Exploring the Challenges and Opportunities for Inclusive Social Robots in Classroom Activities through Participatory Design Activities

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Abstract

Inclusion of vulnerable people in society is essential to grant human rights and equal opportunities for all. Our research goal is to mitigate the disparities in education and ensure access to all children, including pupils having a special educational need and disability (SEND) and promote inclusion among students using social robots.

In schools inclusion has different dimensions to be considered, namely: identification of exclusion reasons and behaviours, accessibility to school activities, and promotion of diverse and inclusive culture among children.

Our approach to this challenge was a 6-month long community engagement effort with a local school community to get insights into different stakeholders: children with and without disabilities (Visual Impairment and Autism), parents, teachers and several therapists, such as: braille, speech and occupational therapy, psychologists, mobility and navigation. We then conducted a participatory design session to build robots, during lectures, with 50 children with mixed abilities. We contribute novel insights on the design of robots for mixed abilities groups of children, in remote and co-located settings and the challenges and opportunities for an inclusive school raised by the school community.

Author Keywords
Inclusion ; Children ; Visually Impaired ; Accessibility ; Educational Robots; Design

CCS Concepts
•Human-centered computing → **Participatory design; Accessibility design and evaluation methods;** *Empirical studies in HCI;*

Contribution
Studies showed that students with special needs increased in mainstream schools [2, 3] demanding new types of support, learning experiences and social dynamics. Schools have to provide full access to all learners to school activities [5, 1], and students need to work in groups. They are creating opportunities for educational technology to adapt to children's needs in order to increase social engagement [7] and enhance collaborative scenarios [4, 6].

Due to their novelty factor, multi-sensory and interactive ability, robots can play a role in building children group engagement and foster innovation, inclusion and creative thinking.

To tackle the real challenges of inclusion in schools, we conducted a six-month-long study where we took a multi-method approach including ethnographic observations, contextual inquiry, group interviews, and design activities to uncover opportunities for inclusive social robots in schools. We collaborated with teachers, teaching assistants, therapists, parents, and children. This longitudinal effort aimed at creating trust and a safe environment where participants (children, teachers, therapists, and parents) shared their fears and challenges, and discuss strategies to promote inclusion and creativity in an inclusive school using robots. From these sessions emerged five different scenarios to explore with robots: dance, friends, student helper, teacher assistant and storyteller.

Figure 1: Card for a material, metal - showing coloradd [1] tangible components, braille labelling and a metal coin

We performed one-month-long participatory design, based on those scenarios, with 50 children, with ages from six to thirteen. One participant had autism, and five participants had Visual impairment with different degrees of visual acuity.

For the participatory design sessions, a multi-sensory approach was build using visual, audio, video and tangible materials, following all the steps and deliverables of the design thinking methodology:

(1) Definition of problem statement " build a robot accessible for all that promotes teamwork ";

(2) Group selection, we asked children to select their partners;

(3) Scenario selection, we shuffle the five predefined scenarios emerged form community engagement;

(4) Research, we asked the children to use their phones to research for robot information, and we brought a couple of robots to the classroom to be explored by the children. Children were able to touch and play with robots. We also created predefined cards (with braille, and tangible materials) for the most common features to flourish their imagination and creativity (as illustrated in figure 1);

(5) Brainstorming in teams to generate ideas and reach a consensus on the ideas to develop;

(6) Each group presented their ideas;

(7) Each child, based on group pre-selected ideas, drew their initial robot model, in pencil and colour, describing size, personality, materials, emotions, interaction modalities and robot roles. Sighted children helped visually impaired children to draw and record their ideas;

(8) Model creation, based on recycling material (made at home, due to COVID pandemic) where they continue to work in groups and share ideas;

(9) The testing phase, and presentation, children were asked to do a video presenting their main robot features;

(10) Role-play: participants decided to build a story based on their predefined scenario and acted with the robot model individually; in the end, they presented a video with this role-play, as illustrated in Figure 2.

Figure 2: Robot Experience showing a roleplay of a participants with the robot, where the robot was helping the students

The significant challenges we faced during the design phase were:

- Present the information in different formats (as illustrated in figure 1)
- Allow disabled students access to the information in a multi-sensory way without creating an individual approach. One example was one blind girl that showed the robots to all her classmates, in-phase (4) while holding and feeling the robots;
- Promote support between all group members (in order to share their ideas in multi-sensory ways and record all ideas);
- Changed to remote way, in the middle of the sessions, due to COVID pandemic. The group work had to be adapted and created multiple communication channels between the research team, teacher and children;
- Some children included family members in the activity, enriching the experience and influencing the final result, this change led to a more substantial influence and agency of the relative instead of the initial group

members.

Lessons learned from this study:

(1) Empathy between group members had a significant impact on the each member creativity. It is recommended to let children choose their teammates, and build their comfort zone that value the differences, openness to fail, co-creation and enables joint idea production;

(2) Teacher engagement and support in these seasons were crucial for maintaining the pace, focus and idea generation;

(3) One adult for every two groups is recommended, for focus children on each phase deliverable, sharing and recording of new ideas (even if when they are crazy);

(4) For younger children (first-grade school) sometimes there is a need for additional support in writing and explaining the activity, that we must be aware; (5) All group members need to acknowledge their role and responsibility in recording and receiving inputs from all, avoiding any exclusion factor due to disability, personality traits such as shyness or previous friendship between team members;

(6) The younger children were more creative but had a more individual approach of the tasks;

(7) The participants' personality influences their capacity to share, show and present their ideas.

In the workshop we can share our insights from this research, that can be addressed by robots but also by other techniques, and also share our design approach, findings, lessons learned and future guidelines for participatory design experiences with mixed abilities.

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