Establishing a Strength-based Technology-enhanced Learning Environment with and for Children with Autism

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Abstract: In this paper, we present four principles and technology solutions for establishing a technology-enhanced learning environment with and for children with autism. We conduct the study as action research that is premised on children’s active role as actors and developers, support and empowerment of children’s strengths and creativity, and the transformability of technology solutions to everyday life. A strength-based learning environment consists of symbol matching, LEGO building, storytelling, and Kinect playing. We expect that the strength-based approach and technology solutions will engage children as creative actors, which is key to opening new possibilities for their education and everyday life.

Introduction

The purpose of this paper is to introduce four principles and technical solutions for the establishment of a technology-enhanced learning environment in the Children with Autism as Creative Actors in a Strength-based Technology-enhanced Learning Environment (CASCATE) project in 2011-2014. CASCATE is an interdisciplinary research project that aims at the investigation of the action (mainly attention, communication, interaction, and creativity) of children with autism in a strength-based multiple-technology learning environment. The project is funded by the Academy of Finland and carried out at the University of Eastern Finland by the School of Educational Sciences and Psychology, Special Education, in collaboration with the School of Computing. The project was launched due to a lack of research on children with autism in a multiple-technology learning environment that highlights children’s creativity and strengths.

We base the development of the environment on four main principles. The first principle is children’s creativity and active roles as actors and developers in the technology-enhanced learning environment (Kärnä et al. 2010). Children’s active role will be implemented by letting the children show through their action with technology what their strengths and potential talents might be. In addition, we modify technologies dynamically during the study in order to guarantee children’s creative action. Thus, the participating children will have an untraditional and unique role in the study; they will appear as innovative and active research partners (Druin 2002; Marti & Bannon 2009; Olkin 2004) rather than as the objects of inquiry.

The second principle for the development of the learning environment is a comprehensive support and empowerment of children’s strengths. As the majority of the research on technology and children with autism is problem based, we investigate the action of the children from an untraditional perspective. Support for the emergence of children’s strengths is based on multimodal interaction, the utilization of different senses, and the modifiability of the technical solutions.

The third principle is the modifiability of technology so that it will enable children’s creative action in the learning environment. In many technical solutions for children with autism, the children’s action is limited and pre-determined. In our learning environment, a high emphasis is put on the modifiability of the technology that will be an ongoing process during the project.

A fourth important starting point for the establishment of the environment is the transformability of the solutions to everyday life contexts. Often new technologies are too expensive and too hard to use to be efficient in everyday life contexts. Thus, many children with autism spectrum disorder do not have access to technical solutions that could considerably facilitate their learning. The goal of the project is to develop technical solutions that are easily transformable into children’s everyday contexts (e.g., kindergarten, school).
Background

The recent research on interventions to support children with autism focuses on technology solutions that address the core characteristics of autism, such as social skills (e.g., communication and interaction) and daily life skills (e.g., psycho-social skills). Technology solutions have been implemented, particularly as single technology solutions in learning environments, including robotics, blocks, games, virtual realities and virtual learning environments, and mobile devices.

Research on robots as rehabilitative, therapeutic, and educational tools has highlighted support for children’s social interaction (Feil-Seifer & Mataric 2008), communication (Robins et al. 2009), and imitation (Fujimoto et al. 2010). As for robotic construction kits, they have emerged in collaborations between children with autism in after-school activities (Wainer et al. 2010). Other kinds of tangibles, such as interactive blocks (Brok & Barakova 2010), have been studied in play contexts. As a result, researchers have found indications of turn taking, imitation, and cooperative play among children with autism (Brok & Barakova 2010; Farr et al. 2010). Positive progress in children’s interaction has also been found by using ordinary LEGO building blocks (Legoff & Sherman 2006).

Social skills have also been highlighted regarding virtual realities and virtual learning environments that indicate support for the learning of social roles (Passerino & Santarosa 2008) and empathy (Cheng et al. 2010). Virtual reality games have also encouraged children to engage in physical exercise (Finkelstein et al. 2010). Computer games have been used in the context of stories and narratives to promote social communication (Gal et al. 2009), and video games with modified controllers can give support to the overall characteristics of autism (Gotsis et al. 2010). Other mobile devices have been used to support daily life skills. Support for daily life has been implemented, for instance, in the form of visual support on mobile devices, displays, and recordings that facilitate structuring daily schedules, but also learning and the production of language (Hayes et al. 2010).

Regardless of the positive results of these technology-supported interventions, recent research indicates that the development of strength-based methods and technologies for children with autism is actual (e.g., Yianni-Coudurier et al. 2008), as many of the current solutions are problem-based (e.g., Goodwin 2008; Passerino & Santarosa 2008).

Participants and Research Activities

The CASCATE project runs group sessions in a technology-enhanced learning environment for four children with autism in one comprehensive school. Two of the children are boys (7 and 11 years old) and two girls (7 and 12 years old). All have limited verbal language skills. One child doesn’t use verbal language at all, and three children use a few words for communicative purposes. The children need augmentative and alternative communication methods, especially picture symbols and sign language, in various situations. In addition, the children have multiple strengths, such as good auditory or visual senses, and a variety of ICT skills.

Group sessions are called action group. The children attend group sessions weekly, approximately nine times each semester (one hour/session). A technology-enhanced learning environment for the sessions is set up in a lunchroom, since it is the biggest available continuous space in the school building. The environment is planned to be easy to set up and easy to remove. There are four workstations in the environment, and each child works at every station for about 10 minutes. The children are given a picture map from which they see the order of how to move on during the session. At each workstation, the children can choose from a variety of tasks or games they want to work with. The children are encouraged to work actively and adults are there to help if needed (e.g., setting a difficulty level).

The children give constant feedback on the technologies and the working model. At this point, there are cards for feedback at each workstation, with both pictures and words, and the children choose a card to describe whether they liked the workstation a lot, liked the workstation a little, or didn’t like the workstation at all. Drawn facial expressions (very happy face – neutral face – sad face) are linked with the words on the feedback cards in order to support the children to understand the scale. At the end of each session, the children choose the most pleasant workstation by pointing to a picture symbol on the session map. Though this is a familiar way for the children to give feedback in various situations, it is crucial to develop multiple ways in which children can give feedback and thereby truly participate in the modification and development of the technologies.

At this phase of the project, we emphasize building the technology-enhanced learning environment with children with autism according to the children’s feedback. The role of the research is about to grow during the project, since it is an important way to get more specific information on children’s actions (e.g., attention and interaction) in the environment. The study uses qualitative action research as a research method. We collect the main
research data by videotaping each child’s action at every workstation during the sessions, and by technology applications that identify and record each child’s actions with the technologies (e.g., selections and time used for selections). We can collect additional data by observation, by interviewing teachers and assistants, and by using an eye gaze camera.

Technology Solutions for the Learning Environment

We have determined four domains that we aim to foster by establishing a technology-enhanced learning environment with four different technology-based workstations with and for children with autism. The domains, presented in Table 1, are 1) children’s active role and creativity, 2) children’s strengths, 3) modifiability of technology that enables children’s role as developers, and 4) transformability of technology in the school context.

At the symbol matching workstation, the children have a task of matching a symbol and a sound (e.g., the symbol of the cat and the sound of cat: “miaou”) from the computer application to the corresponding symbol on one of six tiles. The children choose the topic for the tasks and change the symbols according to the selection on the tiles by themselves. During the task, the children perform the selection by pressing the tile onto the floor with a hand or foot. Symbol matching includes the themes of animals, emotions, shapes, vehicles, and counting.

At the LEGO building workstation, the children make a LEGO® Duplo construction from the model on the computer application. The children choose a task from three alternatives, which are 1) building from the picture of the whole model, 2) step-by-step building of the model, or 3) a memory game that hides the model during the building of the model. The difficulty level can be changed by changing the number of blocks in the application.

At the storytelling workstation, the children create a story by using a picture-based computer application and a touch screen. Hand-drawn pictures with written one-word descriptions are categorized as people, creatures, places, and doings, and presented as visible main categories and subcategories. Children create stories by using drag-and-drop of the pictures to the timeline of the story. The stories are saved to the story library, where the children can share their stories with others. In the story library, the children can review and continue their own stories and review the stories created by the other children.

At the Kinect playing workstation, the children play two or three short adventure games from Microsoft’s Xbox Kinect. Children play games that they select themselves by using their whole body to control the game, for instance jumps, dodges, and use of hands. Games are flexible, allowing a variety of movements as long as the player stays within the play area.

<table>
<thead>
<tr>
<th>Technology solution</th>
<th>Children’s active role and creativity</th>
<th>Children’s strengths</th>
<th>Modifiability of technology</th>
<th>Transformability of technology</th>
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<tbody>
<tr>
<td><strong>Symbol matching</strong></td>
<td>Current solution: Setting the tiles to the shape or to the spots of child’s choice Further development: Producing content to the application and the creation of tiles</td>
<td>Current solution: Choosing an interesting and mastered topic Emphasis on visual and motor strengths</td>
<td>Current solution: Making of self-designed tiles Further development: Generating new tasks and symbols (drawing, taking photographs)</td>
<td>Current solution: Application runs on PC computers available at school, affordable tiles (approx. €2 each). Further development: The use and usability of the application</td>
</tr>
<tr>
<td><strong>LEGO building</strong></td>
<td>Current solution: Choosing space for building (floor or table) Further development: Producing content as LEGO models to the application and sharing them with others</td>
<td>Current solution: Emerging through acting with concrete, physical blocks Emphasis also on visual and tactile strengths</td>
<td>Current solution: Not modifiable Further development: New content to share with others through an application that tracks the construction process and stores the picture of the completed artifact</td>
<td>Current solution: Application runs on PC computers available at school. LEGO Duplo blocks are commercially available. Further development: The use and usability of the application</td>
</tr>
</tbody>
</table>
Table 1. Domains of the objectives at four different workstations

Conclusions

The development of technology solutions with and for children with autism is internationally and nationally acute, as these children still have very limited means to participate in everyday life activities due to their disability. A possible reason for the unsolved problem is that the most challenging children are often excluded from research due to the risks that they may present in the study. We include these children as the creative actors and developers of technical solutions. In addition, we keep in mind the modifiability and transferability of the solutions, as previous studies have indicated that tailored technologies are a key to new possibilities for children with autism.

The development of a strength-based learning environment that supports children’s active participation and creativity is challenging. The currently used technological solutions need further development, as indicated in Table 1. However, the challenge is not a mission impossible if we as researchers are receptive to children’s feedback and actions in the environment and constantly work on including children as research partners.

We expect that our methodological choices and the establishment of a learning environment that supports active roles for children, body and soul, will gain new scientific knowledge of the possibilities and limitations of technologies in education. The project also challenges the existing knowledge about children with autism. Disabilities are also salient in the research project, but we aim at overcoming them by highlighting children’s individual strengths. Strength-based research design empowers the participating children, and the findings enable them to be integrated into society, instead of being trapped in negative and problem-based assumptions about children with special needs. We also expect that the establishment of the strength-based learning environment and the research carried out with children can produce knowledge that can be used to implement an innovative and untraditional pedagogical model to teach children with autism in adaptable learning environments.

References


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