paper, we presented the first step in our research on the role of space and place in institutional learning contexts, where we analyzed in depth the use of a space that is prominent in the life of the residents but is so far only used (and seen) as a non-place, a place of transition from one meaningful space in the institution to another. The workshops with the residents and staff revealed the potential for changing the meaning of this space and turning it into a place for (informal) learning.

The corridor is just one specific area in the building and one can easily imagine an interactive installation inside the corridor. But especially the last workshop opened up to the possibilities of turning the whole institution into a smart learning ecosystem, and thus raised more questions than it answered, e.g. What are the features in relation to this specific group of learners and teachers? Teaching at the institution is based on individual curricula depending on abilities of the resident. How can that be reflected in casual collaborative encounters outside the classroom? How can the classroom learning goals feed into the informal and experiential learning throughout the built environment of the institution? Are there any formal models for this relation/mapping? How has this built environment to change to enable the residents in their learning?

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