Smart Cities for Smart Children

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Abstract. This position paper presents the concept of smart cities for smart children before highlighting three concrete projects we are currently running in order to investigate different aspects of the underlying concept like social-relational interaction and situated and experiential learning.

1 Introduction

It is our conviction that the city itself can become the key element in creating smart learning environments that transcend traditional institutionalized learning by bringing learning back to where it originally belonged: everywhere. Our vision of smart cities for smart children (SC2) is to create a public space for learning experiences that transcend into all areas of the childrens life by the use of modern mobile technology while at the same time establishing traditional institutions (like schools, libraries, museums, etc.) as hubs for information gathering and collaborative interactions. Learning is thus not confined to a traditional institutional setting but the childrens living environment, i.e. the city itself, becomes an enchanted place allowing for discovering hidden knowledge in a playful manner, thus making lust to learn.

Smart cities, in our vision, become creative environments for realizing new ways of interacting with information (and with others), integrating real and virtual as well as social and emotional aspects. By putting learning back into the life of the children we aim at opening up alternative routes to successful learning. This will be beneficial for all children, but it is our conviction that it helps especially children that are challenged by more traditional learning approaches. From a theoretical point of view, our approach is rooted in Gardners account of multiple intelligences [2] that has been shown to be a successful metaphor for individualizing learning experiences.

It is also our conviction that enhancing the smart city to become an active learning environment will also provide large challenges if this should not produce only lighthouse projects and standalone prototypes but actually become part of how we teach and learn. Therefore, it is mandatory to work closely with the current stakeholders responsible for education, for instance municipalities and schools.

In the following, we shortly present two recent projects that investigate different aspects of our vision of Smart Cities for Smart Children, which are tight together by the common theme of bringing learning to life.

2 Collaboration and social-relational interaction: Monsters Eat Art

Collaborating in learning situations has been shown to be superior compared to individual study approaches, for instance according to Johnson and colleagues [5] students performed better in post-tests and according to Wood and colleagues [13] they acquired more knowledge facts when studying together with others. John-Steiner [4] argues that social interaction during the learning process is a key ingredient for the cognitive development of the learner. McInerney and Van Etten [10] additionally collect evidence for a positive impact on the motivation of the learner. Based on such findings, Maldonado and colleagues [9] suggest that computer-based learning should (and could) be designed to afford such social contexts. The theoretical basis for this approach is situated learning theory, which poses that learning is a function of the activity, context, and culture it takes place in. According to Lave and Wenger [8], social interaction is the critical feature for this function and they describe learning as a process where the learner becomes involved in a community of practice, representing beliefs and behaviors, the learner has to acquire. Situated learning theory descended from Vygotsky's social development theory, where he claims that social interaction plays a fundamental role in the development of cognition [12].

The project *Monsters eat Art* realizes an exploration game that is supported by a virtual tour guide in the form of a monster and situated in a museum context for now. As the application is targeting younger children between 6-10, the playful back story for the guide is that it has eaten some of the artworks and – as we all know – "you become what you eat". This is taken literally here, where the monster's body is textured by the artworks it has eaten and the task is now to find these artworks.

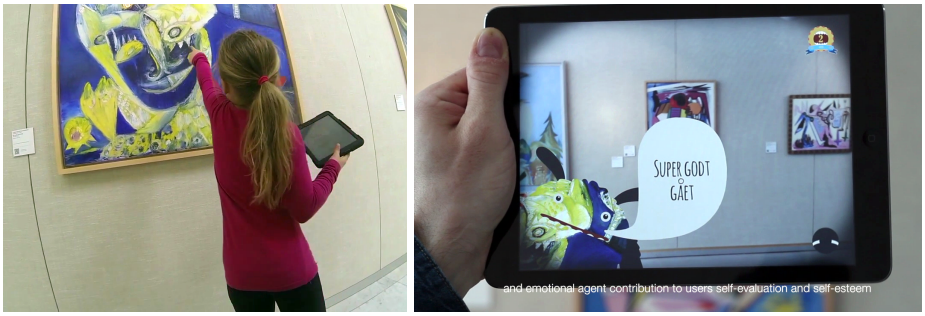

Fig. 1. Children interacting with the artworks at the museum

Social-relational interactions and collaboration are targeted on two different levels with the monsters project. (i) Between user(s) and monster: It has been shown that the integration of an embodied conversational agent that exhibits and

supports social relational behavior triggers more user engagement and a higher satisfaction with the interaction (see [1] for an example and [7] for a theoretical account). (ii) Between users: The application is specifically targeted at groups of users from two different contexts, families and school children. In both contexts, between 2 and 4 users are working as a group during the exploration game and exhibit varying degrees of social-relational interactions.

Results from a month long field study (see Figure 1) comparing the traditional paper based exploration game (treasure hunt) with the monsters application, show that the integration of the character moves interactions from a purely task-oriented perspective (getting it done) to interactions between users and increases actual time spent with the artworks. Additionally, there is a significant increase in retention of details from the artworks.

3 Experiential learning: Geometry City

The general idea behind experiential learning goes back to Kolb [6]. In this paradigm, learning has to take place in specific situations which provide rich contextual clues. Earlier, we have shown how this paradigm can be utilized in a virtual learning environment for increasing knowledge and skills about culture-specific gestures [11]. Transferred to a smart city learning scenario, we have to integrate the city scape in the learning experience, making it an integral part of the learning.

With the Geometry City project, we followed this idea. In collaboration with a local school, the curriculum for teaching geometry was extended by an experiential component that took the children (3rd grade) out of the classroom and into the city where they got acquainted with a range of geometrical concepts making use of buildings in the city. To this end a mobile application was created that triggered specific learning content including some mini games depending on the children's location in the city. Content and games were created following van Hiele's didactic approach [3] and in close collaboration with the local math teacher.

Fig. 2. Children playing the game after unlocking it at the location

Results from the two month field study show that children improved significantly in their ability of answering geometry related questions from a standard-

ized test and advanced from level 1 to 2 in van Hiele's categorization. It was also apparent that binding the experience back to the classroom was essential to maintain the childrens' interest. To facilitate this, the application was available after the actual experience for continuous interactions during math classes.

This is in line with our conviction that to make a difference, Smart City Learning has to be tightly integrated into a larger learning context (be it a museum, be it the traditional classroom) to discuss, debrief and deepen the learning experience.

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